

# The Sustainability Series



University of  
St Andrews

**STACEES**

St Andrews Network for Climate, Energy,  
Environment and Sustainability

# Preface

'The Sustainability Series' is a collection of 15 articles showcasing the work of members of the St Andrews Network for Climate, Energy, Environment and Sustainability (STACEES). Launched in April 2021, this research network aims to enhance and promote world-leading, innovative sustainability research at the University of St Andrews.

The Sustainability Series aims to be accessible to all. Whether you want to learn something new about sustainability or read about the many different ways our researchers are responding to the climate crisis, we hope the series has something for everyone.

Each article showcases the cutting-edge work of a researcher or research team at the University of St Andrews. The Series promotes researchers of all career stages, from PhD students to professors, and one article – 'Creative breathing space for big green research projects' – illuminates the University's vision for its new Eden Campus.

The Sustainability Series is multidisciplinary; it features projects relating to climate inequality, environmental humanities, ecosystems, biodiversity, energy, sustainable technologies and climate change, approached from a broad range of perspectives, and collaborations from across the University.

Each article is also available as an individual PDF at: [www.st-andrews.ac.uk/sustainability/research/](http://www.st-andrews.ac.uk/sustainability/research/). If you require a hard copy of this booklet, please contact [cees@st-andrews.ac.uk](mailto:cees@st-andrews.ac.uk).

If reading The Sustainability Series has inspired you, or challenged the way you think about sustainability and climate change, we would love to hear your feedback. Please submit comments to [cees@st-andrews.ac.uk](mailto:cees@st-andrews.ac.uk).

We hope you enjoy reading!

Sarah Bennison and Laura Pels Ferra  
STACEES Co-coordinators and Sustainability Series Editors.

## Acknowledgements

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STACEES would also like to acknowledge the support and feedback of the University's Environmental Sustainability Board and Steve Bargeton from the University's Corporate Communications team.

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## More about STACEES

Beyond enhancing the visibility of the work being conducted by our research community, STACEES also seeks to promote interdisciplinary collaboration. We achieve this through our seminar series and networking events, which we deliver in a variety of formats. Additionally, STACEES acts as a point of contact for researchers seeking collaborative partnerships with others in the sustainability research community.

STACEES is led by three Co-Directors; Dr Michael Byrne (School of Earth and Environmental Sciences), Dr Catriona

Harris (School of Biology) and Dr Mette High (School of Philosophical, Anthropological and Film Studies). Laura Pels Ferra and Dr Sarah Bennison coordinate the network.

Beyond the STACEES leadership team, the network includes over a hundred colleagues and students from across the University of St Andrews. We welcome participation from all disciplines, career stages and degree stages. If you would like to join the network, email [cees@st-andrews.ac.uk](mailto:cees@st-andrews.ac.uk).

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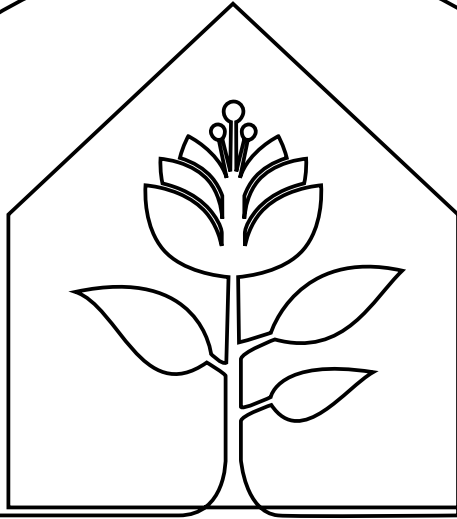
## Our events

In addition to running networking events, we also run a friendly and welcoming fortnightly seminar series, with papers by a diverse range of disciplines. We strive to run accessible, inclusive events held at varying times

of day. If you would like to present your research at a STACEES event, please get in touch. For up-to-date information about our events and initiatives, please see our website: <https://stacees.ac.uk>.

# Contents

1. **Creative breathing space for big green research projects**  
Ian Hill, Eden Campus page 5
2. **The St Andrews think tank pioneering climate education**  
Third Generation Project, School of International Relations page 9
3. **Renaissance recycling: waste paper and the modern environmental crisis**  
Anna Reynolds, School of English page 13
4. **Can artificial trees help us achieve net zero?**  
Paul Webb, School of Chemistry page 17
5. **How eco-anxiety influences climate activism and everyday life in Britain**  
Bridget Bradley, Rika Hirose, Hannah Fitchett and Eleonora Ranuzzi  
School of Philosophical, Anthropological and Film Studies page 21
6. **Menstruation, stigma and sustainability**  
Lara Owen, School of Modern Languages page 25
7. **How can marine mammals live with renewable energy?**  
Gordon D Hastie, Debbie JF Russell, Doug Gillespie and Carol Sparling  
Sea Mammal Research Unit, School of Biology page 29
8. **Ancient lessons and modern climate problems**  
Andrea Brock and Ruben Post, School of Classics page 33
9. **Tropical peatlands and their importance to people and climate**  
Lydia Cole and Katy Roucoux  
School of Geography and Sustainable Development page 37
10. **The value of a river: mining projects and cross-cultural environmentalism in Papua New Guinea**  
Emilka Skrzypek, School of Philosophical, Anthropological and Film Studies page 41
11. **New potato varieties are a hit in East Africa**  
John Jones, School of Biology page 45
12. **How landscape art can help us think about climate change**  
Stephanie O'Rourke, School of Art History page 49
13. **Energy elites: shaping the future of energy**  
Anna Rauter, School of Philosophical, Anthropological and Film Studies page 53
14. **Taking ocean engagement to new depths**  
The Museums of the University of St Andrews, Scottish Oceans Institute (SOI),  
and Marine Alliance for Science and Technology for Scotland (MASTS) page 57
15. **Bringing clouds into focus**  
Anna Mackie, School of Earth and Environmental Sciences page 60



Creative breathing space for  
big green research projects

Ian Hill  
Eden Campus

# Creative breathing space for big green research projects

Ian Hill – Eden Campus

(Article written by Martin Ince)

The University of St Andrews is a historic institution in a historic setting. In business since 1413, it now occupies dozens of more or less suitable buildings all over the medieval Scottish town known to millions as the home of golf.

But while these premises are great for original thinking and small-scale experimentation, they are not well adapted to developing the new, large-scale technology that the world needs in an era of climate change.

The answer to this conundrum lies about six kilometres from St Andrews, in the unlikely setting of a former paper mill by the banks of the lovely River Eden. Stretching over 13 hectares, this site is now the St Andrews Eden Campus and home to the University's most ambitious low-carbon projects.

A key team member for the development project is Ian Hill, Strategic Lead for Innovation at the University (himself locked down in England when we speak). He explains how Eden Campus, the University's first out-of-town development, is a "strategic ambition" that will facilitate "the translation of research to commerce and industry." The site will allow new technology to be developed and used at a near-industrial scale by both academic and industry experts working closely together.

But Eden Campus is far from an overnight project. Hill recalls, "We bought it in 2010, and began by developing the district heating centre. Then we moved the University's professional services here to free up space in town for teaching and research. Only then did we realise that it was a huge strategic opportunity. Companies often ask, 'Who do I talk to if I want to talk to the University?'" Eden is the answer."

After buying Eden, St Andrews spent years demolishing some of the many small and unusable buildings that encrusted the site. Those that remain are now being gradually turned into research and demonstration facilities for future technology. The University has spent £70million on Eden, with an additional £30million coming from external sources.

## **"Face like a prune"**

Hill says that the University's initial Eden investment was a biomass-burning energy centre that has reduced the University's carbon emissions as well as its heating bills. It provides heat and hot water for 45 University buildings in St Andrews town. "That investment cut the University's carbon emissions from energy by 20 per cent and encouraged more low-carbon projects," he notes. From summer 2021, the site will have a

one megawatt solar array for electricity with scope for another megawatt if all the suitable roof space on the site is used.

Now, the University is enhancing Eden's capacity to house a range of research and demonstration projects, with a focus on low-carbon technologies. One major field of interest is battery technology, a good fit for the University due to its strength in relevant areas of chemistry. "If we get more solar panels, we may add a big static battery to store the output," says Hill.

One important asset is a dry room for handling battery chemicals. The atmosphere contains so little moisture that, Hill explains, "You come out after ten minutes with your face looking like a prune." More seriously, it allows new types of battery to be charged, discharged and tested in near-real conditions. For Hill, "This is a good example of our ambition for Eden because it allows us to carry out research and to demonstrate the technology at scale on our own low-carbon campus."

"Our approach," he says, "is to make this a living lab for demonstrating low-carbon technology. We don't expect many academics to be permanently based here. The labs for basic research will mostly stay in town." There will likely be up to 650 people onsite when it is in full use, with 200 of them external to the University.

Expertise in batteries is important to the University's interest in green transport.

So, too, is its background in hydrogen technology. Possibilities currently under research include hybrid power systems that combine hydrogen and fuel cells for large-but-unglamorous vehicles, such as buses and bin lorries. On a more photogenic note, the University is now the owner of a former Scotrail train. The plan is to convert the train to run on hydrogen, then use it to convey delegates to the UN climate change conference (the COP26) in Glasgow in November 2021.

One option for obtaining hydrogen fuel is to use surplus solar electricity to produce it from water, instead of or alongside storing power in batteries. And as a final alternative to fossil fuels, researchers at St Andrews are looking at direct replacements. Hill says, "If you have hydrogen and carbon dioxide available, it's an interesting combination. It will be possible to create synthetic methanol or biodiesel."

Another technology of interest is carbon capture, which is the notion of stopping carbon dioxide generated in bulk from reaching the atmosphere. Here, too, Eden can play a role. Candidate approaches involve the use of flue gases from the University's heating system or possibly those from an onsite distillery (one of the non-academic enterprises on site at Eden).

### **Policy interest**

Eden's main intellectual assets are the University's skills in areas such as chemistry, physics and earth sciences.

It is also a place where, for example, anthropologists can talk to scientists about how people use energy, or where experts from the management school can think about accounting for carbon use.

But Hill is also clear that the Scottish policy environment, with its strong support for low-carbon research, is an important part of the story. He points out that companies based in England are choosing to do energy innovation in Scotland. “While the issues are global,” explains Hill, “Scotland has the right people and the political will to

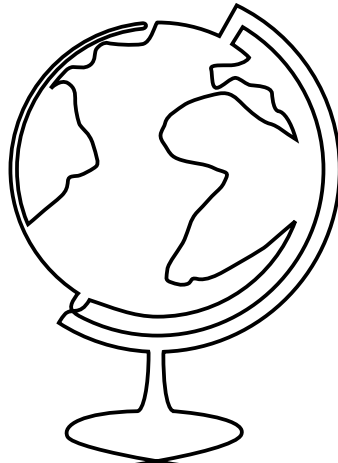
address them. For example, 90 per cent of Scotland’s electricity came from renewable sources in 2019, and we are now moving on to decarbonise heating, which will be a bigger challenge.”

As he sees it, Eden is a site on which people from both business and politics can find useful answers to big problems. New buildings will soon be opened up to meet anticipated demand, including the seven buildings that make up the iconic road frontage to the site. As Hill says, “All of this needs to be out of town: it is very important for us to have lots of hands-on industry here.”

**Find out more**

Website: <https://edencampus.wp.st-andrews.ac.uk>





The St Andrews think tank  
pioneering climate education

Third Generation Project  
School of International Relations

# The St Andrews think tank pioneering climate education

Third Generation Project – School of International Relations

(Article written by Garry MacKenzie)

Talk of climate change is often framed in scientific terms, focusing on the targets that need to be reached or the technology that is being developed to mitigate against it. These are important tasks. But what sometimes gets lost is how climate change is already impacting marginalised communities across the globe – and how prioritising and educating about such climate injustices can potentially lead to climate action. The Third Generation Project (TGP) does just this.

