4TU.Energy

Sustainable ICT

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TU Delft Delft University of Technology
TU/e Eindhoven University of Technology
University of Twente.
Wageningen University & Research

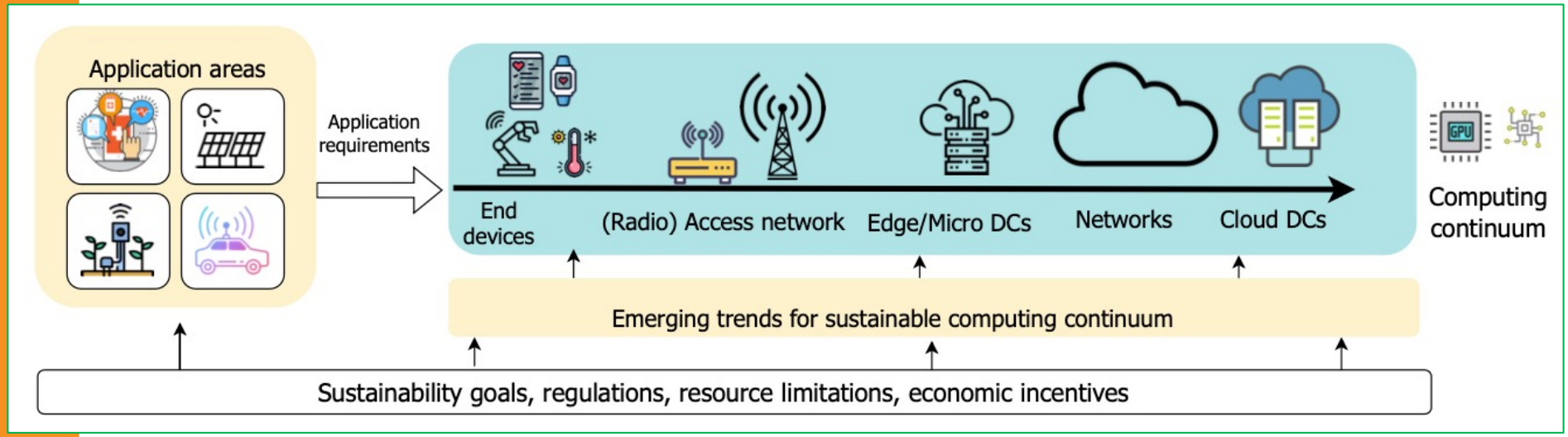
The Netherlands Institute for Research on ICT

4TU.NIRICT

- Mission: *Promote & facilitate research at the intersection of EE and CS for high impact ICT research*
- *Health, agriculture, energy transition, and sustainable ICT*
- *Funding:* community building, DEI funding, special calls
- *Events*: community day and other events (e.g., ICT.Open)
- 10 board members & Program coordinator
  - Scientific-director: Mark van den Brand
  - TU Delft, TU/e, UT, Wageningen, U. Groningen
  - https://www.4tu.nl/nirict/

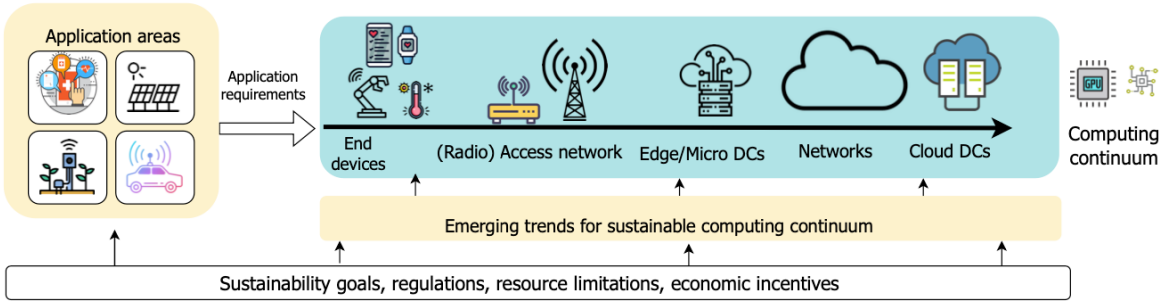
ICT as an enabler for Sustainability and Sustainable Development

Sustainability of ICT [environmental]



Sustainability of ICT [environmental]

- More and more devices (~billions)
- Embodied carbon and e-waste
- AI and big data processing
- Data centers (water and electricity consumption)



How bad is it?

