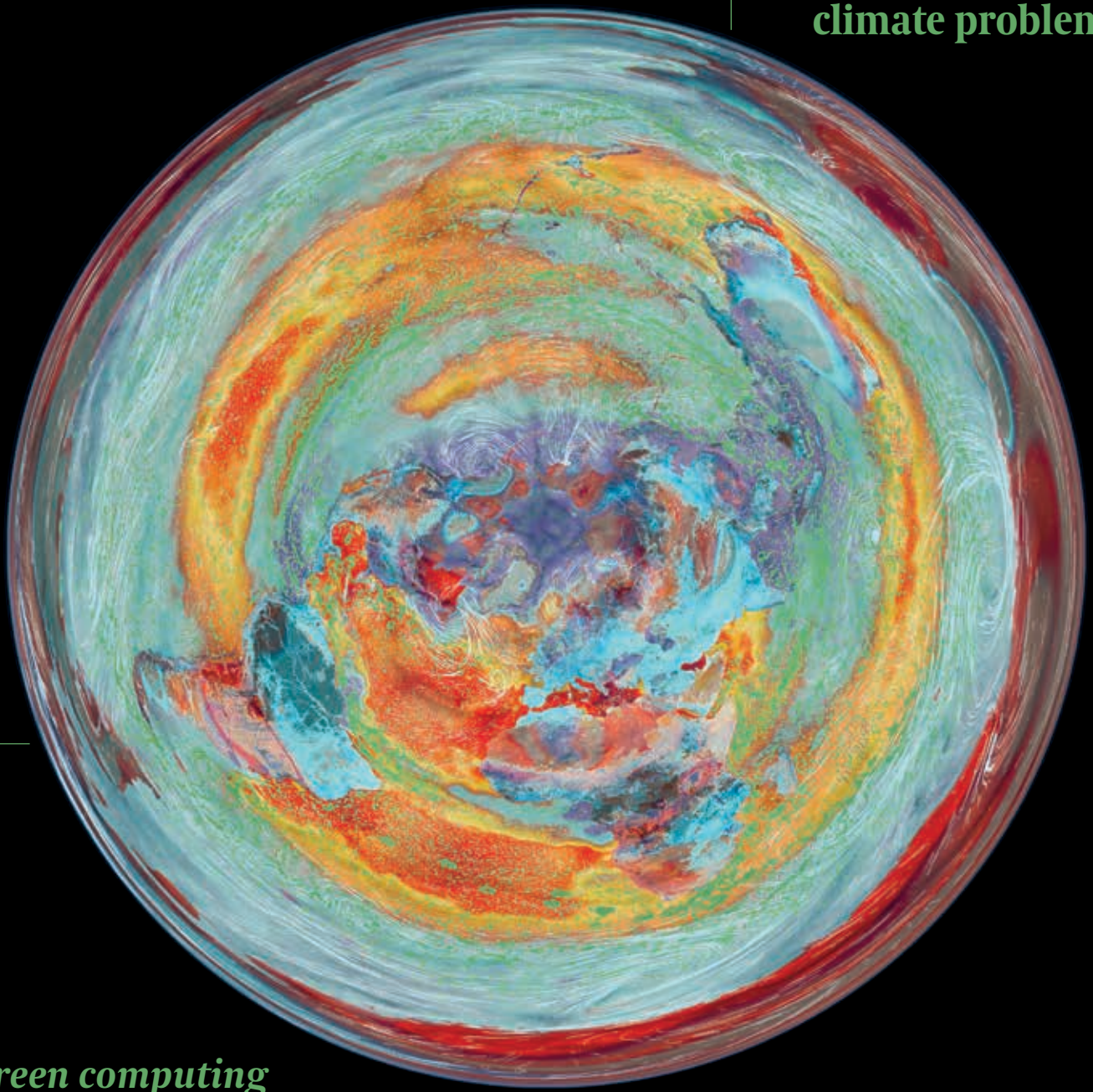
# RESET

a climate magazine by the IT University of Copenhagen

**does IT have a climate problem?**



***green computing needs to be able to do more than talk about power (as energy) and learn to grapple with the power of digital capitalism.***

#1 • MAY 2022

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# RESETS

EDITORIAL

# RESET: AN IT PERSPECTIVE

James Maguire
Michael Hockenhull
Tom Jenkins
Luis Landa

**We need a reset,**

**not a reboot,**

**a reset.**

There is no rebooting the biodiversity we have lost. There is no rebooting the places we have irreparably damaged and the iconic features that constitute them- the ice, the corals, the islands. So, we are advocating for a reset: making anew the planetary relations that are essential to a caring and just existence. While this might be simple enough to say, it is notoriously difficult to enact. Resetting takes vision, will, and the ability to navigate the treacherous waters of power relations and political compromise. As the Intergovernmental Panel on Climate Change (IPCC) has reminded us on many occasions, we are inching toward the possibility of slightly less catastrophic futures. But we don't have time for inches; we need leaps.

## We need a reset.

In our own neck of the woods – the world of IT – resetting is no less difficult. The IT industry is grappling with its own set of climate-related tensions. On the one hand, it claims to be a cross-sectoral industry player that can cut the emissions of other sectors via smart, AI driven efficiencies. On the other hand, its own approach to carbon accounting leaves a lot to be desired. As an IT University, we find ourselves at the crosshairs of such tensions: professing a hope for technology as something that can enrich our lives while simultaneously being ethically bound to research and teach technology in ways that open its manifold invisibilities and ideologies.