As the University of St Andrews' first think tank (and one of the only think tanks in the world to focus on education for climate justice), the TGP mission is to put those on the frontlines of climate change at the heart of a progressive education agenda. Established in 2016 by Professor Ali Watson and postgraduate researcher Bennett Collins, both of the School of International Relations, the project aims to 'do academia differently' by adopting a collaborative approach to education and research. With funding from bodies such as National Geographic, the Global Challenges Research Fund, the Russell Trust and EDI Fund St Andrews, TGP is educating a new generation of climate justice researchers in working with communities both in Scotland and across the globe to facilitate climate action.

## Education for climate justice

In keeping with the collaborative approach of the project, the TGP management team is a partnership between established and emerging researchers comprised of the following: one faculty member (Professor Ali Watson); one postgraduate (Bennett Collins); one undergraduate (Laiose Rogers); two St Andrews graduates (Jamie Hinch and Annabelle von Moltke) and one former postdoctoral researcher (Dr Meghan Laws). Coupled with a wider team of affiliated staff, project partners and a distinguished Strategic Advisory Board, this creates a dynamic range of expertise from which TGP can draw. In turn, this has led to activities ranging from developing learning materials for schools and educating a new generation of scholars, to engaging with practitioners and policymakers in order to prioritise climate justice. TGP's emphasis is always on bringing marginalised voices and perspectives into climate justice education, collaborating with communities in Scotland, East Africa and North America to highlight the importance of prioritising climate justice in both policy and practice.

One of TGP's key programming strands is **Climate Realities**. This began with a project, 'Breaking the 4th Wall of

Climate Migration’, involving a series of workshops that brought community organisers, journalists, human rights advocates and academics together with teachers and pupils from three local Fife schools: Bell Baxter High School, Madras College and St Leonards School. Pupils were given access to a unique set of resources, such as transcripts from interviews conducted by the team in Kenya and Somaliland with those already experiencing the impact of climate change first hand. They were also taught by members of the project team, which included journalists and community organisers, to understand the wider historical context for each situation as well as how digital storytelling can be done in a way that is both ethical and accountable. Following the success of this approach, the team developed a wider strand of programming under the banner of Climate Realities. This strand aims to improve the quantity and quality of climate justice education in the Scottish school curriculum, and to do so in a way that prioritises anti-racist and anti-colonial narratives.

Another key programming strand is the **Emerging Researchers Programme**. The intensive year-long training programme for social science undergraduates intends to teach the next generation of academic researchers about working collaboratively and being accountable to the communities involved in their research and outreach. One aspect of this involves Western biases. Projects from the emerging researchers are driven by the need to address such bias – not just in

educational practice, but by amplifying the voices of marginalised communities in order to create opportunities for collaborative conversations within Scotland and across the globe. This is likewise a priority for TGP’s blog – [The Frontline](#) – which works with frontline communities to tell their own stories. So far, the blog has provided unique first-hand accounts from activists and community organisers regarding the impact that climate change (and those who drive it) is having on marginalised communities. It is also the reasoning behind the upcoming February 2022 launch of the TGP Human Rights Clinic, an adjunct to TGP’s core programming that will operate as a mutual aid clinic working with marginalised communities.

### **Scotland’s oldest university and the challenges of the future**

The core values of the Third Generation Project include putting people first, valuing community, recognising the privileged position of researchers in a Scottish university, and bringing people from all backgrounds together. Its methodology focuses on building equal partnerships that result in research informed (or preferably led) by communities themselves. Still, the project is not just about communicating with communities, policymakers, practitioners and students. It is also about reflecting on how academic disciplines are taught and how research is conducted. Through efforts such as the Whitewashed project, TGP’s aim is to work with student groups at

St Andrews to explore their experiences of the classroom. By focusing on how certain knowledge is prioritised, TGP aims to take a step towards addressing the cultural, political and economic biases long taken for granted in both International Relations and in academia more widely.

a crucial role in shaping what higher education in Scotland can be. By hosting the Third Generation Project, with its clear progressive education agenda focused on climate justice and an internationally collaborative approach, the University is also demonstrating what education in Scotland can become.

As Scotland's oldest university, the University of St Andrews has occupied

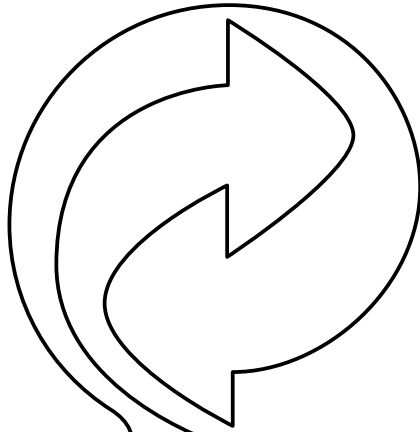
**Find out more**

Website: [www.thirdgenerationproject.org](http://www.thirdgenerationproject.org)

Facebook: [@ThirdGenProject](https://www.facebook.com/ThirdGenProject)

Twitter: [@ThirdGenProject](https://twitter.com/ThirdGenProject)

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Renaissance recycling:  
waste paper and the modern  
environmental crisis

Anna Reynolds  
School of English

# Renaissance recycling: waste paper and the modern environmental crisis

Anna Reynolds – School of English

(Article written by Garry MacKenzie)

One of the most pressing environmental concerns today is the issue of what to do with waste. Humans attempt to manage (or at least put out of sight) their waste through landfills, recycling centres and incinerators. But it is now widely recognised that the sea is contaminated with discarded plastic. Some waste, such as polystyrene, can take hundreds, thousands or even hundreds of thousands of years to biodegrade. Nuclear waste and other hazardous materials need to be stored for similar periods before they become safe. We might define the Anthropocene era as the period in which humans leave their mark on the geological record; the evidence will be the waste products that we leave behind.

Dr Anna Reynolds, Lecturer in the School of English, argues that we can think differently about waste by looking to the example of early modern England. In her project 'Waste, Waste Paper, and the Pre-Anthropocene World', she focuses on the life cycle of one particular product: waste paper in the 16th and 17th centuries. Scholars have tended to assume that at the time, paper was too valuable to waste. But as Reynolds shows, bookbinders, readers, grocers, cooks and housewives habitually repurposed unwanted books by using their pages to bind other books, to wrap food or line pies, and for toilet paper.

Paper, in fact, was too valuable *not* to waste.

## Paper, recycling and the Renaissance

Although waste paper is known to literature scholars as the punchline of literary jokes (bad books are only fit for toilet paper), Reynolds's study reveals how it was a useful resource for everyday life in its own right. By paying attention to early modern attitudes about waste paper, she suggests that we can gain a new perspective on the products and materials discarded in our own daily lives. Waste does not necessarily mean items that are useless, dirty or exhausted; it can also be thought of as material with the potential for re-use. This a valuable lesson for our own age, as concerns about depleted resources and limited storage space for waste are coming to the fore. Gaining a fuller understanding of the meanings of waste and how they have changed over time is an important step in thinking about the impact and sustainability of modern lifestyles on the planet.

'Waste, Waste Paper, and the Pre-Anthropocene World' draws on ideas from a number of disciplines ranging from literary studies to archaeology, and from social anthropology to the emerging field of waste studies. One of the outcomes of the research will be

*Privy Tokens*, the first book-length study of waste paper. The book draws on a range of literary, visual and bibliographic sources to demonstrate how often early modern writers thought about possible uses for paper. These sources include dictionaries, inventories, registers, and poems. Overall, it is a surprisingly potent symbol.

In England, paper had replaced parchment as the main method of literary transmission by the end of the 15th century. This was around the same time that writers from classical antiquity, such as Catullus, Horace and Martial, were being rediscovered and circulated. These poets often referred to intimate 'reuses' for papyri marked with bad poetry. Reynolds uncovers how Renaissance poet John Donne altered this classical insult in surprising ways, including in a funeral elegy where waste paper is compared to the transience of the human body. Other writers, such as antiquarian John Aubrey and the poet Thomas Nashe, found their own meanings in the poignancy and usefulness of papers torn from an unwanted book.

An inherently transient book is the almanac. Containing information about the upcoming year, such as farmers' planting dates, festivals, astrological predictions and much else, almanacs were the bestselling annuals of their time – about one third of all families in England owned one. But at the end of each year, they became obsolete. Almanacs brought a huge amount of paper into circulation that was soon ripe

for repurposing, making them emblems of ephemerality and an example of early modern recycling. In an age when people meditated endlessly on mortality, almanacs also taught their readers that they were interconnected with their environment. Both the human body and the well-thumbed almanac eventually disintegrate, and 16th-century writers dwelt on this lesson about the natural cycles of decay and regeneration.

### **Why paper matters**

Reynolds' project is very much at home at the University of St Andrews, where experts in a variety of disciplines study waste and the School of English has a wealth of research expertise in the early modern period. The library's Special Collections department holds a trove of 16th- and 17th-century literature, some of which refers to waste paper and some of which is literally made of waste paper.

Focus on a single, unremarkable object – waste paper – is part of a wider philosophical trend of thinking deeply about the complexity of commonplace stuff surrounding us. Items that we often take for granted can have surprising hidden lives that tell us about commerce, social values, and our relationships with our physical environment. Paying closer attention can open up new reasons to care about the materials and natural environment that are part and parcel of our daily lives.

Study of waste paper reveals an abundance of ideas about early modern

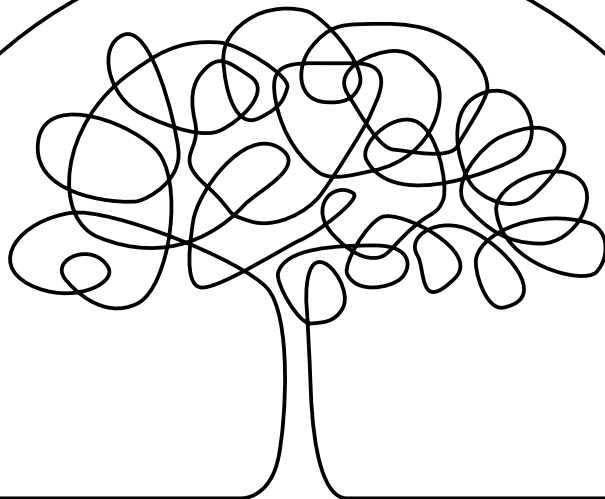
society in which patterns of production and consumption had not yet become what they are in our contemporary Anthropocene age. It raises questions about the ephemerality of a piece of writing, the ways that leftovers and remnants endure over the passage of time, the rhythm at which a society produces and consumes its literature, and how organic matter decays and finds new uses.

These questions highlight an overlooked dimension of English social history. But they are also of lasting relevance: how do we regard our own mountains of waste paper and the other byproducts of 21st-century writing and communication? 'Waste, Waste Paper, and the Pre-Anthropocene World' prompts us to look differently at – and live differently with – our own waste.

**Find out more**

Researcher profile: [www.st-andrews.ac.uk/english/people/acr25](http://www.st-andrews.ac.uk/english/people/acr25)





Can artificial trees help us  
achieve net zero?

Paul Webb  
School of Chemistry

# Can artificial trees help us achieve net zero?

Paul Webb – School of Chemistry

(Article written by Martin Ince)

The issue of intermittency is one of the most well-known challenges facing the transition to renewable energy. It refers to the fact that the wind does not always blow and the sun sets at night.

But Dr Paul Webb, Reader in Chemistry at the University of St Andrews, is among those developing technology that involves making use of surplus power as it arises. For him, this apparent problem is an opportunity. Many research groups around the world are working on batteries and other devices to store electricity, helping match production to demand. Another approach is to store energy in chemical form, a concept often referred to as 'Power to X'.

Asked about this mysterious term, he explains, "X could be anything. We would harness surplus renewable energy to produce an intermediate storage medium X which can be used later."

## Hydrogen first

As with other St Andrews work in this area, the key to his approach is hydrogen. The first phase of development uses surplus electricity to break water into hydrogen and oxygen, making what Webb terms "a fuel with no carbon footprint." Hydrogen could be used in power stations not unlike the gas turbine plants of today, or for applications such as vehicle propulsion. And while hydrogen is a fuel of vast

promise, it is also a potential starting point for the important task of greening the world's chemical industry.

