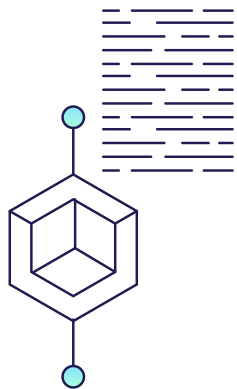


Evaluate the environmental impact of ICT



With open data, methods and tools



PRÉSENTATION



David Ekchajzer

Research \Rightarrow Action

Co-founder of Hubblo.org

Contributor at Boavizta.org





Open-Source products

Integrate and automate environmental evaluation



Engineering and consulting firm

Evaluate environmental impact of ICT

Open R&D

more systemic consideration of impacts

Boavizta - evaluation of the environmental impact of IT

Working group

**Organizations
Researchers
Freelancers**

Themes

**Data Repository
Cloud measurement
Calculation methods
Convince top-management
Open-source tools**



<https://boavizta.org/>

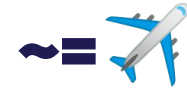
The environmental impacts of digital technology



How ICT contribute to global warming ?






02

2020 : 2,1 to 3,9%



2025 : 6 to 8%



%	 Energy	 GHG	 Water	 Electricity	 Resources
Users	60%	63%	83%	44%	75%
Networks	23%	22%	9%	32%	16%
Datacenters	17%	15%	7%	24%	8%

Répartition des impacts du numérique mondial en 2019

How to evaluate them ?



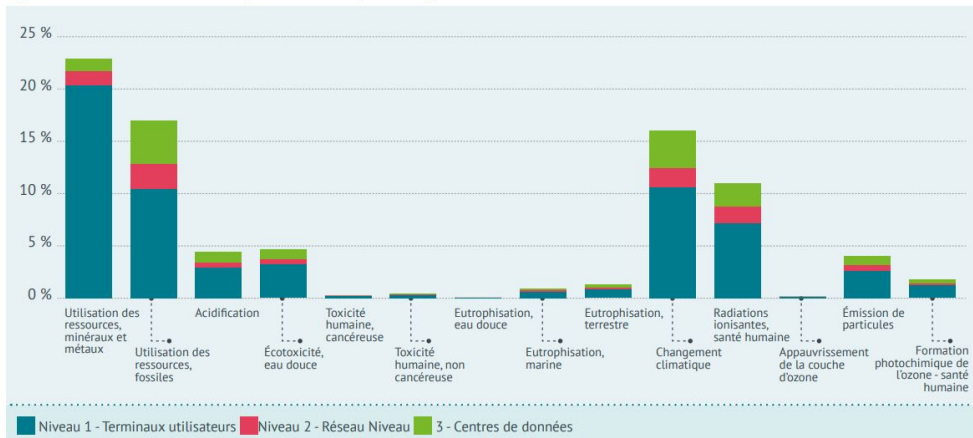
Perimeter

Mutli-steps

Multi-perimeters

Multi Criteria

Figure 1 - Distribution normalisée et pondérée de l'impact le long des 3 niveaux



The Green / EFA - Ponderation of 13 impacts criteria

EF Impact Category	EF Impact Assessment Model	EF Impact Category indicators	Source
Climate Change	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon.	kg CO ₂ equivalent	Intergovernmental Panel on Climate Change, 2007
Ozone Depletion	EDIP model based on the ODPs of the World Meteorological Organization (WMO) over an infinite time horizon.	kg CFC-11 equivalent	WMO, 1999
Ecotoxicity for aquatic fresh water	USEtox model	CTUe (Comparative Toxic Unit for ecosystems)	Rosenbaum et al., 2008
Human Toxicity - cancer effects	USEtox model	CTUh (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008
Human Toxicity - non-cancer effects	USEtox model	CTUh (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008
Particulate Matter/Respiratory Inorganics	RiskPoll model	kg PM2.5 equivalent	Humbert, 2009
Ionising Radiation - human health effects	Human Health effect model	kg U ²³⁵ equivalent (to air)	Dreier et al., 1995
Photochemical Ozone Formation	LOTOS-EUROS model	kg NMVOC equivalent	Van Zelm et al., 2008 as applied in ReCiPe
Acidification	Accumulated Exceedance model	mol H ⁺ eq	Seppälä et al., 2006; Posch et al., 2008
Eutrophication - terrestrial	Accumulated Exceedance model	mol N eq	Seppälä et al., 2006; Posch et al., 2008
Eutrophication - aquatic	EUTREND model	fresh water: kg P equivalent marine: kg N equivalent	Struijs et al., 2009 as implemented in ReCiPe
Resource Depletion - water	Swiss Ecoscarcity model	m ³ water use related to local scarcity of water	Frischknecht et al., 2008
Resource Depletion - mineral, fossil	CML2002 model	kg antimony (Sb) equivalent	van Oers et al., 2002
Land Transformation	Soil Organic Matter (SOM) model	Kg (deficit)	Milà i Canals et al., 2007