This issue launches ITUs Climate Magazine, **Reset**: a faculty-led climate initiative that draws attention to the climate agenda by inspiring, encouraging, critiquing, and even cajoling our collective University body. Our intended audience is the ITU in its entirety, students, scientific, technical, administrative and management staff alike. While Denmark struggles to live up to its promised 2030 carbon emissions reduction targets, we feel that ITU is a place that **can** make a meaningful difference. But only if we dare. But to dare is not easy. Institutional inertia coupled with complex governance structures militates against action. Small, positive signs are on the horizon, however, as the university works on a new climate strategy. While this includes an institutional acknowledgement that climate-based research and teaching is important, it also requires us – its students and employees – to urge our collective body into more timely - and no doubt radical - climate-conscious actions. Achieving this, we feel, is dependent on **re-setting** the university's self-understanding as a public leader on climate action.

Concretely, this magazine will offer you a selection of perspectives on climate, sustainability, and so-called green transition agendas: how they are problematized, researched, taught, advocated for, engaged with, and implemented (or not). Our feature articles will connect to broader climate questions with a particular emphasis on how we can - as researchers, students, and organization - work together toward making the planet more inhabitable, less toxic, and richer in all forms of life.

As our first issue shows, while ITU has little formal track record in questions of climate, there is still a rich engagement with the quandaries and concerns that climate and sustainability questions generate. This is manifested through funded research projects, sustainability related or inflected teaching, student research engagement, and a general faculty desire to work across disciplines on the big challenges that the climate emergency poses. Our very first feature story is on **Green Computing**, a research front where ITU can make a substantial contribution. This feature shows how computational and environmental infrastructures are entangled at multiple scales. Whether it is the invisible resource burden of AI and the potentially creative ways we can address this, or the **en masse** arrival of Big-Tech data centers to Denmark and how we should engage them, the range of enviro-computational connections is compelling.

The magazine also intends to shine a light on the amazing work that ITU's labs are doing, while following developments on the teaching front. Finally, we will also solicit the opinions and perspectives from the operations and administrative branches of the organization while updating you on developments in ITU's climate strategy. Future issues will discuss the pathways that ITU researchers and students have taken, and continue to take, through their focus on various aspects of the climate and sustainability agenda (see our ABC of climate-related research).

While the campaign to keep "1.5 degrees alive" lives on - albeit barely - we are most likely facing at least a 2.7-degree increase in temperature by 2100. And that is only if all the recent commitments at the Conference of Parties 26 (COP26) in Glasgow are met. And there is no doubt that this is a big if. What the Glasgow meeting highlighted is the agonizingly slow pace of these arduous, bewilderingly complex climate governance forums. Places rich in ritual and ceremony, high in emotion and sleep deprivation, plagued with intransigence and limping with hope, the complexity and, at times, absurdity, of the COP process resonates with many. While his magazine cannot redress or intervene in any of these particular issues, we can endeavor to become a voice for our collective concerns around climate-related IT. We hope that you will accompany us on this journey to **reset** the IT agenda, to **reset** our idea of what is possible, and to **reset** our collective imaginaries of life in the Anthropocene.

Our plan is to bring you the next edition of **Reset** in early 2023. For now, a big thank you to our inaugural contributors as well as our collaborators in the Communications department, and our funders in the Business IT department.

James Maguire
*Associate Professor*

Michael Hockenhull
*Post-doc*

Tom Jenkins
*Associate Professor*

Luis Landa
*Climate Research Assistant*

FEATURE ARTICLE

# Does IT have a Climate Problem?

## An Agenda for Green Computing

James Maguire
Luis Landa
Tom Jenkins
Michael Hockenhull

Does IT have a climate problem? The simple answer, of course, is yes. Like every other sector of society, the IT industry struggles to acknowledge the extent of its own carbon emissions. In fact, it has become considerably better at arguing for its capacity to reduce carbon than highlighting its own carbon footprint. While many industry sectors play this rhetorical game—the amplification of *potential savings over actual emissions*—as a cross-sectoral industry, IT is uniquely positioned to do something more than claims making. In this feature article, we want to suggest what that something might be by sketching out a robust agenda for green computing.

If we want to empower green computing research that holds the IT Industry accountable for the deleterious effects of its actions, we need a more expansive understanding of green computational practices. If our aim is to make more liveable futures, then green computing needs to be able to do more than talk about power (as energy) and learn to grapple with the power of digital capitalism. Otherwise, it will remain a well-meaning, albeit disempowered, interdisciplinary quirk.

Take writing code as one example. It's a computational practice that is oftentimes ignored as a carbon producer. The climate footprint of Artificial Intelligence (AI), and particularly the, at times, trillion-parameter machine learning ML models that undergird it, incur huge energy (and carbon) costs. Such costs arise from training the models as well as ensuring their predictive capacity.

A notable example of this is GPT-3, a language prediction model created by Open AI (a non-profit funded by Elon Musk and Microsoft, amongst others). Never has a model been so successful in creating dad jokes, writing fiction, and even, at times, poetry. The only thing that matches the predictive power of GPT-3 seems to be its power consumption: current estimates suggest that a single 'training session' for the model uses the same amount of energy as driving 700,00 kilometers by car. Another startling statistic shows that the computing power used in such deep learning models has grown 200,000-fold between 2012 and 2018.