Report March 2024

How bad is it?

Data centres in the EU used an estimated 45–65 TWh of electricity in 2022, equivalent to 1.8–2.6% of total regional electricity consumption. The top four data centre markets – Germany, France, the Netherlands, and Ireland – accounted for nearly two-thirds of the region's data centre energy use, despite having less than 40% of the population. Data centres represent over 2% of national electricity use in Ireland (18%), the Netherlands (5.2%), Luxembourg (4.8%), Denmark (4.5%), and Germany (3%), Sweden (2.3%), and France (2.2%).

On the average: 2%
NL: 5.2%
Ireland: 18%

Irish power crunch could be prompting AWS to ration compute resources

Users report being pointed to other EU regions if they need more grunt

Dan Robinson

Tue 9 Apr 2024 // 09:36 UTC

EXCLUSIVE Datacenter power issues in Irelan
from customers that Amazon is restricting resou
even directing them to other AWS regions acros

Energy consumed by datacenters is a growing
Ireland where there are clusters of facilities aro
significant share of the country's energy supply.
how much infrastructure can be used, given the

AWS users have informed *The Register* that th
that they can access in its Ireland bit barn, hom
especially with power-hungry instances that ma
such as AI.

"You cannot spin up GPU nodes in AWS Dublin
wise. There is reserved capacity for EC2 just in
problem with that, AWS Europe will point you a
parts of the EU."

We asked AWS about these issues, but when it finally responded the company was somewhat evasive.

Ireland's power grid operator, EirGrid, was likewise less than direct when we asked if they were limiting the amount of power datacenters could consume.

"EirGrid is responsible for the safe and secure operation of Ireland's electricity transmission system. As part of its role, EirGrid supplies electricity directly to Large Energy Users, which includes larger datacenters connected directly to the transmission system," a spokesperson said.

"EirGrid may from time to time request Large Energy Users to reduce their energy use as part of our Demand Side Management," the spokesperson added.

In other words, EirGrid does sometimes ask Large Energy Users to dial back their energy draw, but is declining to say explicitly if this has ever involved any of those bit barns.

https://www.theregister.com/2024/04/09/aws_resource_restrictions/ [April 9. 2024]

How bad is it?

Telecommunication networks used an estimated 25–30 TWh of electricity, equivalent to 1–1.2% of total EU electricity use. The four largest Member States by population and GDP (Germany, France, Italy, and Spain) were also the four largest users of energy for telecommunication networks, accounting for 65% of the total. Network energy use as a share of national electricity use was both lower and more uniform compared with data centres, ranging from 0.5% to 1.5%. In contrast, data centres as a share of national electricity use range from as low as 0.4% in some countries to as high as 18% in Ireland.