Default EF impact [...] for PEF studies

Life Cycle Assessment

ISO 14040

ISO 14044

Multi Criteria analysis



<https://pre-sustainability.com/>

Why make open evaluations ?





Because it is a democratic necessity

**THE GREEN
NEW DEAL
FOR EUROPE**

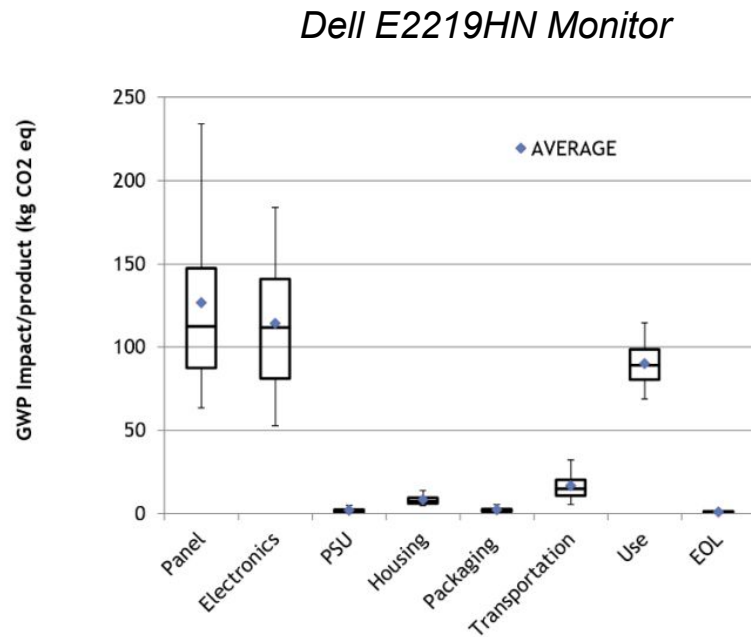
*Political
orientations*



*Environmental
labeling*

Because the measurements are of poor quality

Average GWP impact of screen manufacturing (kgCO ₂ e/inch)	
Dell (PAIA)	11,4 to 26,7
Lenovo (PAIA)	5,7 to 24,5
HP (Other)	3,3 to 8,6
NegaOctet	2,94
Base Impacts (ADEME)	≈ 2,7



Is it possible?

Spoiler : Hardly





The allies



Bundesministerium
für Umwelt, Naturschutz
und Reaktorsicherheit



Green
Software
Foundation

Measuring the impact of user terminals



Perimeter



End-user equipments

Network



On-prem infra



Cloud (As a service)