Models such as GPT-3 are based on Natural Language Processing (NLP), an area studied by Associate Professor Leon Derczynski at ITU. "NLP models are huge; they have millions and millions of parameters, and they need hundreds of kilowatt hours to train. They are really demanding in terms of both energy and hardware." What adds fuel to the fire from Leon's perspective is how the seemingly unlimited availability of hardware has become part of the problem. "I like efficiency, I grew up with ridiculously small computers that could do pretty amazing things. However, the turn to big data means that the challenge has become less about being efficient and more about producing predictive results, no matter what the energy cost."

Google Data Center - Photo: Connie Zhou

*we want to make IT more accountable for its climate impacts by sketching an outline for a robust green computing agenda.*

NLP serves as a fitting example of the challenges green computing faces. As these models move more into the mainstream, a huge increase in power and materials consumption will follow. "It ends up with lots of bad code on way too many computers in datacentres doing little else than predicting the next ad on your app." Leon's current research tackles this problem space: an effort to map the carbon landscape of AI by assessing the energy intensity of its code. By making models that are sensitive to energy consumption at a given performance level, one can invert the process in order to figure out how to keep the performance level stable while turning down energy intensity.

In a recent paper, Leon, along with co-authors Lucas Høyberg Puvis de Chavannes, Mads Guldborg Kjeldgaard Kongsbak, Timmie Mikkel Rantzau Lagermann, showed that 90% to 95% of the ways of configuring these big AI language models are sub-efficient (in terms of either performance or energy efficiency). This is the type of work that green computing can do, and do well, namely, outline the factors at play in energy intensive code and pinpoint the frontier points at which code can consume markedly fewer resources. While moves like this alone won't get us out of the current emergency, Leon remarks, "they will stop us doing stupid things automatically, which seems to be our default state at the moment."

The problem is getting the big tech corporations to pay attention to research of this nature. As publicly funded work, these findings can be generalized and input into the models of tech companies giving them an energy efficiency gain for free. It speaks volumes about the current moment and its embeddedness in surveillance capitalism that this isn't happening.

While energy-efficient AI is clearly important, what Leon's work draws attention to is the meeting place between environmentally sensitive computing and power (relations, not watts). Said in another way, AI, and the vast ML models that serve it, is one part of vast digital surveillance infrastructures that have taken form over the preceding decade, and which look set to continue to be the dominant mode of conceiving, designing, building and partaking in digital life. This means that green computing must be about more than energy-efficient AI if it wants to have an impact.

*if green computing is to mean something, then we need to think seriously about the various interconnections between the scales of AI, Big-Tech capitalism, and climate.*

**700,000 kms**

a single 'training session' for an ML model uses the same amount of energy as driving 700,00 kilometers by car.

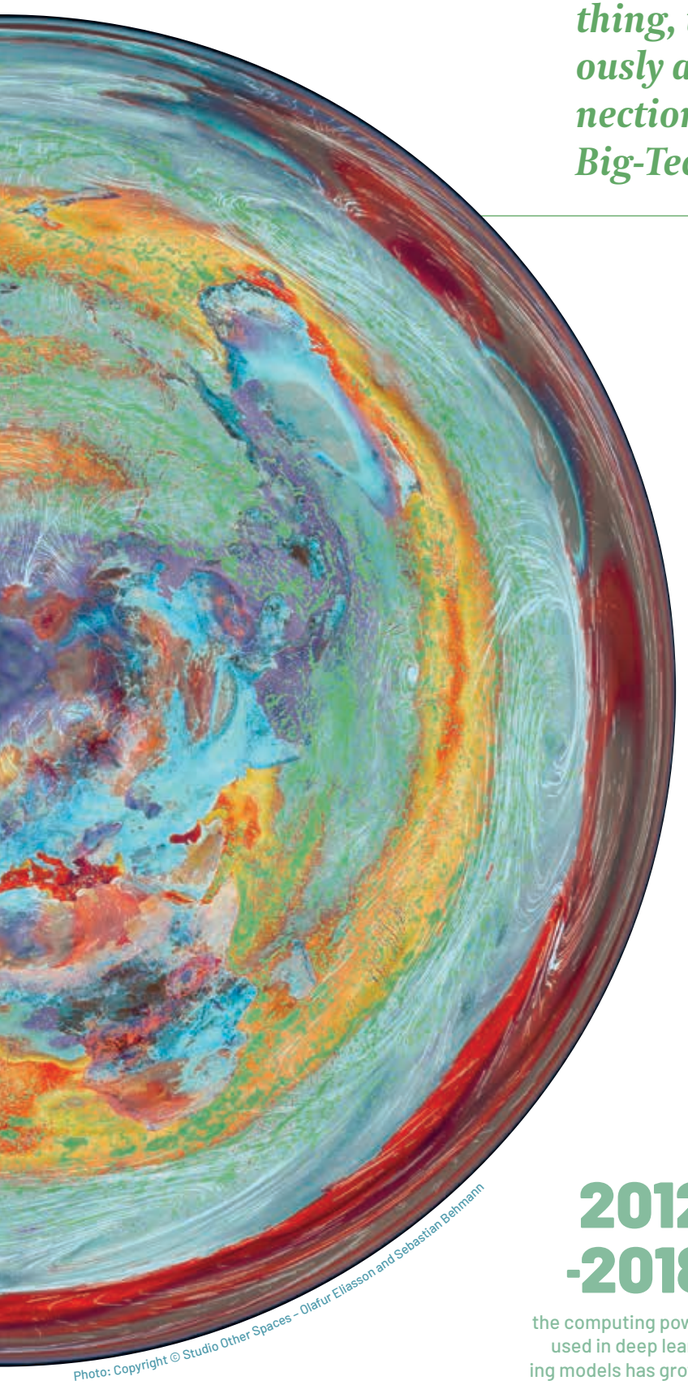


Photo: Copyright © Studio Other Spaces – Olafur Eliasson and Sebastian Behmann

**2012 -2018**

the computing power used in deep learning models has grown 200,000-fold between 2012 and 2018.