This massive industry is a vital part of both modern economies and modern life. It provides the materials for everything from pharmaceuticals and agrichemicals to transportation fuel. The problem is that it demands vast amounts of fossil fuel. According to the International Energy Agency, the chemical industry accounted for 14 per cent of global oil demand in 2018.

We cannot go without the products of the chemical industry, says Webb, and their production relies on a steady supply of carbon. To reduce emissions, the chemical industry must begin to use sources of so-called above ground carbon such as waste or biomass. But as he points out, there simply isn't a supply of biomass sufficient to meet the world's needs and there will always be concerns about responsible land use and food security. If we can mimic what plants do, by converting water and carbon dioxide directly into chemicals, we can circumvent the need to grow crops as a carbon feedstock.

The approach can be summarised as the creation of 'artificial trees'. The term, Webb admits, is a loose one. For one thing, the plant he is developing will not look like any known type of tree. But the name contains a grain of truth. He explains,

“A tree harnesses energy from sunlight and uses it to convert water and carbon dioxide into chemical energy in the form of carbohydrates. We want to do the same. The only difference is that a tree uses photosynthesis, a photoelectrochemical process, whereas we use renewable energy to produce an electric current first.”

A steady supply of carbon dioxide and hydrogen along with an abundance of green electricity are the essential inputs for manufacturing what Webb calls “platform chemicals,” the major building blocks from which other chemicals are derived. This approach has its challenges. And Webb warns that without better technology, it will remain a pricy option. “There are certainly opportunities to improve the efficiency of carbon capture. At the moment, it costs around £8 to £10 to capture a tonne of carbon dioxide from a highly concentrated source such as a fermentation process, but as the levels of carbon dioxide fall, the cost of capture goes up. Capturing carbon dioxide from the flue gas of the University’s biomass power plant, for example, will cost around £40 to £60 per tonne. For direct air carbon capture, the costs escalate to well over £300 per tonne using current technology.”

The global adoption of a carbon dioxide-based chemicals platform will be dictated both by the ability to generate low-cost hydrogen from water and by a significant reduction in the energy requirements and associated costs of carbon capture. An established hydrogen economy will overcome the first obstacle but the second requires a rethink in carbon capture technology. “Our artificial tree

concepts overcome this challenge by using low concentration waste streams of carbon dioxide directly as a carbon source, bypassing the need for costly carbon capture. This also allows us to harness residual heat energy from a flue gas to drive chemical reactions.”

### **Beyond net zero?**

Today’s global carbon politics never tires of the term ‘net zero’, the idea that carbon inputs and outputs must be balanced in order to avoid a catastrophic rise in global temperatures. To do this, pathways to limit global warming to internationally agreed targets will become increasingly reliant on carbon-negative processes that offset the emissions of systems more difficult to decarbonise. This can be achieved by removing carbon from the natural carbon cycle through the capture and utilisation or sequestration of biogenic carbon dioxide. Power to X provides the mechanism for developing the carbon-negative technologies that will be critical to reaching a net zero carbon future.

The application of this technology to the direct capture of carbon dioxide from air opens the possibility of decentralised chemical synthesis opportunities with global reach. When paired with new solutions for sequestering carbon, these technologies can do more than just reduce emissions – they may provide a crucial carbon sink.

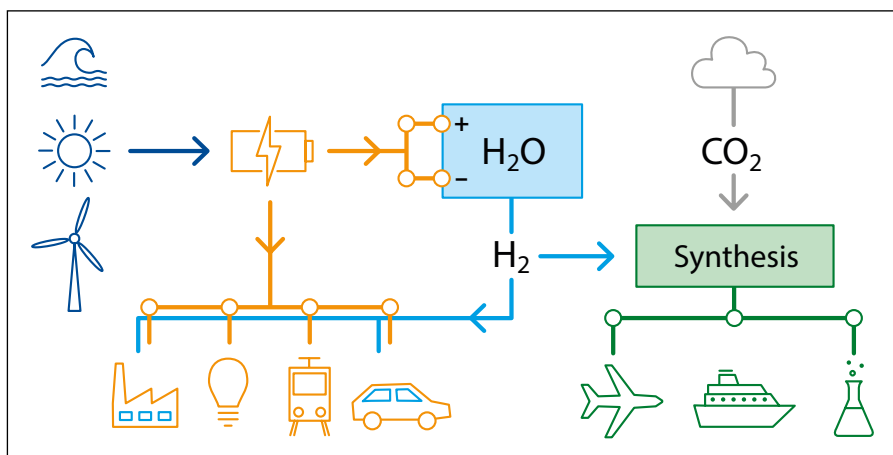
### **Renewing Scotland**

Webb is quick to point out that Scotland is the perfect place for the chemical and

energy transformation that he has in mind; “there are many new wind farms, and soon the country will generate more energy than it needs.” One use for all the surplus power is to export it, but other options might be preferable. Webb notes, “Scotland needs to replace North Sea jobs as oil output declines. Rather than being a net exporter of power, Scotland could utilise this energy and instead export X, high-value chemical products.” He adds that this approach is

in line with the Scottish Government’s ambitious plans to grow the nation’s chemical and life sciences sectors.

On a more local basis, he stresses that the St Andrews Eden Campus is the ideal home for this research: “It has lots of renewable energy and biogenic carbon dioxide, from the Eden Mill distillery, and from the University’s own biomass power plant. Not many places have both.”



**Find out more**

Researcher profile: [www.st-andrews.ac.uk/chemistry/people/pbw](http://www.st-andrews.ac.uk/chemistry/people/pbw)



How eco-anxiety influences  
climate activism and everyday  
life in Britain

Bridget Bradley, Rika Hirose, Hannah Fitchett  
and Eleonora Ranuzzi

School of Philosophical, Anthropological  
and Film Studies

# How eco-anxiety influences climate activism and everyday life in Britain

Bridget Bradley, Rika Hirose, Hannah Fitchett and Eleonora Ranuzzi –  
School of Philosophical, Anthropological and Film Studies

(Article written by Garry MacKenzie)

Imagine living with the knowledge that the world you grew up in is about to change, and that with this change comes a great deal of unpredictability. Perhaps daily chores, like grocery shopping, no longer involve such a large range of produce. Perhaps bad weather is a serious hazard rather than merely a hindrance. Energy use is rationed, so the appliances and gadgets whose usefulness you take for granted are no longer available round the clock. And every time you drive to work, buy a product, or switch on the central heating, you're contributing to the environmental problems that have brought about those changes. Of course, governments and corporations have played a much larger role in this process. But your power to alter their behaviour is limited, whereas there might be more that you feel you can do in your daily life. You feel compelled to take a stand, however small it may be.

Worry about the environment is a feeling shared by many people today and it is easy to see why. News reports frequently speculate about the world being on the brink of catastrophic climate breakdown. Many environmental activists are driven by a desire to avert or alleviate this catastrophe. This has led to a related fear: that generations of people may be increasingly affected by 'eco-anxiety'.

For those involved in climate activism, environmental work, protests and education, it is common to experience feelings of fear, grief and anxiety about the natural world.

The phenomenon of eco-anxiety is the subject of the 'Eco Worrier, Eco Warrior' project funded by the Scottish Funding Council. Led by Dr Bridget Bradley, a Lecturer in Social Anthropology (with support from Research Fellow Dr Rika Hirose and Research Assistants Hannah Fitchett and Eleonora Ranuzzi), the project seeks to understand how eco-anxiety affects the everyday lives of those involved in climate-related work.

## **Lifestyle and the impacts of climate change**

Much of the existing research on mental health and climate change focuses on those communities most severely affected by environmental disasters so far. But many people in Britain, as yet relatively unaffected by climate change, believe that the coming decades will be marked by dramatic upheaval and even widespread suffering as societies struggle to adapt to the effects of a new climate. Rising sea levels, food and water shortages, unmanageable changes in temperature, and mass extinction are features of an imagined

future. It is rational to look towards this future with fear. At the same time, increasing numbers of people are getting involved in climate activism – particularly young people motivated to hold school strikes, inspired by the example of Greta Thunberg. Alongside activists who have campaigned for climate justice for decades, many older people are also taking to activism for the first time: many Extinction Rebellion protestors attributed their participation in demonstrations to a desire to ensure a better world for their grandchildren. Some environmental groups advocate for a cultural approach, such as finding new stories to tell or creating new art, new philosophical frameworks and new lifestyles – all of which they hope will better equip us for the changes to come.

‘Eco Worrier, Eco Warrior’ asks how anxiety about the environment shapes perceptions about the future, family relationships, and life choices. If you live with the conviction that future generations will face climate chaos, does this reduce your desire to have children? If family members fail to share your worry, does that put you on opposing sides of a political struggle? If humanity faces an emergency that needs to be addressed urgently, are you more likely to make sacrifices (from becoming vegan to going to prison for civil disobedience) to halt the emergency?

‘Eco Worrier, Eco Warrior’ tells a story about how ordinary people in contemporary Britain relate to the

natural world in terms of what it means to grow old and to plan for the a future that exists in the wake of environmental collapse. The project asks why people choose to take part in climate activism or actions and how their participation affects eco-anxiety. It explores the different generational experiences of climate activism, including how families talk about activism and worry about the climate at home.

### **‘Eco Worrier, Eco Warrior’**

In order to better understand the interplay of these dynamics, Bradley and her team are interviewing people across generations. Beginning with virtual fieldwork undertaken during the Covid-19 pandemic, their research uncovers the everyday climate concerns of parents, teenagers, and those in later life. Eco-anxiety is sometimes labelled a mental health issue requiring a pathological response. As such, it has been studied by psychologists and psychotherapists, however, ‘Eco Worrier, Eco Warrior’ shines an anthropological lens on the fears felt by many people about a future where the climate is increasingly unstable. It highlights the urgency of taking time to listen to the concerns of those who are extremely concerned about the climate crisis, and whose experiences are sometimes dismissed by the media as the behaviour of ‘anxious personalities’.

The University of St Andrews has a growing reputation as a leading centre for research on climate and energy issues. The recently-launched

interdisciplinary Centre for Energy Ethics is at the forefront of this research. 'Eco Worrier, Eco Warrior' benefits from the support and collaboration of colleagues at the Centre who are specialists in a range of fields. The project is also part of the School of Philosophical, Anthropological and Film Studies' focus on health and disease, climate and energy, and the anthropology of activism. As an anthropological study of medical labels and diagnoses, the everyday experiences of anxiety, and the local and global impacts of the

climate crisis on families, activism and perceptions of the future, the project intersects with each of these topics.

'Eco Worrier, Eco Warrior' seeks to understand the emotional impacts of climate change on people in Britain today. With this understanding, we can be better equipped to face a challenging and uncertain future. Further information about the project can be found on the official [Eco Worrier, Eco Warrior](https://ecoworriersecowarriors.wordpress.com/) project website.