Manufacture



Transport



Use



Waste



Reset filtres

Fabricant

Apple

DellLenovoHPLexmarksamsungSeagate

Catégorie

Workplace

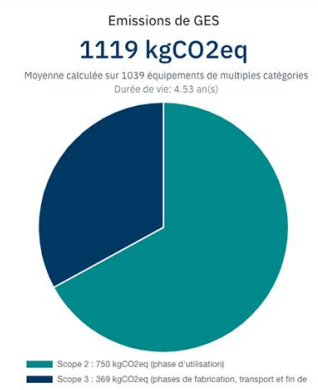
Datascanner

Sous-catégorie

Laptop

MonitorSmartphoneDesktopServerTabletPrinter

Fa...	Nom	Catégorie	Sous-c...	Date Fabric...	Li...	Durée de vie	Sources
Apple	15-inch MacBook Pro (2.3...	Workplace	Laptop	November 2019	VW	3	https://www.apple.com/environment/pdf/products/notebooks/16-inch_...
Apple	15-inch MacBook Pro with...	Workplace	Laptop	October 2016	VW	3	https://www.apple.com/environment/pdf/products/notebooks/15inchMB...
Apple	16-inch MacBook Pro (M1...	Workplace	Laptop	October 2021	VW	3	https://www.apple.com/environment/pdf/products/notebooks/16-Inch_...
Apple	16-inch MacBook Pro (M1...	Workplace	Laptop	October 2021	VW	3	https://www.apple.com/environment/pdf/products/notebooks/16-inch_...
Apple	16-inch MacBook Pro (2.6...	Workplace	Laptop	November 2019	VW	3	https://www.apple.com/environment/pdf/products/notebooks/16-inch_...
Apple	16-inch MacBook Pro (2.3...	Workplace	Laptop	November 2019	VW	3	https://www.apple.com/environment/pdf/products/notebooks/16-inch_...
Apple	21.5-inch iMac with Retina...	Workplace	Desktop	March 2019	VW	3	https://www.apple.com/environment/pdf/products/desktops/21.5-inch_i...
Apple	21.5-inch iMac with Retina...	Workplace	Desktop	March 2019	VW	3	https://www.apple.com/environment/pdf/products/desktops/21.5-inch_i...
Apple	24-inch iMac with 4.5K Re...	Workplace	Desktop	April 2021	VW	3	https://www.apple.com/environment/pdf/products/desktops/24-inch_iM...
Apple	24-inch iMac with 4.5K Re...	Workplace	Desktop	April 2021	VW	3	https://www.apple.com/environment/pdf/products/desktops/24-inch_iM...
Apple	24-inch iMac with 4.5K Re...	Workplace	Desktop	April 2021	VW	3	https://www.apple.com/environment/pdf/products/desktops/24-inch_iM...
Apple	27-inch iMac with 5K Reti...	Workplace	Desktop	August 2020	VW	3	https://www.apple.com/environment/pdf/products/desktops/27-inch_iM...
Apple	27-inch iMac with 5K Reti...	Workplace	Desktop	August 2020	VW	3	https://www.apple.com/environment/pdf/products/desktops/27-inch_iM...
Apple	27-inch iMac with 5K Reti...	Workplace	Desktop	August 2020	VW	3	https://www.apple.com/environment/pdf/products/desktops/27-inch_iM...
Apple	27-inch iMac with 5K Reti...	Workplace	Desktop	August 2020	VW	3	https://www.apple.com/environment/pdf/products/desktops/27-inch_iM...
Apple	27-inch iMac with 5K Reti...	Workplace	Desktop	August 2020	VW	3	https://www.apple.com/environment/pdf/products/desktops/27-inch_iM...
Apple	iPhone 11 128GB	Workplace	Smartphone	September 2019	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone11_PE...
Apple	iPhone 11 256GB	Workplace	Smartphone	September 2019	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone11_PE...
Apple	iPhone 11 64GB	Workplace	Smartphone	September 2019	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone11_PE...
Apple	iPhone 12 128GB	Workplace	Smartphone	October 2020	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_PE...
Apple	iPhone 12 256GB	Workplace	Smartphone	October 2020	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_PE...
Apple	iPhone 12 64GB	Workplace	Smartphone	October 2020	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_PE...
Apple	iPhone 13 Pro 128GB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro 1TB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro 256GB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro 512GB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro Max 128GB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro Max 1TB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro Max 256GB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 13 Pro Max 512GB	Workplace	Smartphone	September 2021	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone13_Pr...
Apple	iPhone 8 256GB	Workplace	Smartphone	September 2017	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone8_PE...
Apple	iPhone 8 64GB	Workplace	Smartphone	September 2017	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone8_PE...
Apple	iPhone SE - Gen 2 128GB	Workplace	Smartphone	April 2020	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone_SE_P...
Apple	iPhone SE - Gen 2 256GB	Workplace	Smartphone	April 2020	VW	3	https://www.apple.com/environment/pdf/products/iphone/iphone_SE_P...



Personnaliser

Total ☒ Annuel ☐

Région

Utiliser la valeur par défaut

Région ou pays, remplace la valeur constructeur

Durée de vie

4,53 années


remplace la valeur constructeur

Vous pouvez faire varier la durée de vie et choisir un lieu d'utilisation des équipements sélectionnés pour visualiser

Export

Exporter en PNG Exporter en CSV

Partager <https://dataviz.boavizta.org>

 **Measure the impacts related to usage.**



Perimeter



End-user equipments

Network



On-prem infra



Cloud (As a service)