To try and think about this, let's turn to another scale at which green computing can have an environmentally significant impact. As many will know, the hyper-scale data centres of Big-Tech have taken up residence on multiple Danish landscapes: Facebook in Odense and Esbjerg, Apple in Viborg, Google in Fredericia, and Microsoft in several locations on Zealand. As (server) farms of the 21st century, datacentres gobble up vast resources. Not just energy, but minerals, electronics, and land, too. Their current rate of growth is phenomenal, rising in tandem with both our cultural habitus of archiving – if not dumping – our digital wares in the so-called 'cloud,' and the structural relations that come with the business of surveillance capitalism.

If green computing is to mean something, then "we need to think seriously about the various interconnections between the scales of AI, Big-Tech capitalism, and climate," says James Maguire, Associate Professor of Climate and Digitalization at ITU. To do this we need to ask, "what green computing has to say to the staunch silence that emanates from large technology companies." As Leon's research points towards, these organizations pay very selective attention to publicly available research on energy deintensification. Renewable energy is undoubtedly high on their public agendas – although the various means by which organizations can 'claim' to consume such energy is bewilderingly extensive – but reforming the energy intensity of their code and the resource use this implies, or altering their data-driven business models is a different matter entirely.

There are two research trajectories James thinks are fruitful in this regard. The first is one that analyses and advocates for entirely new ways of organizing digital infrastructures as planetary-computational artefacts, an approach connected to, but not identical with, the degrowth movement. There are several new, and alternative, models currently circulating, including My Data, Tim Berners-Lee's Datapods, or what's referred to as the Barcelona Open Data Model, derived from the city's efforts at reabsorbing corporate data into a public data infrastructure. Each one has merits as well as blind spots, but they all make claim to a similar idea: the fundamental reimagination of digital infrastructures as organizers of socio-political and economic life, including their planetary implications. Such an agenda includes rethinking questions of digital ownership, rights, access, and ethics. We need not venture too far into the current fantasies of the 'metaverse' as conceived by the organisation-formerly-known-as-Facebook to get a feel for how far away these more carbon sensitive, collective alternatives are.

**6%-12%**

recent estimates suggest that only 6% to 12% of the work done on datacentre servers is computational, the rest is what the industry refers to as 'comatose' servers.

Another road of travel is to ask what more sustainable algorithmic practices might look like. This is less about degrowth and more about decoupling our practices from their toxic effects. Such an approach doesn't seek to reorganize digital capitalism but works within its currently existing structures to effect change. This could be, for example, designing ML models differently, not just through energy deintensification strategies, but through an infrastructural setup that thinks of AI as both a technical and planetary artefact embedded within a constellation of ethical social systems. For example, more recent estimates suggest that only 6% to 12% of the work done on datacentre servers is computational, the rest is what the industry refers to as 'comatose servers' – the slew of computers that are fully powered on and sitting idly by in anticipation of user profile updates. Simply put, these servers not only use vast amounts of resources to remain in comatose mode, but they use them for almost no productive purpose whatsoever.

So, what might a green computing agenda say to such flagrant unsustainability? How might we work towards modes of organizing digital infrastructures that take account of such blatant resource abuse? Well, to start, we believe that proper inter-disciplinary studies are necessary. Not just tokenism, or green supplements to already over-burdened courses, but actual spaces where computer scientists, designers, and social scientists can research and teach on common, collectively defined, problems. Not as silos connected through neat organizational diagrams, but as sets of citizens concerned with how their studies address the climate problem as an existential one. We need the coming generations to collectively engage the complexities that data and technology practices give rise to. For them, it needs to be obvious that the multi-scalar nexus of practices that constitute IT – ML models, accumulation culture, surveillance capitalism, and sustainable design – be considered, problematised, diagnosed, and solved together.

It is only when we do this work that the power deficit in green computing can really be addressed. When students become alumni and begin to take up the extraordinary challenges that lie before them, then, and only then, will we be able to talk to, and through, power in any meaningful sense. Let us hope that ITU, amongst others, is willing to meet the call for such an emboldened green computing agenda.

# Column:

# What is ITU doing now, and must do in the future, to ensure that our education helps tackle the climate crisis?

Pernille Rydén, *Dean of Education*

Education

I wear my Dean of Education hat and cognitive research glasses when trying to answer this important question. Consider the following an "appetizer" as to what ITU is already doing and should continue to do.

Research has firmly established that climate change is human-made. Likewise, the solutions to these problems must also be human-made. Education is crucial in helping us respond, and in re-thinking our approach to the coming climate emergency. Many look to IT and digitalisation as ways to tackle and prevent climate problems, but it is also important to be aware of the social and mental pitfalls.

ITU's programmes contribute on several fronts to the development of "climate skills" and we need to continue to do so. However, I want to focus on three types of skills, in addition to sustainability and ethics. They are reflected in ITU's "Employability profiles", which describe the cross-cutting core competences of ITU programmes:

- Critical and innovative thinking
- Collaboration across disciplinary, industrial and geographical boundaries
- Digital competences and adaptability

**Critical and innovative thinking:** Einstein is quoted as saying that we cannot solve our problems with the same thinking we used to create them. This is particularly true for climate change, which is characterised by a range of paradoxes.