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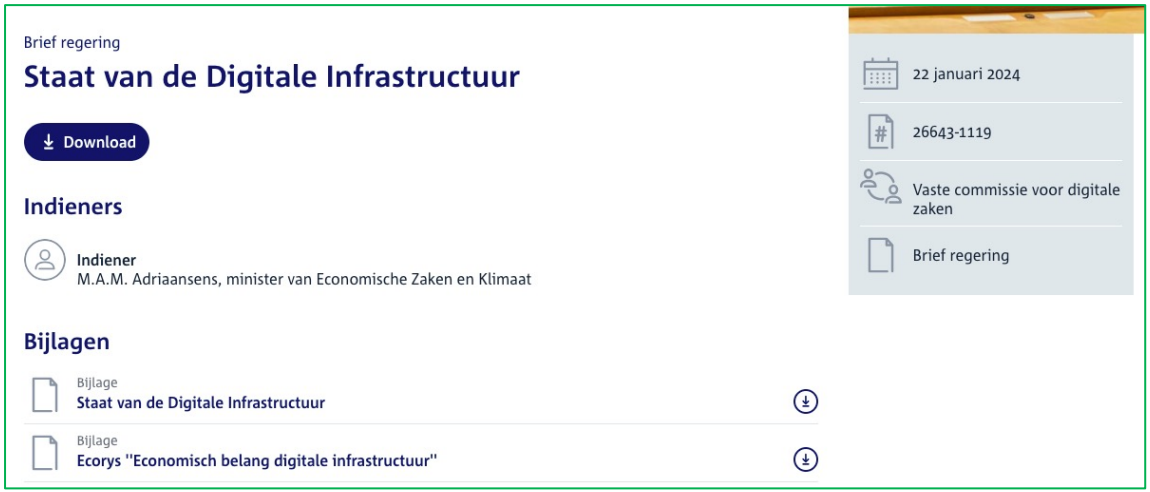
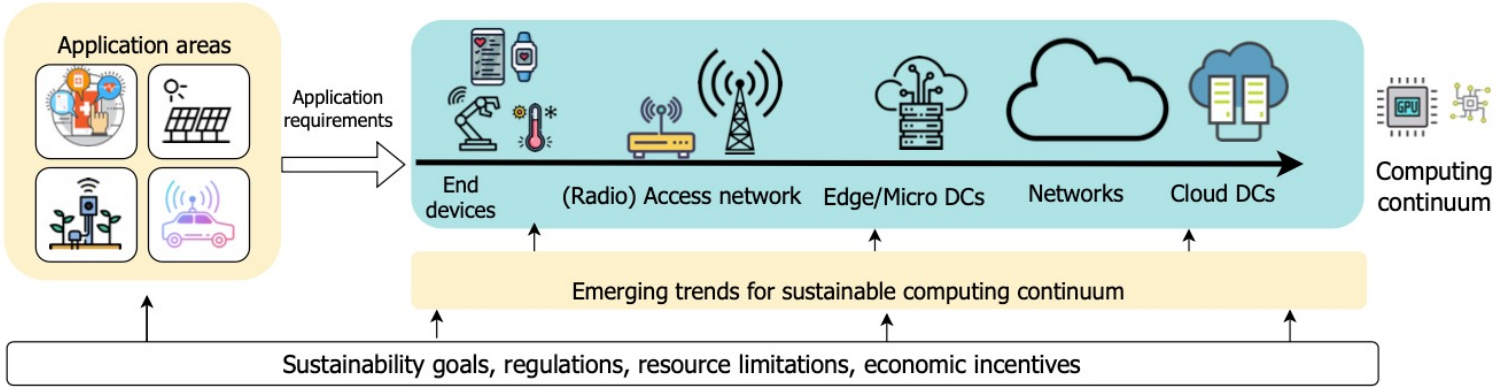
On the average: 1-1.2% total EU electricity use

How bad is it in the NL?