Manufacture



Transport



Use



Waste




$$\text{kWh} \quad * \quad \text{Co2eq./kWh}$$

kWh : Power consumption

Co2eq./kWh : Impact of a kwh of electricity

kWh : Power consumption

Open-methodology

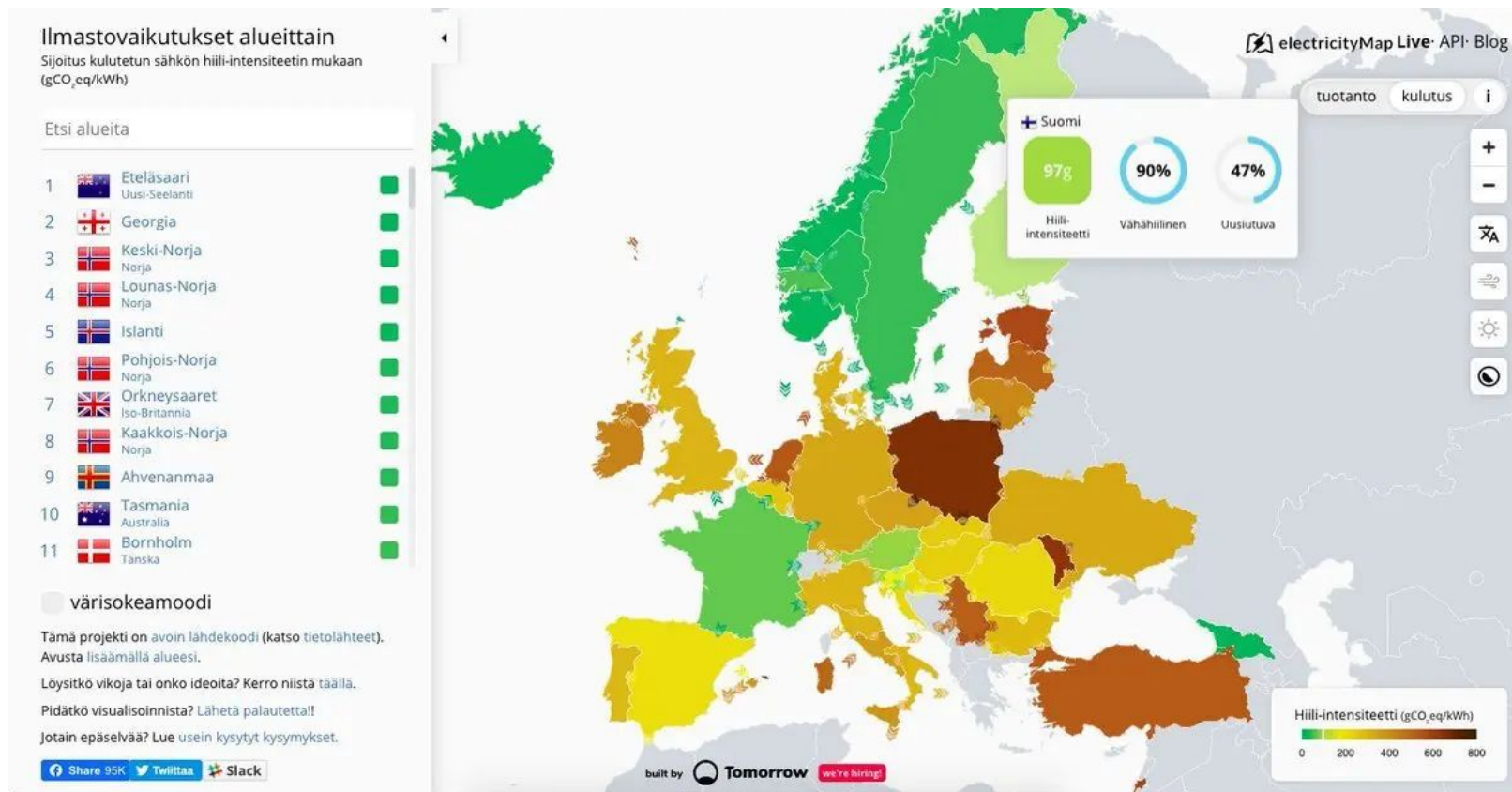
Physics

Software sensor

Open-Source



Impact of a kwh of electricity : Electricity map



What about the cloud ?