ITU's programmes develop students' ability to think critically about IT solutions and their implications for people and the planet. One of these is the ability to identify different needs, desires and contexts, as well as how IT can be integrated within them. Another is to be critical of the assumptions about cause and effect relationships upon which many solutions are based. What might pass for a solution in one place, can create new and unforeseen problems in another. For example, the digitalisation of processes has reduced global paper consumption, but cloud-based solutions have increased $CO_2$ emissions.

Because sustainability involves overlapping ecosystems, assumptions about causality and linearity can be flawed, even life-threatening. ITU graduates can help identify and calculate the unexpected and exponential effects of climate problems as well as potential solutions. Disciplines such as mathematics and statistics underpin complex and predictive analyses that can help discern climate solutions and conclude whether they create problems in other areas.

As a university, ITU contributes to Danish democracy and society, and we therefore share the responsibility to empower students and future generations. We teach our students to program, but we should not "program" our students. We need to develop their critical thinking skills and enable them to make free, independent and rational choices. After all, it's their future we're talking about.

**Working together across disciplinary, industrial and geographical boundaries:** the climate crisis requires a 360-degree response. ITU education is based on the trinity of IT, business and digital design. Scientific, social and business insights, as well as the ability to balance different courses of action, help to create respect for stakeholders with different disciplines and realities. It sharpens students' ability to collaborate in different contexts. It is important to remember that sustainable solutions are often based on sustainable relationships in education, research and industry.

**Digital competences and adaptability:** at ITU, teachers and students often experience complex and rapidly changing realities. This is a basic condition of working with IT, but the same rules apply to climate issues. Rapid and radical shifts are taking place, so learning competences are as important as professional skills. Human behaviour is influenced by upbringing and education, so unlearning is as important as learning. IT education affects student behaviour directly and indirectly, but it is problematic to assume that IT education automatically changes behaviour in the right direction.

***we teach our students to program, but we should not "program" our students. We need to develop their critical thinking.***

# Column:

# A secret “laboratory”

Malene Holm Smed, *FM*
Michael Bloch, *FM*
Thomas Jensen, *FM*
Michael Hockenhull, *Post-doc*

Facilities Management

The work of the Facilities Management department is invisible to people most of the time. And that’s how it should be. We keep the water running, the lights on and ensure the toilets are kept clean. It’s often only when these things don’t work that you think of us. Similarly, many aspects of climate change are not as dramatic as flooding or forest fires. Working against climate change, while requiring new research, is also about using less resources and simply doing more with what you have.

So, while you may not have noticed it, we in FM have implemented a number of improvements at our two campus buildings in order to help fight climate change. In the Fall of 2021, we changed all of the bathroom water faucets to sensor-based ones, saving a lot of water. Similarly, we have exchanged kitchen faucets with Quooker faucets to reduce the waste of water and energy associated with electric kettles.

We have also focused on lighting solutions. For example, we have improved the lighting that uses localized sensors. This enables us to ensure that lighting is turned on in the exact area you are studying, rather than lighting up an entire corridor. We’re also experimenting with more precise sensors in the hallways. It’s worth saying that before we implement these improvements across the whole building, we also test them out in our own FM corridor, to make sure that they work properly. As a rule, we only offer systems that we have tested on ourselves first. One might even say it’s a kind of secret “laboratory” down in the FM corridor: we conduct small, informal experiments on ourselves, prototyping and testing changes to the built environment, so that we can be sure that the changes we make at ITU are improvements to your life and the environment.

Obviously, there are many more things to improve, and we have a lot of ideas “bubbling” away which we look forward to trying out and possibly implementing. For example, we want to install solar panels on the building façade, power the elevators with green energy, and reuse water from the mandatory sprinkler-tests we are required to do every week. Of course, we seek to improve not only the “hard services” of the building itself, but also the “soft services” we support, such as cleaning, recycling, and catering. However, while there are many things we want to do, some of these things are out of our hands. For instance, certain parts of the building, such as the façade, are under the remit of the Building Agency, rather than the ITU itself. This means we can’t do anything without their cooperation, and that takes a lot of time and lobbying to achieve. That’s of course no excuse not to improve what we can. We try to ensure that efficiency and climate considerations are central to how we approach our work.

We are always interested in hearing from you with suggestions for how we can do better. Please write to fm@itu.dk if you should have any. Everything isn’t possible, but a dialogue always is.


working against climate change, while requiring new research, is also about using less resources and simply doing more with what you have.

**WE HAVE**

exchanged kitchen faucets with Quooker faucets to reduce the water and energy waste associated with electric kettles.