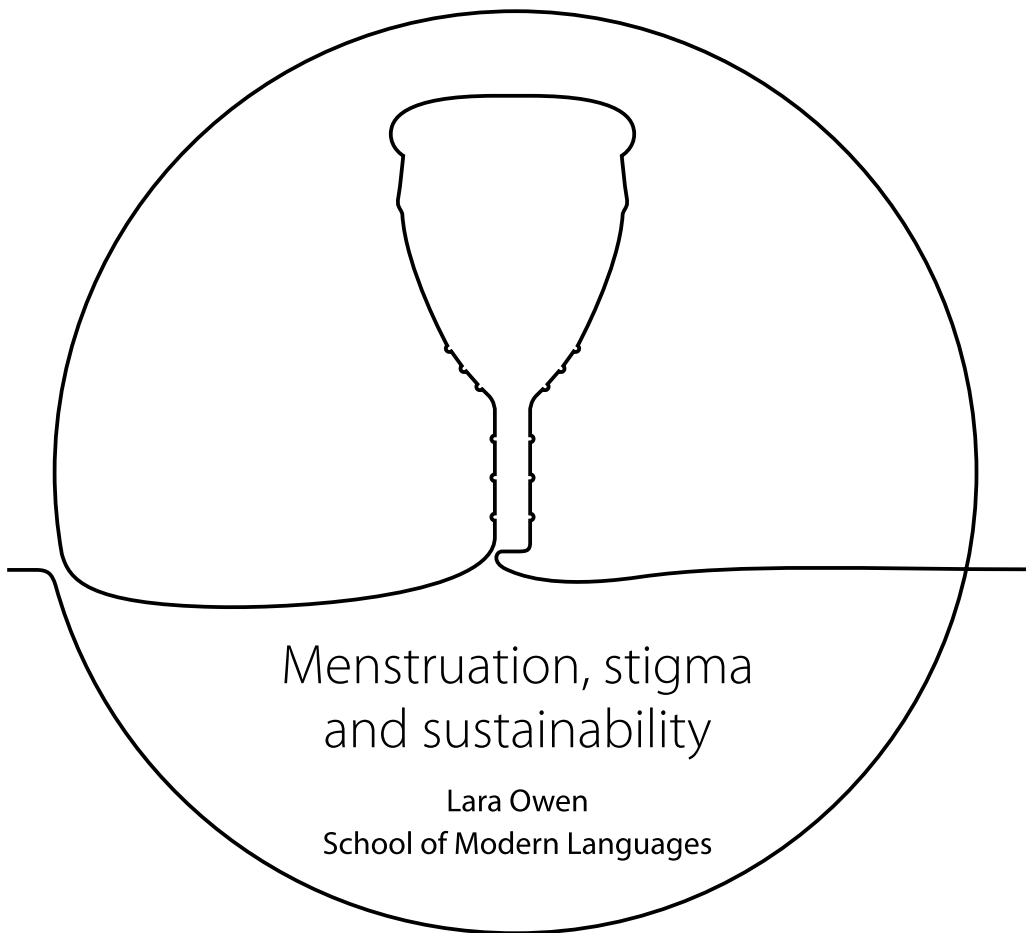
**Find out more**

Website: <https://ecoworriersecowarriors.wordpress.com/>

Twitter: [@ecoworrier4](https://twitter.com/ecoworrier4)

Instagram: [ecoworrier4](https://www.instagram.com/ecoworrier4)





Menstruation, stigma  
and sustainability

Lara Owen  
School of Modern Languages

# Menstruation, stigma and sustainability

Lara Owen – School of Modern Languages

(Article written by Garry MacKenzie)

Finding ways to reduce the human impact on the environment means looking at every aspect of our lives and asking what can be done to make them more sustainable. Sometimes, this task needs to address everyday activities that are not usually discussed. Menstruation is one such under-researched topic; historically stigmatised, it has been given little academic or wider public attention. This has resulted in a lack of knowledge about how women, trans and non-binary people manage their menstrual cycles – whether in terms of choosing which kinds of menstrual products to use and the subsequent disposal of these products, or how employment practices can both help and hinder those who menstruate.

Research at the University of St Andrews is seeking to address this lack of knowledge. At the School of Modern Languages, Dr Lara Owen and Professor Bettina Bildhauer are investigating how culture affects the use and disposal of period products. Funded by the St Andrews Restarting Research Funding Scheme, their project is titled 'Menstrual cups vs tampons: an interdisciplinary analysis of barriers and changing attitudes to sustainable period products in contemporary Scotland'. It asks whether the ongoing stigmatisation of menstruation is a major factor that deters some menstruators from disposing of period products sustainably. It also asks whether stigmatisation stops more

menstruators from choosing reusable products (including menstrual cups). Owen's academic background is in the field of organisation studies and this project is part of her ongoing research into innovations in the organisation of menstruation.

## Plastics and the marine environment

Access to menstrual products or the choice of which products to use may seem like social or economic issues rather than issues related to environmental sustainability. However, recent research from the Scottish Government shows that disposable period products (tampons and single-use pads) are a major source of marine pollution in Scotland. In a public survey, around one quarter of the respondents told researchers that they either always or frequently flush tampons down the toilet. A significant number also flush sanitary towels. These products can not only block the sewage network, but also find their way into rivers and oceans. Many tampons and pads contain plastics that contaminate marine ecosystems, and they are often disposed of in ways that maximise concealment and minimise environmental protection.

There is rising interest in sustainable alternatives, such as menstrual cups. Still, reusable period products remain less popular than disposable ones. The reasons for this include: disposables

brands dominating retail and advertising space; greater initial cost (although reusable products are cheaper in the long run); uncertainty about switching from a familiar product; and issues relating to poverty and menstrual stigma, such as lack of access to private bathroom facilities.

### **Language, stigma and cultural change**

Language plays an important role in shaping and reflecting our attitudes and identities. So, linguistic analysis of the stigmatisation of menstruation is a vital tool for better understanding and normalising the topic of menstruation. The 'Menstrual cups vs tampons' project is an interdisciplinary study involving sociological and linguistic analyses of menstrual practices in contemporary Scotland. It includes interviews with representatives from the environmental organisations Zero Waste Scotland and Resource Futures, as well as an analysis of the language relating to menstruation used online by Scottish period product manufacturers.

The project also seeks to understand what consultants, campaigners and manufacturers have to say about issues related to sustainability and the stigmatisation of menstruation. What are their concerns and goals in these areas, and what lessons have they taken on board through their own experience and research? How aware are they of menstrual stigma as a factor in the selection of period products?

Delving into questions of stigma and sustainability, the project investigates the growing use of menstrual cups and reflects on ongoing barriers to greater uptake of this sustainable period product. Owen's previous fieldwork in Australia found that sustainability was a selling point, making menstrual cups acceptable and even 'cool' to young users and their peer groups.

Owen's research further explores workplace management. When the menstrual cycle and menopause are not factored into working conditions (as reasons for leave or flexible working, for example), this can impact both employee wellbeing and staff turnover. As with the sustainability of period products, this topic is relatively understudied and underdiscussed. In response, Owen's research explores how menstrual stigma contributes to the silence around menstruation at work and how this can be overcome.

### **St Andrews, Scotland and beyond**

This research into issues of stigma and sustainability is part of the growing academic field of Critical Menstrual Studies, which seeks to address the relative neglect of the topic as a subject of scholarly study. With its Menstruation Research Network, the University of St Andrews is establishing itself as a leading international centre of expertise in the field. Within the study of menstruation, the network is distinctive in its embrace of the humanities as well as the social and medical sciences.

Globally, the Scottish Government is at the forefront of destigmatising menstruation in public life. In landmark legislation aimed at ending period poverty, Scotland has become the first country in the world to enshrine in law a universal right of access to free period products. Local authorities, schools, colleges and universities are legally committed to ensuring that tampons and pads are available to anyone who needs them.

destigmatisation within Scotland and beyond, educating people about reusable period products and specifying how work and learning environments can become more menstruation-friendly. As people around the world reflect on ways to reduce their impact on the environment, the project sheds light on how this question might apply to one of the most intimate and under-discussed aspects of everyday life.

The research from Owen and Bildhauer will contribute to the process of

**Find out more**

Researcher website: <http://laraowen.com>

Researcher Twitter: <https://twitter.com/laraowen>

Researcher LinkedIn: [www.linkedin.com/in/laraowen/](http://www.linkedin.com/in/laraowen/)

Research Network Twitter: <https://twitter.com/menstruationRN>



# How can marine mammals live with renewable energy?

Gordon D Hastie, Debbie JF Russell,  
Doug Gillespie and Carol Sparling  
Sea Mammal Research Unit,  
School of Biology

# How can marine mammals live with renewable energy?

Gordon D Hastie, Debbie JF Russell, Doug Gillespie and Carol Sparling –  
Sea Mammal Research Unit, School of Biology (Article written by Martin Ince)

Sea mammals of all sizes are always a welcome sight for visitors to the UK coastline. But while they are abundant in British waters, especially in Scotland, they now face a new challenge: coexisting with offshore renewable energy.

Gordon Hastie is a Senior Research Fellow at the Sea Mammal Research Unit (SMRU) at the University of St Andrews. He and colleagues have been tracking sea mammals to discover how they might adapt to the presence of machinery that extracts power from the winds, the tides, and the waves.

But first, how do we know where these intriguing animals are? Hastie explains that he works mainly with two species: the harbour seal and the harbour porpoise. “With harbour seals, we capture them and superglue a small GPS tracker to their fur. It stays in place for up to ten months, and they lose it because they moult once a year. It records their movement, including diving, and sends the data to us via the mobile phone system when the seal is on land.”

With harbour porpoises, however, it is much more difficult to attach a tracker. Instead, scientists often use arrays of hydrophones (underwater microphones) to listen for their characteristic clicking sounds. For this research, dozens of animals have been

tracked around marine renewable developments.

Research by Hastie and colleagues has focused on tidal power systems, which gather energy from strong ocean currents. The focus is on Orkney, where this technology is now being installed on a commercial scale. He says, “Early studies of animal movements indicate that they may be able to avoid the tidal energy turbines when they are running. That is good, because it avoids the risk of a dangerous collision. But it could deter them from important feeding grounds.”

Hastie explains that modern tidal turbines look “very like a wind turbine under the water.” In a collision with a moving blade, a seal or porpoise risks severe injury. To find out how severe, he and his colleagues carried out an extraordinary experiment. “We mounted a simulated blade on a jet boat, which allowed us to collide with a seal carcass and see how the injury varied with speed, looking at both skeletal and soft-tissue damage.” It turns out that if the velocity of the blade exceeds five metres per second, there is a risk of serious injury. Actual blade velocities tend to be about 12 metres a second. This finding has been fed into policy by the Scottish and Welsh governments and will inform environmental risk models for tidal turbine installations.

## Noise nuisance

The technology of seal and porpoise tracking has also been applied to offshore wind farms, a more established and fast-growing source of offshore energy. Hastie notes, "Here the risk seems to be mainly in the construction phase, when they often use a large pneumatic hammer to drive foundations into the seabed." This creates the possibility of hearing damage, a potentially severe hazard for animals that rely heavily on sound in their daily lives. In addition, there is the risk of preventing them from accessing their typical foraging habitats. However, research carried out in The Wash (southeast England) shows that animals avoiding the loud noises often return within a few hours of the work being completed.

This is a striking example of how sea mammals seem capable of living alongside human technology. Another example was uncovered by Hastie's colleague, Debbie Russell, who found that some seals do not avoid human structures on the sea floor. Rather, they prefer to feed at the artificial reefs that are often hosted by these structures. Hastie points out, "The North Sea is one of the most industrialised in the world, and interactions between human activities and marine mammals are inevitable. However, the impact of such activities is multi-faceted and complex."

He adds that future technology, such as wave energy, may complicate matters further. Still, Hastie says, "We have not looked at this in detail because the

industry is still in its infancy." It is hard to assess the effects of this industry until more wave machines are deployed at sea, as is now the case for wind and tidal devices. But there is certainly a potential risk if large pieces of equipment with moving parts are installed at the sea surface.

Although most of their work is with smaller animals, Hastie points out that marine energy can also create peril for larger sea mammals, including migrating whales. "Whales are increasingly affected by industrial activities. At the moment the industry has not reached a size where this is a factor. But there are proposals for big offshore wind farms off the East coast of the US, and these could affect the migration of the endangered right whale."

Hastie is clear that these hazards "are not likely to be a show-stopper" for offshore renewable energy. Instead, they point to recommendations that will improve planning and engineering practice. "Every offshore installation requires planning consent," he points out, and this consent comes with conditions. For example, it may be possible to limit how fast a turbine blade can spin under water. For Hastie, "That's the value of having biologists talking to engineers and developers." He adds, "This research also feeds broader policy decisions about how much offshore energy can be developed and where." So, it has a direct effect on Scotland's ambitions to become a world leader for low-carbon energy.