Perimeter



End-user equipments

Network



On-prem infra



Cloud (As a service)



Manufacture



Transport



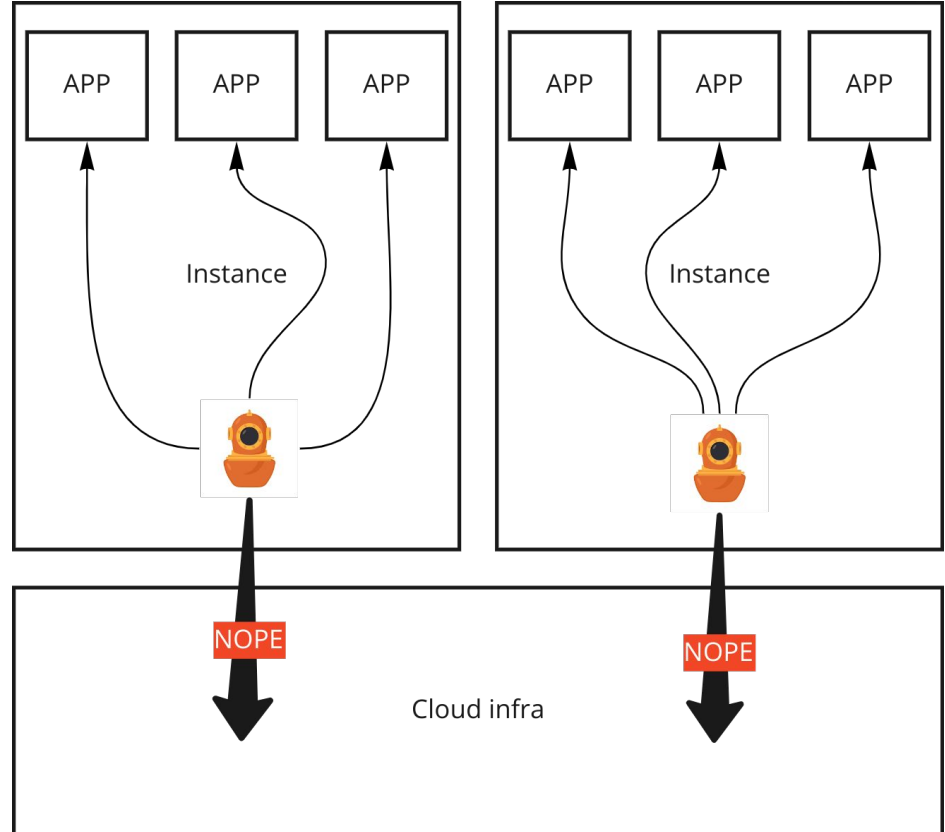
Use



Waste

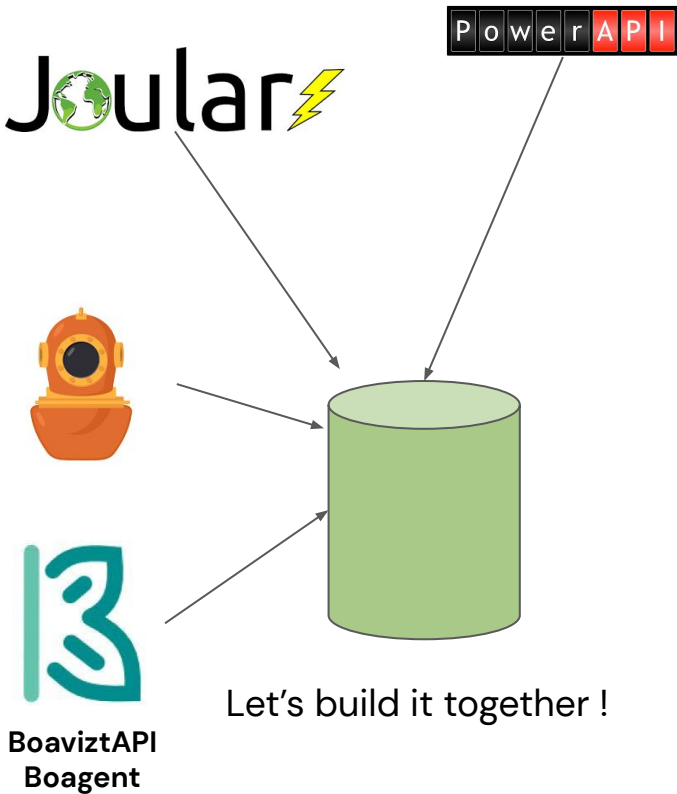
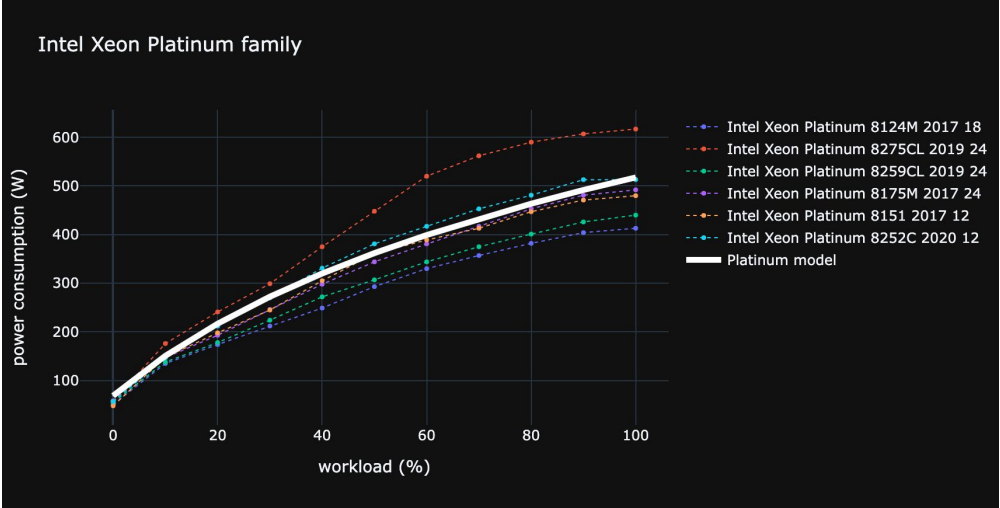