# VIEW FROM THE LABS: DASYA

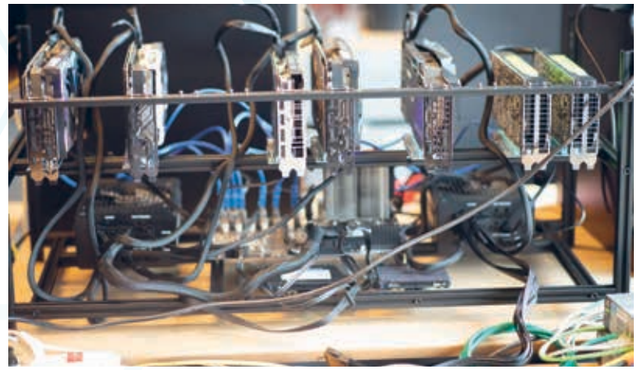
Luis Landa
James Maguire

Come with us to the 5th floor, where we enter one of several unique lab spaces at ITU. Meet Sebastian Büttrich, lab manager of DASYA (Data-Intensive Systems and Applications), a lab that focuses on the infrastructures of data science. From data collection to data curation, it is firmly rooted in the various possibilities that IoT holds. The lab has a very DIY feel and experimental practices are encouraged. Their project portfolio ranges from air-related sensor data to water and energy data, to more resource friendly data-intensive workloads. While these projects and experiments serve to train students and researchers in industry norms and expectations, the lab's motivations are deeply connected with a net-zero carbon future. Transition thinking materializes in various technical manifestations – from IT systems, to emerging technologies – but it even extends to the debates that lab members have about how they can reconcile their love for IT with its obvious climate impacts.

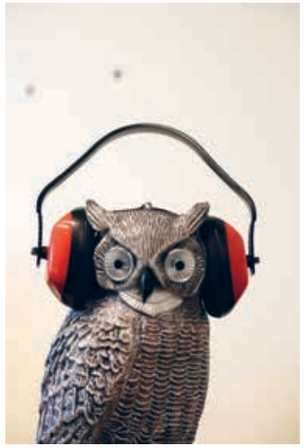
It is this 'sceptical love' that drives lab members, as they invite us to challenge the idea that IT is somehow inherently sustainable. For them, this is something to be demonstrated rather than merely claimed. And such a demonstration requires work, lots of work, if IT is to serve a net-zero transition.

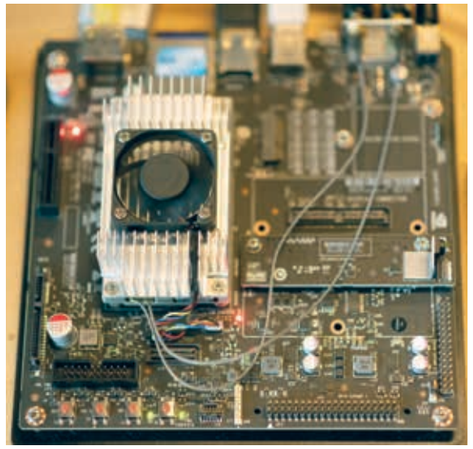
The message of the lab's tough love is: let us dispense with the general belief that IT *is* sustainable and rather let's focus on *how* it can actually help mitigation endeavours.

The lab's biggest and most important sustainability project is energy. Current estimates suggest that, for example, data centers and their data flows will consume somewhere between 25% and 30% of the world's electricity by 2030. And AI and other computational processes are highly implicit in these exorbitant numbers. So, there is a need to think computation, and its panoply of processes, sensors, and machines, in a more resource constrained fashion, and not as boundless entities of infinite potential.



Sebastian Büttrich (lab manager).





*the lab is suffused with a DIY spirit and experimentation is a key practice.*

Transitioning to a fully-fledged renewable energy matrix implies a huge change in energy distribution system, a change that necessitates a revamping of the current production-consumption energy model. It is here that the lab can help by leveraging its expertise in data science principles, machine learning, and sensor technology, as it models demand and production as close to real time as possible. So, whether it's at the scale of personal or household technologies, or the energy grid, DASYA serves as a knowledge hub for all interested in putting data science to work in these areas.

The enthusiasm and motivation of students is a driving force in the lab, one that is met with welcoming arms, honesty, and space. Projects proliferate. One initiative has been an effort to analyse and improve the water quality of a housing co-operative in Copenhagen with as little 'new tech' as possible. In other words, the question of "how can IT help us in this case?" is not always answered through adopting the latest tech gadgets but is approached in a pragmatic manner utilizing the simplest solutions possible.

What the lab shows us is that students are eager to work on climate and sustainability related questions. They even bring a healthy 'tough love' to the table. DASYA, as one of ITUs oldest labs, continues to produce an atmosphere of critical engagement to prepare students for the many and varied challenges that the climate emergency will thrust upon them.

*lab members have frequent debates about how they can reconcile their love for IT with its obvious climate impacts.*



# WORDSEARCH

U J P Q E M I S S I O N S I G R E E N H O U S E Y
R B Z Y U E C O N S E R V A T I O N J N E N I T N
R E S M V M Z D V G L V O T N U N D C O S K I E T
I Q C B X C I R C U L A R O N P L S B Q V L K N R
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G G P C H L R F B L E C H B K E I I A Q C X P X E
M R F K C S E J H O A H F Y U W H N L I V P M Q W
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L N G V C F D D E R A R A O A V F C R M S T U M J
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C O X L Z R D Z F W U D G Y I N P M O A W N M O N
K G R K T S T X L F E C N E A O G H P T I A G X N
V M L R Y E R A N S S U E G V I N M M J P I S I M
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F W S A L D C Q S K O Q C S K V T K S M B V R N V
M V N G N A J F A Z G K B Y T Q O U Q Y T D Y X T

SUSTAINABILITY
CLIMATECHANGE
DEFORESTATION
GLOBALWARMING
CONSERVATION
GREENWASHING
PRESERVATION
CLOSEDLOOP
COMPOSTING
GREENHOUSE
EMISSIONS
FOOTPRINT

EFFICIENT
FAIRTRADE
RENEWABLE
ZEROWASTE
CIRCULAR
OFFSETS
NETZERO
ORGANIC
RECYCLE
IMPACT
REDUCE
GREEN
VEGAN

# Research Profile

Tom Jenkins

Welcome to our research profile segment, the section where we get into some of the details of a particular researcher's work, or research project, that we find especially interesting.