Hastie says that St Andrews is ideally placed to be a global focus for this activity. He points out that the SMRU is probably the biggest centre in the world for pure and applied work both in this area and in terms of sea mammal behaviour. SMRU marine renewables research is funded by the Department of Business, Energy and Industrial Strategy, Natural Environment Research Council, NatureScot and the Scottish Government.

And he is clear that results of this research must be viewed alongside the clear benefits that renewable energy brings: "Marine mammals have a huge amount to lose from climate change and global warming, and that is the context for all this activity."

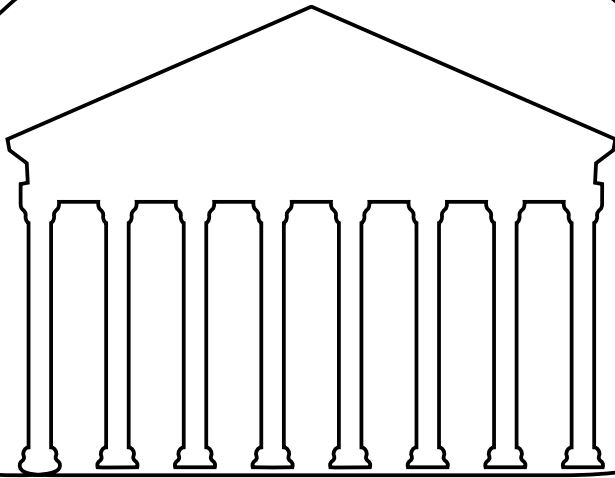
**Find out more**

SMRU research website: [www.smru.st-andrews.ac.uk/research-policy/human-impacts/](http://www.smru.st-andrews.ac.uk/research-policy/human-impacts/)

EcoSTAR project website: [www.smru.st-andrews.ac.uk/ecostar/](http://www.smru.st-andrews.ac.uk/ecostar/)

Twitter: [@\\_SMRU\\_](https://twitter.com/_SMRU_)





Ancient lessons and modern  
climate problems

Andrea Brock and Ruben Post  
School of Classics

# Ancient lessons and modern climate problems

Andrea Brock and Ruben Post – School of Classics

(Article written by Garry MacKenzie)

What can the ancient Greeks and Romans tell us about climate change? Is there anything we can learn from these societies as we address environmental challenges in our own time? Ancient Greece and Rome faced their own environmental problems. How did the inhabitants of those societies survive, and even thrive? How can their examples contribute to a greater understanding of climate change and sustainability among 21st-century students of ancient history?

Thinking about the climate means thinking about long periods of time. This often involves considering the long-term environmental impacts of contemporary activities, such as burning fossil fuels and depositing plastics in landfills. At the same time, we risk getting stuck in a perpetually anxious present where we worry about our every action even as we are overwhelmed by the enormity of climate changes beyond the power of any individual to alter.

Dr Ruben Post and Dr Andrea Brock, researchers in the School of Classics, are working to draw attention to how people in ancient Greece and Rome managed changes in their environments. Their research encourages us to learn from the steps taken by ancient societies in response to environmental problems. As a result, we may consider how our

own actions – from fuel consumption to recycling to holding politicians to account – can make a difference.

## Climate change and flooding in the ancient world

Along with Professor Jason König, Post and Brock are co-directors of the Centre for Ancient Environmental Studies (CAES). Based in the School of Classics, CAES is an international network of scholars of literature, history, archaeology and the sciences working to uncover more about the environment of the ancient Mediterranean.

Funded by a Leventis Foundation Postdoctoral Fellowship, Post's research is an innovative combination of scientific, archaeological and historical evidence. Using scientific data, he reconstructs models for how the Greek climate changed during the first millennium BCE. He then adds crucial Greek crops into the equation: how were wheat, barley, grapes and olives affected by the climate? After establishing this climatic and agricultural framework, Post explores how the ancient Greeks felt about climate variability, the impact of extreme weather on their food supplies, and the communities most affected. What effect did climate fluctuations have on the economy and what measures did Greek communities take to ensure their survival?

Previous studies have sought to understand the relationship between environmental problems and the collapse of pre-modern civilisations. But less attention has been given to the ancient societies that showed resilience in the face of environmental pressures. Post's research will contribute examples and lessons from the past that may help us better understand how to manage our own crisis in the present.

One of the main environmental challenges faced by the ancient inhabitants of Rome was flooding. Funded by a Leverhulme Early Career Fellowship, Brock's research involves analysing a new and unprecedented set of data from early Rome: geoarchaeological samples from over 15 metres below the modern-day surface of the city. Brock directs the Forum Boarium Project, a coring survey of Rome's central river valley that involves international and multidisciplinary collaboration between scholars working to reveal what the pre-urban landscape of Rome was like.

As the city grew in the first millennium BCE, the Tiber River valley changed dramatically. Floods became more destructive and sedimentation made it necessary for Romans to adapt, changing how they built, planned and lived on a floodplain. Because Rome provides one of the world's longest records of urban flooding, it offers an invaluable example for planners, governments and environmentalists facing rapidly expanding cities, rising sea levels and catastrophic flash floods in the 21st century.

## **Interdisciplinarity, education, and learning from the past**

CAES is the first scholarly organisation specifically dedicated to ancient environmental studies. The projects led by Post and Brock are examples of the inherently interdisciplinary nature of the research that CAES brings together. Studying the ancient world means bringing together a variety of sources ranging from literary texts to soil samples, and from pottery to human remains.

Alongside their CAES research, Post and Brock are also pioneering a new environmental history curriculum for Scottish secondary school students. Building on their research into ancient Greek and Roman responses to environmental change, the curriculum will enable students to discover more about how environmental problems affect societies and how human activities have dramatically altered landscapes in turn. Shining a light on how past societies responded to ecological problems and developed resilience over time, the environmental history curriculum will offer a valuable and unique perspective for addressing modern ecological challenges.

One reason why Post and Brock are committed to developing a new school curriculum focused on the ancient environment is the multi-disciplinary approach of their own research. What better way to teach young people about complex issues, such as climate change, which require interdisciplinary and

problem-solving approaches, combining scientific data with cultural study? With funding from the Royal Society of Edinburgh and the St Andrews Knowledge Exchange and Impact Fund, the materials for this new curriculum will be piloted in the 2021-2022 academic year.

Ultimately, they hope the curriculum will enable future generations to learn about why past societies either collapsed or proved resilient in the face of their own environmental crises. As the history of the ancient Mediterranean shows, the environment is ever changing. It has always impacted human society even as it has been impacted by human interventions. Studying the ancient environment encourages students to

consider their own contemporary role: rather than seeing themselves as passive subjects of environmental change, students will be better equipped to evaluate how they can contribute to discussions about the environment at political, cultural and social levels.

Post and Brock view St Andrews, with its commitment to sustainability and interdisciplinary study, as the perfect home for their research. Through support from the St Andrews Network for Climate, Energy, Environment and Sustainability (STACEES), their work brings together a community of like-minded scholars exploring how their expertise can contribute to addressing the pressing environmental challenges of today.

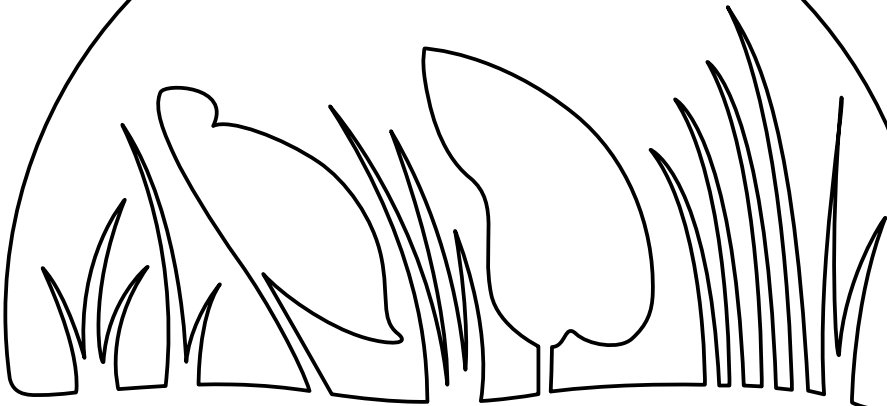
### **Find out more**

Centre for Ancient Environmental Studies (CAES) website:

<https://caes.wp.st-andrews.ac.uk/>

Dr Andrea Brock researcher profile: [www.st-andrews.ac.uk/classics/people/abh1](http://www.st-andrews.ac.uk/classics/people/abh1)

Dr Ruben Post researcher profile: [www.st-andrews.ac.uk/classics/people/rmp26](http://www.st-andrews.ac.uk/classics/people/rmp26)



# Tropical peatlands and their importance to people and climate

Lydia Cole and Katy Roucoux  
School of Geography and  
Sustainable Development

# Tropical peatlands and their importance to people and climate

Lydia Cole and Katy Roucoux – School of Geography and Sustainable Development  
(Article written by Garry MacKenzie)

Here in the United Kingdom, we are accustomed to the term ‘sustainability’ referring to issues such as energy use, recycling or even seasonal eating. But what does living sustainably mean in remote, flooded, forest regions of the Peruvian Amazon? The peatlands of the Pastaza-Marañón foreland basin are in the Loreto region of northern Peru. This swampy habitat is still largely intact, but in other parts of the world such as Indonesia, tropical peatlands have already been extensively drained for agricultural use. This development has repercussions for both the global climate and the livelihoods of local people.

Little is known about the value placed by the people of the Pastaza-Marañón on the peatlands in terms of their day-to-day subsistence and culture. Is the biodiversity of the region important to the people who live there? Do they find the peatland ecosystems useful, beautiful or spiritually significant? Study of their interactions with the peatlands and the meanings that the terrain holds for them is essential to a fuller understanding of how local and global influences could affect this internationally significant ecosystem.

Dr Katy Roucoux of the School of Geography and Sustainable Development leads an interdisciplinary team exploring the significance of the peatlands of

the Pastaza-Marañón foreland basin. Titled ‘Valuing Intact Tropical Peatlands: an Interdisciplinary Challenge’, the project seeks to understand more about the ecology – including the relationship between local people and the environment – of this region. Using research methods from natural and social science, the researchers aim to create a fuller picture of the importance of the wetland ecosystems in the region. This information is contributing to the Peruvian government’s recognition of the peatlands as a unique ecosystem worth including in its sustainable land management policies.

## Why peat matters

Peat is an accumulation of partially decayed plant matter. Peatlands are waterlogged throughout the year, slowing decomposition to such an extent that dead plant remains accumulate faster than they decay. This forms layers of peat which, over thousands of years, can become many metres deep. Peat is among the largest terrestrial carbon stores on the planet: carbon dioxide captured by living plants during photosynthesis is locked in, meaning that it is not released into the atmosphere. Globally, peatlands hold an immense amount of carbon – more than is held in the rest of the world’s vegetation, including forests, combined.

Peatlands are found across the world, and they range from the treeless, boggy Flow Country in northern Scotland to swamp forests in the tropics. In addition to the vital role they play in storing carbon, peatlands are unique habitats that are important for regional biodiversity.

To store carbon and therefore help mitigate global warming, peatlands must be wet. When the land is converted to agricultural use, drainage ditches lower the water table and dry out the upper layers of peat. Oxygen gets into the peat and speeds up decomposition. Once stored for thousands of years, carbon is now released into the atmosphere as carbon dioxide. Dry peat is further susceptible to wildfire, which causes additional carbon release.

Over the last few hundred years, vast tracts of peatland have been lost. Loss is usually due to drainage and conversion for agricultural use. In Scotland, an estimated 80% of peatlands have been affected by drainage and other human interventions. Recently, this trend has rapidly expanded in tropical regions. Peatland drainage for oil palm plantations in Indonesia has resulted in the release of a huge amount of carbon dioxide, frequent peat fires leading to toxic haze events, and land subsidence.