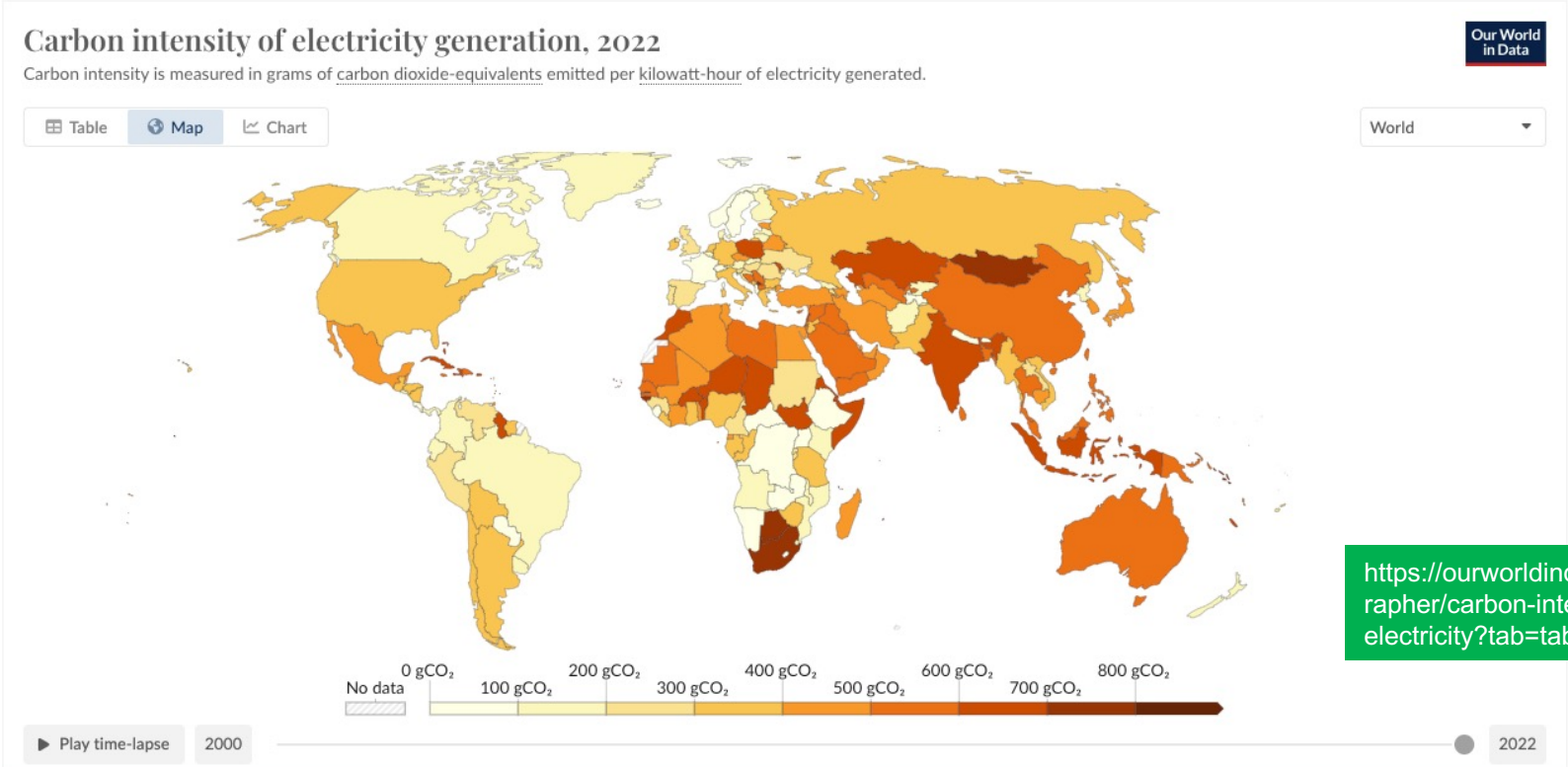
"The Digital Sector in the Netherlands is around 4% of the electricity use and 0.65% of total energy consumption."
Tweede Kamer report, 22 January 2024