Meet Michael Szell and Anastassia Vybornova, researchers in the NERDS research group. As associate professor, Michael is leading a research project on bicycle network analysis, within which Vanessa is doing her PhD. In broad strokes, the research project is trying map and model bicycle networks with the aim of assisting urban planners in their development of more sustainable transport infrastructures.

While both researchers have various motivations for engaging with this type of work, central is the hope of making it easier for planners to argue for more sustainable transport options. Sustainability, in this context, works as a tool that helps planners on multiple fronts. For example, cycling, over and above a means of transport, is a social pursuit that enjoins people in communities and fosters more healthy lifestyles. Sustainability here is a question of living well, both personally and communally. At the same time, there is an economics to it. Per kilometer of travel, cars are incredibly expensive, and this cost must often be borne by cities. Construction and paving, road maintenance, and increased public health expenditure contribute to car-based spending. The high speed of automobile traffic means that a collision is more likely to result in serious injury or death. On the other hand, cycling offers economic **benefits** per kilometer, and as a lighter and lower-speed mode of travel, riding a bicycle is safer and puts less pressure on city infrastructure.



*maximizing city cycling has obvious implications for the environment.*

Further, research suggests that cycling decreases obesity and leads to improved public health outcomes, cumulatively adding money to public coffers.

Szell and Vybornova's projects use large data sets such as OpenStreetMap to computationally model more effective routes for urban areas, using already-existing street networks as the starting point. By growing a grid between the nodes of that network, they think that these models can help cyclists to access much more of the city. The researchers hope that developing models for planning bicycle infrastructures will lead to future cities that more concretely support different modes of transit. Traditional traffic engineering privileges automobile use, and city planning most often takes the same position. The result; more and wider roads. This research is based on the idea that city residents would use other forms of transportation if they were available, safe, and comprehensive enough to get people to where they need to go.

The other side of this modelling work is to analyze the current bicycle networks in cities in order to pinpoint problem areas and offer suggestions for making the network more comprehensive. For example, almost all cities, Copenhagen included, do little to support child-friendly cycling, because almost all routes require bicycles to mix with automobile traffic. Further, these analyses offer a way of articulating some of the shortcomings of current bicycle route planning. Where bicycle infrastructures are constructed often reflect areas of greater wealth or education, and these models can make such socio-economic network disparities clearer for future planning efforts.

Maximizing city cycling has obvious implications for the environment. It not only decreases carbon emissions, but also reduces the particulate matter that affects air quality. Transportation continues to be responsible for a substantial percentage of carbon emissions and, notably, is the sector that has seen the most relative emissions increases over the last thirty years. Put differently, while other domains are becoming increasingly more efficient in terms of carbon impact, transportation has been falling behind the curve. And this is for a range of reasons: higher-efficiency automobiles mean that people can travel more for the same amount of money, or lower fuel costs lead to buying larger cars like SUVs. Over time, this rebound effect cancels out possible gains. Szell and Vybornova hope that their modelling research can continue to improve decision making for bicycle network infrastructure, and maybe even push us towards a positive tipping point in the battle for more sustainable cities.

# STUDENT VOICES

Luis Landa
James Maguire

Laura Amalie Augustinus (Analog Chairperson)

In this segment, we bring you a range of engaged student voices on climate and sustainability questions. This can be anything from student projects to student initiatives, to extracurricular activities. We also want to open a space for former ITU students who have become involved in green issues, whether it be through the formation of start-ups, work with organizations, activism, or voluntary work. In this first edition you will meet a current DIM master thesis student, an interesting alumni start-up organization, and our very own Analog café.

## Kathrine Lundberg Friis (DIM, 5th semester)

Kathrine has been active in sustainability issues for numerous years, both personally and professionally. She has been involved in a range of diverse initiatives: work on reducing food waste in the ITU canteen, founding the "Student Community for Sustainability" – a LinkedIn student group with an interest in sustainability internships, as well as engaging actively in "Sustainable Change Makers", a network for young sustainable change agents.

She is enthusiastic about getting to work on the green transition and promoting sustainability as diversely as possible. Currently, she is researching the Environmental, Social and Governance (ESG) framework as a means of understanding how green transformations are unfolding within large corporations. ESG is fast becoming an industry standard for environmental governance and Kathrine is eager to put the methods she has learned at DIM to use in investigating this newly emerging phenomenon. At the core of her thesis lies the question, "Is Green Transformation a digitalisation issue?"

Kathrine's sense is that many fellow students are keen to pursue some form of sustainability-based research. From her perspective, prioritizing sustainability within ITU education programmes is a must for the future of any modern educational institution.

*prioritizing sustainability within ITU education programmes is a must for the future of any modern educational institution.*

*one solution would be to share some of the canteen's cleaning resources, but making such a simple cross institutional arrangement is difficult.*

## KARL.farm

**Laura Asta Rendboe (DDT Graduate) and David Alexander Wollesen (SWD Graduate)**

Laura and David, recent graduates of ITU, now run a start-up called KARL, an SaaS coordination platform for farming sub-contractors. Beyond the more standard work of providing digital solutions for administrative tasks, the firm also seeks to provide climate data to its users with the aim of becoming a "digital and data resource" for all farmers. Using satellite imagery to forecast weather events including, for example, temperature and daily rainfall, is one way, they suggest, of keeping farmers up to date in a world of volatile weather patterns.