The Peruvian Amazon contains one of the largest remaining areas of intact peatlands in the tropics, but the landscape is under threat. There are economic pressures to drain the peatlands for the development of

transport links and oil palm or cacao plantations. There is a risk that this currently remote region could be viewed as swampy wasteland ripe for conversion into alternative land uses. Protection of these lowland Amazonian peatlands requires the territory to be clearly defined. It also requires official acknowledgement of the region's importance for carbon storage as well as the role played by the peatland in the culture and livelihoods of its inhabitants.

### **Valuing peatland**

Funded by the Leverhulme Trust, the Scottish Funding Council and the British Council Newton Fund, the 'Valuing Intact Tropical Peatlands' project involves Roucoux, together with Research Fellow, Dr Lydia Cole, and other researchers at the University of St Andrews working as part of an international and interdisciplinary network of specialists. Collaboration is helmed under the umbrella of the Tropical Wetlands Consortium, which seeks to understand more about Peru's Amazonian peatlands. Alongside colleagues at the University of Edinburgh and the Instituto de Investigaciones de la Amazonía Peruana (Research Institute of the Peruvian Amazon) in Peru, the team is cooperating with the Peruvian government and the United Nations Global Peatlands Initiative to develop a definition that articulates the value of the peatlands and emphasises the need for their protection.

The team seeks to understand the value of the Pastaza-Marañón basin in terms

of what the ecosystem means to local people. This means finding out about the social, cultural, spiritual, subsistence and economic value that environments, locations and species in the peatlands hold for their inhabitants. They also want to uncover how the peatlands are changing. For example, is the vegetation changing? Are people making use of the

area in new ways? Their aim is to produce a more cohesive understanding of the ecology and value of Peru's Amazonian peatlands, the costs of developing these vital habitats, and the factors that could affect sustainable use of the ecosystems of the Pastaza-Marañón long into the future.

**Find out more**

Project exhibition website: <https://peatlands.wp.st-andrews.ac.uk/>

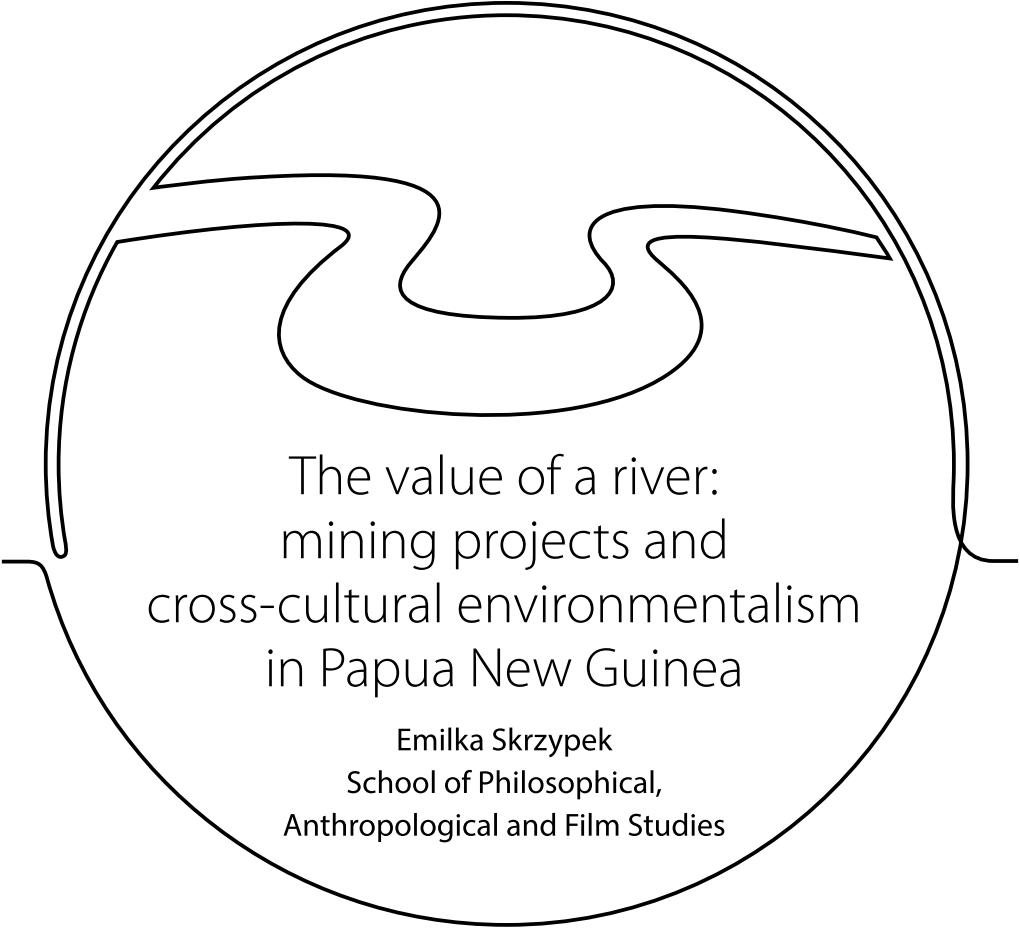
Dr Lydia Cole researcher profile: [www.st-andrews.ac.uk/geography-sustainable-development/people/lesc1](http://www.st-andrews.ac.uk/geography-sustainable-development/people/lesc1)

Dr Katy Roucoux researcher profile: [www.st-andrews.ac.uk/geography-sustainable-development/people/khr](http://www.st-andrews.ac.uk/geography-sustainable-development/people/khr)

Instituto de Investigaciones de la Amazonía Peruana (Research Institute of the Peruvian Amazon): [www.gob.pe/iiap](http://www.gob.pe/iiap)

Tropical Wetlands Consortium: <https://tropicalwetlands.wp.st-andrews.ac.uk/en/about/>





The value of a river:  
mining projects and  
cross-cultural environmentalism  
in Papua New Guinea

Emilka Skrzypek  
School of Philosophical,  
Anthropological and Film Studies

# The value of a river: mining projects and cross-cultural environmentalism in Papua New Guinea

Emilka Skrzypek – School of Philosophical, Anthropological and Film Studies  
(Article written by Garry MacKenzie)

One of humanity's most pressing challenges is how to reconcile our need for natural resources, including metals and minerals, with the impacts that mining has on the climate, habitats and people who live near mining projects. As a major industry in both developing and developed countries, resource extraction is a fundamental part of the global economy. In addition to the fossil fuels and heavy metals used in conventional industry, mining provides materials that are essential for transition to green energy technologies.

However, extracting these resources comes at a cost to the local environment and its inhabitants. Any project involving large-scale mining or dam building raises ethical questions about the effects it will have on the surrounding area and its people that must be weighed alongside practical considerations. These issues can be particularly fraught when different communities, companies and governments, all with a range of cultures, priorities and worldviews, collide over projects that have both potential benefits and significant risks.

## The value of Frieda River

Frieda River is a tributary of the Sepik, a vast river that runs through northern Papua New Guinea (PNG). A globally important ecosystem, the Sepik River

is over 1100 km long and one of the largest intact freshwater basins in the Asia-Pacific. The Sepik region is home to around 300 language groups, making it one of the most linguistically diverse areas on the planet, and 430,000 people who depend on the river for a living. The region is part of the world's third-largest rainforest after the Amazon and the Congo Basin rainforests.

Frieda River is also home to one of the largest undeveloped copper and gold deposits in the world. Mining at Frieda could produce an estimated 175,000 tonnes of copper per year as well as a substantial amount of gold. Any project to mine at Frieda River would mean bringing industrial development to an ecologically sensitive area and on land that belongs to indigenous people. At the core of debates surrounding a mine is a proposal for an integrated storage facility at Frieda River, where all mining toxins would need to be stored underwater in perpetuity. Any damage to the dam would have devastating effects – posing risks to not just the environment, but to the livelihoods and lives of the Sepik communities living on the banks of the river.

Although deposits were discovered in the 1960s, development intensified in the mid-1990s. In the last decade, plans to develop a mining project at

Frieda River have reached an advanced stage. In 2018, the company proposing the development submitted an Environmental Impact Statement (EIS) to the PNG government as mandated by domestic law. In PNG, the approval process for a new mine requires the company to prepare an EIS to identify the impacts and risks associated with the proposed venture. Once submitted to the government regulator, the EIS is available for public consultation during which groups and individuals can review and comment on the document. Both the EIS and the reviews are then considered by the government as it decides whether to approve a new mine.

Dr Emilka Skrzypek, Senior Research Fellow in the School of Philosophical, Anthropological and Film Studies, is an anthropologist specialising in the dynamics of encounters between exploration companies and local communities. Working with her Research Assistant Sonja Dobroski, her Scottish Funding Council-funded project 'Local Effects, Global Assemblages, and Assessing Future Impacts of Undeveloped Mining Projects' focuses on the EIS review process for the proposed Frieda River mine.

Rather than simply analysing the pros and cons of the Frieda River mining development, Skrzypek is looking into the review process itself. When assessed from a range of perspectives, including that of people who live in the vicinity of the proposed mine, how valuable and effective is the EIS review? How has the

process generated new relationships between those favouring and those opposing the mine? Were particular groups marginalised from the review process, and what cultural, commercial or political positions were prioritised – consciously or not – by the EIS review process? How is the EIS perceived by those involved or otherwise affected by it? Is it biased in favour of one outcome? In theory, the EIS should address the imbalance that leads to some voices being heard much more easily than others when it comes to proposals for large-scale resource extraction. Does that theory hold true in practice?

### **International conversations**

Little is known about how groups of people and organisations come together in response to the EIS. These congregations are at the heart of Skrzypek's research, which looks at how the process involves a fascinating coming-together of different worldviews. Indigenous communities opposing the Frieda River development rely upon an international combination of advisors, lawyers, environmental organisations and journalists whose expertise lends authority to their campaign. At the same time, these international allies are less familiar than locals with the actual environment that they are seeking to protect. So, they rely on accounts from those who know the river well and see their role as supporting and amplifying indigenous voices.

There are a host of political reasons why international partners are important

within the Save the Sepik Campaign to resist the mining development, but Skrzypek identifies some factors intrinsic to the EIS itself. The report is written in highly technical English, for instance. It stretches over 7000 pages long and is the result of millions of dollars of funding. It also assumes that the mine is an exercise in logistics, finance and technological capabilities. This worldview contrasts with the priorities of local people resisting the mine, whose culture is intrinsically linked to the Sepik. For them, the river is a living spirit celebrated in songs and stories. It has its own voice, and is part of a tight web of cultural, spiritual and ecological connections drawing together plants, animals, water and human beings.

In their declaration of opposition to the mine, a federation of village elders stated that they were acting under the authority of the Supreme Sukundimi, the River God, and in the name of the

ancestral spirits inhabiting the landscape. The elders demonstrate a connection to the land that is far removed from the language and priorities of international corporations, and view the area according to a timescale that is very different from the 33-year projected lifespan of the mine: 'The Sepik River is not ours. We are only vessels of the Sepik Spirit that dwells to protect it. We will guard it with our lives'.

Reconciling local culture, environmental concerns, corporate interests, government bureaucracy and international activism is a challenging task. Still, it is one that the EIS and process of EIS review are meant to fulfil. Skrzypek's research aims to shed a light on this process. While the case study focuses on one development on the Frieda River, its findings are relevant across the world as we strive to meet our need for natural resources in the face of environmental and social concerns.

### **Find out more**

Researcher profile: [www.st-andrews.ac.uk/social-anthropology/people/ees7](http://www.st-andrews.ac.uk/social-anthropology/people/ees7)



New potato varieties  
are a hit in East Africa

John Jones  
School of Biology

# New potato varieties are a hit in East Africa

John Jones – School of Biology

(Article written by Martin Ince)

With an estimated production of 368 million tonnes in 2018, potatoes are one of the world's most important crops. If the potato harvest is lost or reduced in output, farmers and consumers alike will suffer.

The arrival of a new and damaging parasite, first detected in Kenya in 2015, means that this issue is a live one in Kenya and across East Africa. Scientists at St Andrews are a key part of the international team that is working to solve the problem by breeding a new type of potato.