Now, let’s talk about some promising directions



Data center load shifting:
Geospatial and temporal carbon intensity



https://ourworldindata.org/grapher/carbon-intensity-electricity?tab=table

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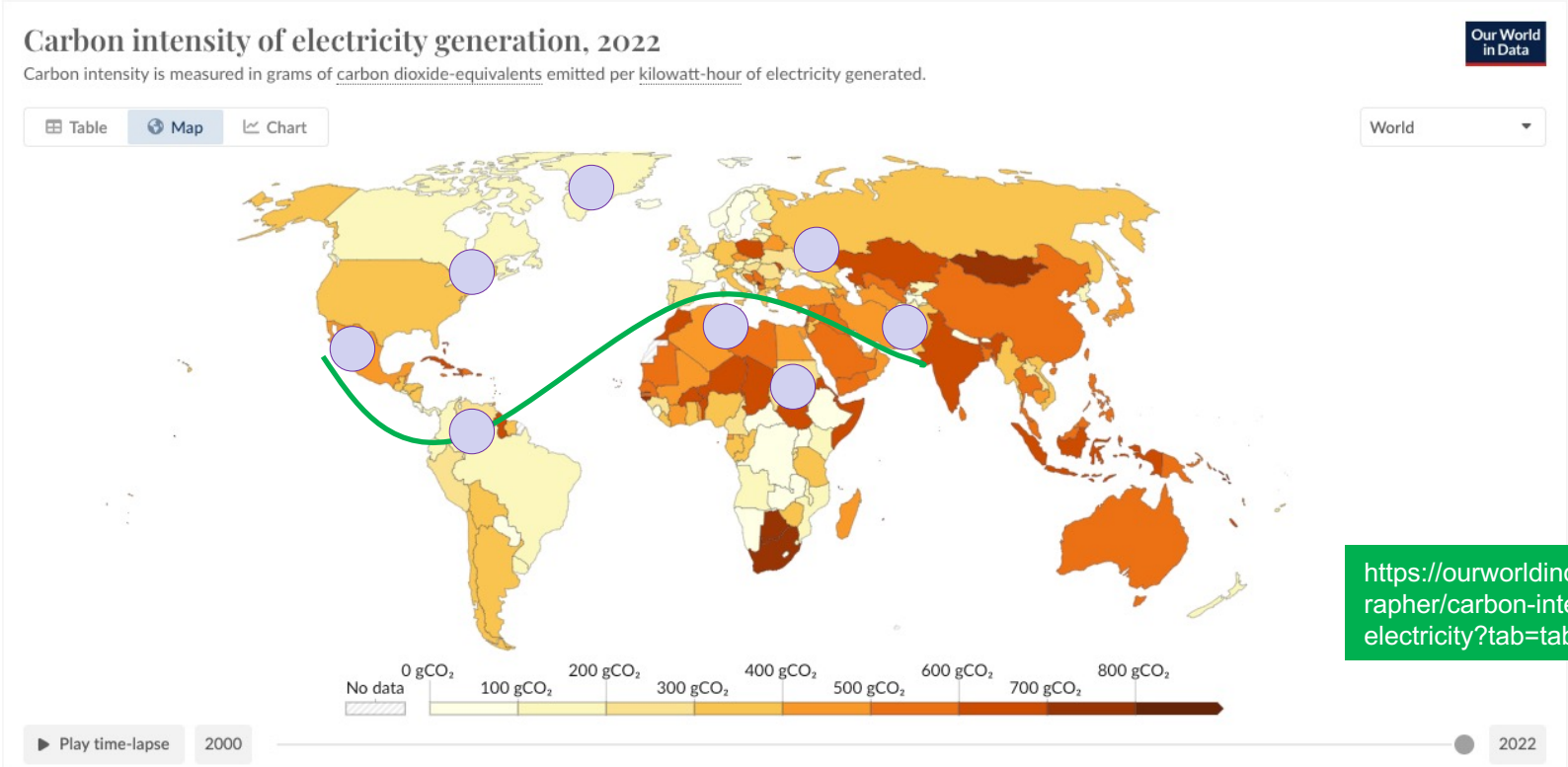

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Data center load shifting:
Geospatial and temporal carbon intensity

- DCs compute workloads
  - Move computation to clean energy locations
  - Postpone computation to cleaner times
- Challenges:
  - Cost of moving the computation & data (communication's footprint)
  - Meeting strict deadlines for completing computation
  - Meeting the regulatory restrictions & privacy & security

Co-optimization of smart grid with DC flexibility models

- DCs can be heavy consumers of electricity
- But, can also be load balancers
- How to co-optimize DCs and smart grid?
- MISD: Modular Integrated Sustainable Data Centers

Curious?
For more: talk to MISD team@UT

4TU.Green Sensors: Biodegradable sensors

https://www.4tu.nl/greensensors/

- Challenges in recycling and collecting e-waste
  - In 2019, 7.4 kg e-waste per capita, 17.4% recycled [source]
  - By 2030, the global electronic waste will reach 74 million Mt.
  - Air, water, soil pollution
- Solution: Biodegradable sensors
  - Replace electronic components with biodegradable components
  - Adapt protocols for transmission/reception for intermittent energy resources

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4TU.

This was just a very tiny part of Sustainable ICT discussion
For more: Stay Tuned!

4TU.NIRICT LinkedIn
4TU.NIRICT website