Work on the start-up began as part of the ITU student incubator initiative. The idea was born out of David's personal experience in farming, where, he thinks, too much time is spent on administrative work – contacting, re-scheduling, ordering, and the like. Combining Laura's expertise in design and David's software skills, the platform helps farmers automate and organize a range of tasks. But what is the connection to sustainability, we wondered? Well, it's really a question of freeing up time to focus on core issues, they suggest. Farmers who want to take climate transitions seriously need time to focus on the various sustainability requirements mandated by the state, as well as emerging farming standards for greener processes. Increasingly, a lack of time is cited by farmers as a reason for not taking these standards up more quickly.

Laura believes in creating and using data as a way of developing and sharing sustainable practices. For this, KARL is seeking to create a Danish knowledge base of seeds and crops to help the next farming generation root themselves more firmly in sustainable farming knowledge and practices. KARL is one example of how ITU graduates can use the skills acquired at the university to help different sectors transition towards more sustainable operations.

## Analog Café and Kleen Hub Collaboration

**Laura Amalie Augustinus (Analog Chairperson)**

As an integral part of ITU life, Analog needs little introduction. It is extremely popular with students and faculty alike; this is evident from the long queues one encounters while standing in line gasping for a morning coffee. This ITU coffee institution has battled with sustainability questions over the years, switching out the yearly 2000 to 3000 single-use cups to reusable cups, only to realise that their army of volunteer baristas couldn't cope with the cleaning demands that all those cups entailed. Hence the reverse thrust move back to using single cups. So far, so bad!

Not everyone was happy with this regression, but pairing manageability with sustainability was, and is, challenging. Enter Kleen Hub, a firm fighting single-use packaging. By providing standardised stainless-steel cups and boxes to different restaurants and cafes, they seek to reduce the material impact of takeaway cups and food boxes. The idea is simple: these standardised cups and boxes can be picked up and dropped off at any participating business thus reducing the need for single-use packaging.

So far, the Kleen Cup collaboration is going well. Currently, there are 30 cups in circulation. A quick survey of students showed that the vast majority are positive about the initiative. However almost all of them mentioned how hard it is to actually get a hold of a cup. When asked whether they envision putting more Kleen cups out there, Laura, Analog's chairperson, said they don't have the cleaning capacity to add more reusable cups.

"We simply need more resources to wash them!" she told us. Running Analog is more expensive than one might suppose, and while ITU has offered to cover some of the initial costs, the day-to-day operations are still too expensive to make these meagre sustainable dreams come true.

One solution would be to share some of the canteen's cleaning resources, but making such simple cross institutional arrangements is difficult. Laura hopes that, with an institutionally based climate strategy on the way, good sense will prevail, and Analog will get the sustainable cups it deserves!


Kleen cup initiative at analog

# ABC *of ITU climate-related research*

**Do you want to know more about ongoing climate-related research at ITU?**

**The following list is a taster based on a survey carried out in connection with the development of the ITU Climate Research Strategy.**

**The list is an aggregation of responses from all three research departments and shows the variety of topics already under investigation.**

**If you think we've missed something, please let us know, we'd be very happy to keep an informal log of all the great climate work currently being researched at the university.**



## A

Air pollution and urban technologies.

Algorithm efficiency.

## B

Blockchain (proof of stake).

## C

Carbon technologies and inter-generational climate conflict.

Citizens' climate assembly.

Climate data and expertise.

Climate change adaptation in developing countries.

Climate resilience.

Climate-smart agriculture.

Climate migrants and health-care in developing countries.

Co-design with young climate activists.

CubeSat programme (climate satellite).

## D

Database mapping of sustain-ability initiatives & knowledge practices in Danish companies.

Data analytics and the gover-nance of green finance.

Data centers: environmental governance and impacts.

Designing for inter-generation-al technologies.

Digital infrastructures.

Distributed learning for energy systems.

## E

Ecological understandings of the body in more-than-human relationships.

Energy Data Governance.

Energy infrastructures.

Energy retrofitting of buildings.

## G

Games and sustainability.

Green IT.

Green AI.

Green Computing.

Green transitions.

## H

Hardware and sustainability.

Hardware reusability.

## I

IT industry and climate change.

## L

Limiting paper waste.

Long-term ecological research into the socio-material environment.

Low carbon development and green finance.

## M

Models and predictions of climate fluctuations.

Mobility modelling.

Modelling weather and energy relationships.

## P

Participation of youth in public climate mitigation initiatives.

## R

Renewable energy technologies.

Renewable energy communities.

Renewable energy mapping.

## S

Satellite image analysis for irrigation.

Smart city planning and green living.

Social implications of wave energy and technologies.

Societal impact of renewable energy transitions.

Socio-cultural challenges of living with carbon (technologies and emission data).

Sustainable digitalization (future imaginaries).

Sustainable blockchain.

Sustainable data analytics.

Sustainable retail ecosystems.

Sustainable IT (resource allocation).

Sustainable transport planning.

Sustainable surveillance technologies.

## T

Teaching as a means of attuning students to ecological issues.

## W

Wind power prediction.

# Notes

Design and print: Stibo Complete

Funded and published by the
Department of Business IT
IT University of Copenhagen
Rued Langgaards Vej 7
2300 Copenhagen
Denmark

IT UNIVERSITY OF COPENHAGEN