John Jones is a Professor of Biology at St Andrews and Head of the Cell and Molecular Sciences Department at the James Hutton Institute, a Scottish research organisation specialising in crops, land use and natural resources. He explains that the problem is the arrival in Kenya of the potato cyst nematode (PCN) *Globodera rostochiensis*, a parasite of common potato varieties in the area. Jones says, "Most farmers are unaware of PCNs, microscopic worms which live in the soil and are invisible to the naked eye. Their presence is not obvious and there are no defined symptoms that are characteristic of this disease – the plants just appear generally unwell."

According to Jones, "These parasites co-evolved with potatoes in South America and were brought to Europe when new varieties were introduced after the Irish

potato famine [in the 1840s and 1850s]. Then, the seed potato industry spread them from Europe across the world in the 20th century."

Unlike the blight that caused the Irish potato famine, Jones says, PCNs "do not destroy the entire crop in the field." Instead, the parasite reduces the yield per hectare to a damaging level. "Crisis would be too strong a term," he notes. "The picture is not black and white, but it is a big problem." The PCNs are present in Europe and found "wherever you look" in East Africa, including in Rwanda, Uganda and Kenya. Alongside the financial and nutritional consequences of reduced crop yields, this also means possible ecological damage as the lower output per hectare tempts farmers to increase capacity by cutting down virgin forest.

## Making a new potato

Jones and colleagues responded to the problem by developing a new potato that has some major advantages. The new lines, which are undergoing further testing in Kenya before being designated with a formal name, are resistant to PCNs. But they must also be acceptable to farmers and to the people who do the cooking (mainly women, in this part of the world).

The aim, Jones recalls, was to produce a potato that mimics Shangi, an existing

variety that accounts for up to 75 per cent of Kenya's current potato crop grown by smallholder farmers – but with better PCN resistance. Shangi has no dormancy, which is the requirement for exposure to cold conditions that characterises many potato types. This is a welcome feature because there is no cold storage in Kenya, and farmers want to plant the next crop as soon as they can. Growers in Kenya often produce two crops each year, aligned with the rainy seasons. Those who prepare meals also want the potato to cook quickly – a further attribute of the popular Shangi that is also a feature of the new lines. "We wanted this project to have impact, so we took time to find out what the users want," Jones says.

Creating a new potato is not a simple task. Jones explains that the potato genome is large and complex, which means that a rich variety of types are available as source material. The problem is that it typically takes five to ten years to develop a new one. However, the timescale has been telescoped to one or two years for this project.

Such rapid progress was possible because the team already knew about potato lines at the Hutton Institute that combined a potato called *Solanum phujera* with conventional *Solanum tuberosum* lines containing a gene called H1. Identified in the 1950s, H1 conveys PCN resistance to potato varieties. The hope was that these new lines would have all the attributes desirable to smallholder farmers in addition to PCN resistance.

Jones emphasises that the new lines were generated by cross-breeding, an orthodox plant breeding method, rather than genetic engineering. This is because there is strong social resistance to the latter in some parts of the world.

Thus far, the new lines have passed every test for adoption in Kenya. Jones explains, "They have been planted in field trials which have been pretty good, and which have shown that they can control PCN levels. So, the farmers like it. In addition, the women's groups we have consulted say that it passes the taste test." The new potato is rich in chemicals called carotenoids that add to flavour and appearance, comparing well to the Shangi in trials. In appearance, Jones says that it looks like the Mayan Gold (a potato familiar to shoppers in European supermarkets).

The next stage of development is to get this new variety from testing to bulk use. To achieve this, the potato has to be approved as a new line by the Kenyan authorities. Then, it has to be introduced into the channels through which Kenyan farmers get seed potatoes. Jones says, "This could be done through commercial networks. They do exist, but most smallholder farmers cannot access them. It is likely that if it is a success, the lines will feed into the informal exchange markets which most farmers use."

Jones is keen to stress the multinational nature of the Kenya potato project, which has been carried out by two Scottish institutions, the University

of St Andrews and the James Hutton Institute. They have worked alongside the International Institute for Tropical Agriculture (IITA), a Kenya-based research organisation specialising in food issues. The organisation has expertise in nematode science and other aspects of African farming systems, and provides valuable expertise in working with African farmers and consumers. It is also part of CGIAR, the food-oriented research agency for the Global South. The project further included involvement with icipe, the Kenya-based International Centre of Insect Physiology and Ecology. Jones notes that St Andrews is “a critical

part” of the project due to its biological knowledge and that “collaboration between the three institutions is very close and we have full information sharing.”

This promising project was enabled by UK development aid spending, including cash awarded to St Andrews from the Global Challenges Research Fund (part of the UK aid system). In addition, Professor Jones received £150,000 for this work from Innovate UK, part of UK Research and Innovation, via the James Hutton Institute.

**Find out more**

Researcher profile: [www.st-andrews.ac.uk/biology/people/jj33](http://www.st-andrews.ac.uk/biology/people/jj33)





How landscape art can help us  
think about climate change

Stephanie O'Rourke  
School of Art History

# How landscape art can help us think about climate change

Stephanie O'Rourke – School of Art History

(Article written by Garry MacKenzie)

Climate change is among the most complex problems that humanity has ever faced. One of the reasons for this is that it is simply too big for anyone to experience in its totality. The effects of climate change can be seen all over the world, but they sometimes seem to contradict one another. For example, global warming does not affect every region equally. Rising sea levels and increasing temperatures need to be plotted as long-term trends in order to be seen and understood. It is hard to relate our everyday experience of the world around us to events changing the climate of the planet, let alone to understand the causes of these events and how they can be alleviated. Comprehending facts, theories and case studies can only take us so far: nobody can grasp everything to do with climate change all at once. In fact, coming to terms with its complexity is often overwhelming.

At the start of the 19th century, geologists and other scientists were grappling with a similar dilemma as their discoveries revolutionised notions about the age of the earth. They discovered that instead of comprehensible timescales dating back a few thousand years, continents actually had a deep history stretching back hundreds of millions of years. As with climate change, deep time is measured on a scale that is

almost impossible for a human being to imagine. How do we begin to comprehend that a mountain is millions of years old when even the oldest humans live only about a century and recorded history stretches back only a few thousand years?

In her Leverhulme Trust-funded research project titled 'Picturing Nature, Painting Landscape', Dr Stephanie O'Rourke, a Lecturer in the School of Art History, explores how artists in the late 18th and early 19th centuries dealt with this newly unfathomable distant past. Her research looks at how landscape artists engaged with the cutting-edge science of their day alongside a parallel rise in the commercial extraction of natural resources (especially coal). While it is tempting to assume that scientific thought and the arts exist in separate spheres, O'Rourke reveals a great deal of overlap between the disciplines around the time of the Industrial Revolution. Many artists were keen students of the natural world. They were often at the forefront of societal debates about how nature works, the role of human beings in nature, and why we should care about the world around us.

## The art and science of landscapes

'Picturing Nature, Painting Landscape' reveals just how central contemporary

science was to landscape artists around the start of the 19th century. To begin, it examines the representation of two kinds of natural resources in landscape painting: wood and minerals. The management of forests, a then-growing industry, raises questions about long-term sustainability. Maintaining a steady supply of timber requires thinking decades or centuries ahead into the future, which is something that societies throughout history have struggled to remember. In contrast, mining raises different questions about scale; materials such as coal are hidden underground and formed over a vast timescale. O'Rourke also looks at how British artists engaged with geology, particularly in their representations of volcanoes. Her research uncovers how French, German and British painters brought these questions of scale into their work.

Finally, 'Picturing Nature, Painting Landscape' turns to an area in which European scientific, economic and political thinking perhaps carried the most pronounced impact: colonialism. O'Rourke considers how the visual culture of Pacific exploration brought together ideas about human evolution, race and resource extraction. These ideas were at the heart of contemporary Western thought and the imperialism that it underpinned.

The artists that O'Rourke discusses used their work to explore a new worldview in which the earth was so much older than human history and the impact of human activity suddenly seemed less

significant. Ironically, this was also the era when steam power was revolutionising European industry – an era that some environmental historians identify as the beginning of the Anthropocene. So, how does studying 18th- and 19th-century art relate to the climate concerns of the twenty-first century?

### **Landscape art and the 21st century**

While these topics may seem to address the role of art in one historical period, 'Picturing Nature, Painting Landscape' is not just about the art of the past. O'Rourke's research shows that artwork helps us experience ideas in a tangible and visual form rather than merely formulating them as abstract concepts. While landscape painters living two hundred years ago developed a visual culture that articulated the awesome power and incomprehensible age of the physical world, artists and art historians today can enable us to think more clearly about climate change.

The causes and effects of climate change are incredibly hard to disentangle from each other. The difficulty of having a clear perspective on this complex phenomenon – one in which we are both a perpetrator and a victim, which affects a planet that we are both part of and yet able to profoundly alter – can lead to confusion and defeatism. The arts are a valuable tool for understanding, and perhaps even shaping, our relationship with the world around us.

'Picturing Nature, Painting Landscape' further illustrates how thinking about

climate change requires us to reach across disciplines. As the project reveals, artists have often engaged with the scientific ideas of their time. Art historians, too, must be alive to how interdisciplinarity opens up new ways of exploring complex issues. The multi-disciplinary research culture of the University of St Andrews has played an essential role in enabling O'Rourke's research. The project draws on initiatives including the Centre for French History and Culture as well as the c19c Cross Cultural Circa 19th Century Research Centre. Contributions from historians

of science (including Dr Sarah Easterby-Smith) and earth scientists (Dr Andrea Burke and Dr James Rae) have provided invaluable assistance.

Understanding climate change, its ramifications and its possible solutions is an immense scientific and cultural project. 'Picturing Nature, Painting Landscape' focuses on one aspect of cultural history so that we might learn from the art and science of the past. In doing so, we are better equipped to come to terms with both the present and the deep future.

**Find out more**

Researcher profile: [www.st-andrews.ac.uk/art-history/people/so38](http://www.st-andrews.ac.uk/art-history/people/so38)



Energy elites:  
shaping the future of energy

Anna Rauter  
School of Philosophical,  
Anthropological and Film Studies

# Energy elites: shaping the future of energy

Anna Rauter – School of Philosophical, Anthropological and Film Studies  
(Article written by Garry MacKenzie)

As world leaders commit to lowering carbon emissions, the transition to renewable forms of energy becomes not simply a practical necessity but also a creative task regarding what kind of lives we desire for ourselves and future generations. Coal, oil and gas are still the main sources of global energy, but use of renewables is growing. As societies work towards a more sustainable future, it is important to ask who is actually leading this transition to renewable energy. If the leaders are from the energy industry, then what are the implications of energy elites (executives, managers, investors and shareholders in fossil fuel and renewables firms) making important decisions behind closed doors? What is their vision for the future of energy and how do they intend to bring that future about?

These are not just theoretical questions: because the global energy transition will affect every household and business, there is a danger that existing social inequalities will become increasingly entrenched. Considering the fact that energy demand is still rising, the problem becomes even more complex.

Anna Rauter, a doctoral candidate at the School of Philosophical, Anthropological and Film Studies, seeks to demystify the notion of energy elites in her research project titled 'Powering our Futures: Energy Elites, Energy Imaginaries, and

Energy Production in Norway'. As the public faces of institutions that are ascribed at least some of the blame for climate change, those who direct strategy for the energy industry are sometimes portrayed as 'polluters-in-chief' or 'climate criminals'. In uncovering how energy elites themselves envision the future of energy production and consumption, her work establishes the grounds for future research, policy and industry at a time when debates about the future of energy are increasingly polarised.

## In dialogue with energy elites

Rauter began her project with eighteen months of ethnographic research in Oslo, Norway, interviewing over 100 people in leadership and expert positions at energy companies. This is innovative in itself because it is rare for researchers to gain access to the executives of energy companies. Over the course of her involvement with these leaders – to whom she applies the term 'energy elites' – she engaged in open dialogue as her interviews opened up the possibility of new approaches to thinking about energy. Rauter starts from the principle that if we are to understand the complex dynamics governing the future of energy, the views of all actors in society must be taken into account. Her work provides an illuminating record of the deeply

personal motivations and perceptions of those at the helm of the Norwegian energy industry.

Rauter's research also offers more nuanced perspectives on energy elites than are sometimes put forward in popular debate. As with other groups in society, these elites are concerned about issues such as climate change and sustainability. They share the same uncertainties that many others feel about the environment. Furthermore, they respond both personally and professionally to growing public anxiety surrounding energy and the climate.

Nearly one third of the energy professionals interviewed by Rauter over the course of her fieldwork have made a career change from hydrocarbons to renewables. Many explained that this was due to their shifting perceptions, including an increasing desire to work towards a low-carbon future. Even many who remained in the hydrocarbon sector admitted that their personal and professional lives were marked by a deepening engagement with climate matters.

Despite the plutocratic connotations of the word 'elites', Rauter uses the term to highlight the shared socio-economic background and privilege connecting the leaders and experts she worked with. Their career mobility and socio-economic security allowed them to lead change within the industry (one example is those energy elites who decided to leave the hydrocarbon industry in pursuit of renewables).

Rauter further notes particularities of the Norwegian context for her research, where the actions of energy elites are characterised by collective decision-making as moves towards energy transition involve close dialogue with interest groups, government, and other stakeholders. Elites are also attentive to international discussions about climate change, which include the work of activist movements, the impact of the School Strike for Climate, and influencers such as Greta Thunberg.

According to Rauter, this means that action to reduce carbon emissions and improve sustainability must be taken in conversation with the energy industry. She argues that challenging dominant energy regimes (such as those resistant to lowering emissions) necessarily involves cross-societal dialogue rather than retreat into echo chambers. Her study shows that the perceptions of the leaders and experts in Norway's energy companies have been instrumental in shaping the future of energy – not least because those who left work in fossil fuels played a crucial role in promoting the growth of renewable technologies and businesses.

### **Public dialogue: St Andrews and beyond**

Rauter's research is part of the Energy Ethics project funded by the European Research Council and led by Dr Mette High, director of the newly established Centre for Energy Ethics at the University of St Andrews. The Centre combines academic excellence with a supportive

community in which to conduct research, and its work complements the University's wider commitments to both interdisciplinarity and environmental sustainability.

Although her work engages with an academic audience (she has given presentations to specialists in both anthropology and energy ethics, and her first peer-reviewed journal article on energy elites is forthcoming), Rauter sees it as part of a wider cultural debate that is relevant to everyone in society. As such, sharing her research with a wide audience is a crucial aspect of her work. Rauter has shared her findings at

the Rotary Club of St Andrews and also with a Norwegian energy company. She is also a regular co-host of the Centre for Energy Ethics' podcast series, which can be found via her research profile at <https://energyethics.ac.uk/people/anna-rauter>. Her blogs on topics relating to sustainability can be found at <https://energyethics.ac.uk/blog>, while her Instagram [@missanthropologist](https://www.instagram.com/missanthropologist) includes posts and Insta stories inviting readers to discuss the topics of her research. Although her work focuses on Norway's energy elites, it is part of a much broader conversation aimed at creating a sustainable low-carbon future for us all.

**Find out more**

Researcher profile: <https://energyethics.ac.uk/people/anna-rauter/>

Researcher profile video: <https://youtu.be/64psQurlUjY>

Researcher Instagram: [www.instagram.com/missanthropologist/](https://www.instagram.com/missanthropologist/)

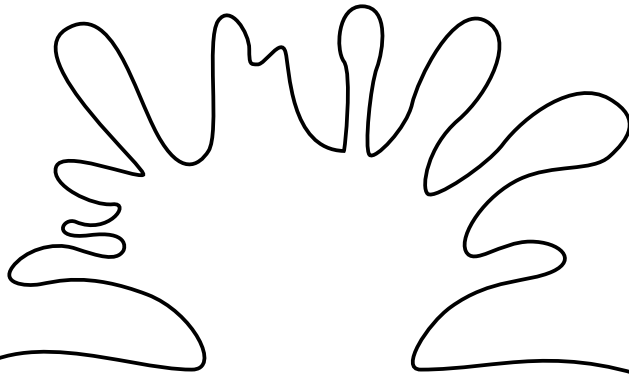
Researcher LinkedIn: [www.linkedin.com/in/anna-rauter-09b943103/](https://www.linkedin.com/in/anna-rauter-09b943103/)

Project website: <https://energyethics.ac.uk/>

Centre for Energy Ethics Twitter account: [@EthicsEnergy](https://twitter.com/EthicsEnergy)

Centre for Energy Ethics LinkedIn account: [www.linkedin.com/company/centre-for-energy-ethics/](https://www.linkedin.com/company/centre-for-energy-ethics/)





# Taking ocean engagement to new depths

The Museums of the University of St Andrews,  
Scottish Oceans Institute (SOI), and  
Marine Alliance for Science and  
Technology for Scotland (MASTS)

# Taking ocean engagement to new depths

The Museums of the University of St Andrews, Scottish Oceans Institute (SOI), and Marine Alliance for Science and Technology for Scotland (MASTS)

(Article written by Martin Ince)

*Dive in: Protecting our Ocean* is an interdisciplinary collaboration between museums, marine scientists and behavioural change experts that will take visitors under the sea to explore the importance of the ocean for life on Earth, the threats that it faces, and the changes we can make to address these challenges. It will result in an immersive exhibition and programme of events at the University's Wardlaw Museum from autumn 2021. The exhibition draws together museum professionals, experts in behavioural change, and marine scientists from the University's Scottish Oceans Institute (SOI) and the People Ocean Planet initiative from the Marine Alliance for Science and Technology for Scotland (MASTS).

"The learning process of creating the exhibition is as important in some ways as the final result," says Claire Robinson, Collections and Exhibitions Curator at the University Museums. The project seeks to understand how museums can encourage visitors to change the way they behave in order to have a positive impact on the environment. "We want to go beyond providing information on topics such as climate change and its effect on the oceans. We want visitors to have a more impactful journey," she adds.

The *Dive In* team seeks to build visitors' understanding of the importance of

the ocean through the world-leading research of marine experts at the SOI and the University's extensive natural history collections, building an emotional connection through an immersive, experiential exhibition. *Dive In* will encourage audiences to take action to protect the marine environment, promoting solutions that demonstrate that everyone can contribute to ocean sustainability. This, in turn, supports wider social and cultural change.

The museum's relationship with the SOI and MASTS is key to the success of the project, which makes use of the latest research to understand the problems and explore solutions. "The ocean is vital to life, but people don't always understand the way it works," says Robinson. We now appreciate that as well as being a highway for transport and a source of food, the oceans store and move immense amounts of heat and carbon. This makes them a key factor in climate change.

## Positive thinking

The situation described at *Dive In* is urgent, particularly in light of climate change. But individuals are powerful, especially when their combined force is more than the sum of their parts. So, the aim is not to leave visitors to *Dive In* feeling overwhelmed. A positive

audience is an engaged audience, and an engaged audience is an empowered audience. While there are plenty reasons to lay bare the stark realities, the organisers want their audience to leave the building with a sense of purpose and a can-do attitude.

Another area where *Dive In* aims to innovate is by greening its own practices. As Robinson explains, museum displays are often produced in a far-from-sustainable manner. "Exhibitions often use a large volume of new materials (for example, graphics). Displays are often bespoke and cannot be reused. And they involve materials that are hard to recycle. There is also a lot of travel involved in transporting loans for display in exhibitions. We are working with exhibition designers to work in a far more reusable and recyclable way."

The exhibition will have an online component, allowing those who cannot travel to St Andrews to engage with the topic. Online events, including a series called Critical Conversations, have already started and will continue throughout the exhibition's run.

The team's ambition is not limited to *Dive In*. Learning from the project will inform future museum practice and programming. The organisers are keen to share their research for the benefit of the wider museum and marine science sectors.

The project is part of the University's response to the UN climate change conference COP26 and it has received funding from the Calouste Gulbenkian Foundation UK and Museums Galleries Scotland.

### **Find out more**

Website: <https://divein.wp.st-andrews.ac.uk/>

Marine Alliance for Science & Technology for Scotland (MASTS) Twitter account: [@mastscot](https://twitter.com/mastscot)

People Ocean Planet Twitter account: [@OceanBehaviours](https://twitter.com/OceanBehaviours)

Museums of the University of St Andrews on Facebook, Instagram and Twitter: [@MuseumsUniStA](https://www.facebook.com/MuseumsUniStA)



Bringing clouds  
into focus

Anna Mackie  
School of Earth and  
Environmental Sciences

# Bringing clouds into focus

Anna Mackie – School of Earth and Environmental Sciences

(Article written by Martin Ince)

Measuring the clouds might seem like the definition of an impossible task. But without accurate knowledge of how clouds behave, our models of the present and future climate will be imprecise.

That is the logic behind CIRCULATES, a multi-institutional collaboration designed to improve the way that clouds are captured by the global circulation models (GCMs) that feed predictions of climate change.

Anna Mackie, a postdoctoral Research Fellow in climate science, says that the University of St Andrews is one of a group of universities and research institutes involved in CIRCULATES. From 2020 to 2024, the University has a budget of £343,000 from the UK's Natural Environment Research Council for its share of the project.

Mackie explains that today's GCMs often work with a horizontal scale of 100 kilometres. She says, "The limitations of computing power hold back the amount of detail you can simulate. The more data points you have, the more computationally expensive the model is to run. So it is very expensive to run a model with high resolution over a long time period."

But as Mackie points out, most clouds are nowhere near 100 kilometres in

size. St Andrews' role in CIRCULATES is to examine models with a resolution of three kilometres. These models can actually simulate clouds, allowing us to understand how cloud behaviour in a warming climate might be different at a higher resolution. "Today's GCMs contain assumptions about what is happening on a small scale," she says. "We want to improve our understanding of how model behaviour changes at high resolution. This could reduce the uncertainty of models at all scales."

She adds, "There are many global climate models developed by groups around the world. Sometimes, their projections diverge significantly." One key difference between them is how clouds respond to global warming. So, characterising cloud feedbacks on a smaller scale could reduce uncertainty and help these models to converge.

## Clouds from both sides

The wider CIRCULATES project is both observational and computational, and the modelling studies will be complemented by high-resolution satellite data. The aim is to understand cloud processes on the finest scale at which data is available. Mackie says, "A cloud is a difficult thing to model. It is not just about cloud cover. The types of cloud and their height in the atmosphere are also important. So,

there are quite a few variables to take into account when you model a cloud.” Broadly speaking, clouds reflect sunlight and therefore cool the Earth. But they also warm the Earth by trapping surface heat. The balance between these competing effects depends on the type of cloud. Clouds are also highly variable in both space and time, which means they are a significant source of uncertainty in climate projections.

The CIRCULATES project is at an early stage, so the exact directions of the different observational and computational strands have yet to be developed. However, the overarching aim is to better understand how clouds and circulation interact in a warming climate. The outcomes of CIRCULATES, including the St Andrews contribution, will hopefully inform climate policy by

reducing the uncertainty inherent in GCMs. Mackie stresses that this work is made easier by the academic setting of the University’s School of Earth and Environmental Sciences: “There is a huge amount of expertise here. There is always someone to talk to about the project, perhaps from a field very different from my own.”

While the Earth’s surface is cooler than it would be without clouds, the big question is whether future changes in clouds will heat the Earth or cool it. How might the balance change between clouds reflecting heat into space and trapping heat from the surface? Mackie is cautious. “It depends on the cloud changes. A small change in cloud properties or cover can have a big effect on this balance between heating and cooling.”

**Find out more**

Researcher profile: [www.st-andrews.ac.uk/earth-sciences/people/arm33](http://www.st-andrews.ac.uk/earth-sciences/people/arm33)

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