Where to connect my power meter?



Modeling electrical consumption

Open Science



Measuring the impacts of manufacturing



Perimeter



End-user equipments

Network



On-prem infra



Cloud (As a service)



Manufacture



Transport



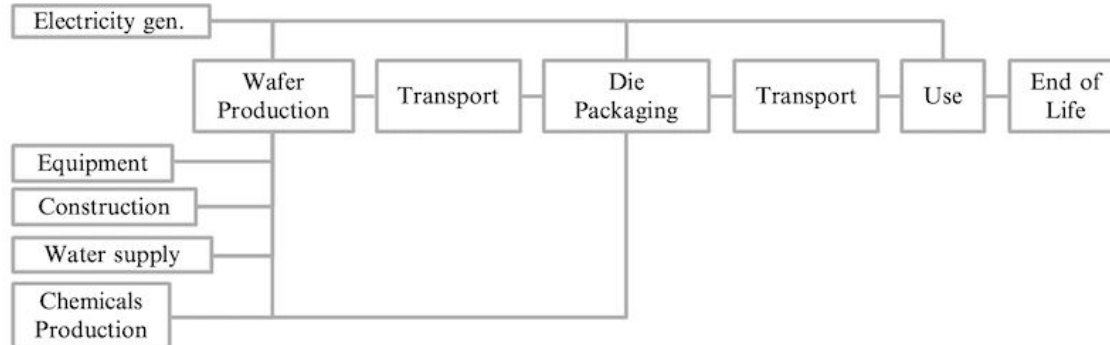
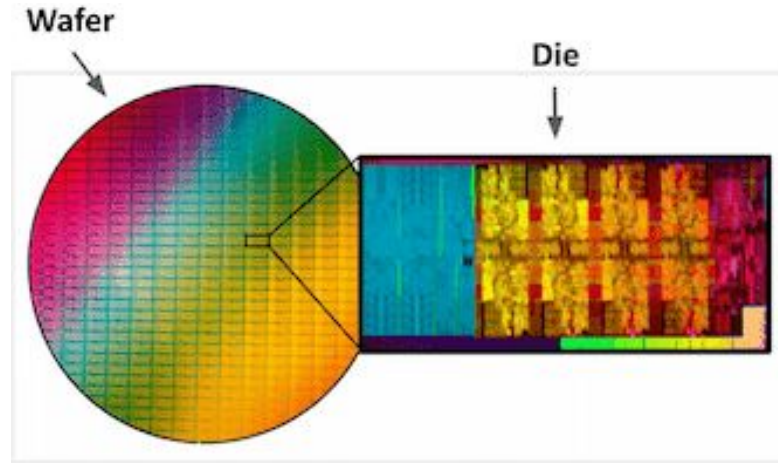
Use



Waste



Die size



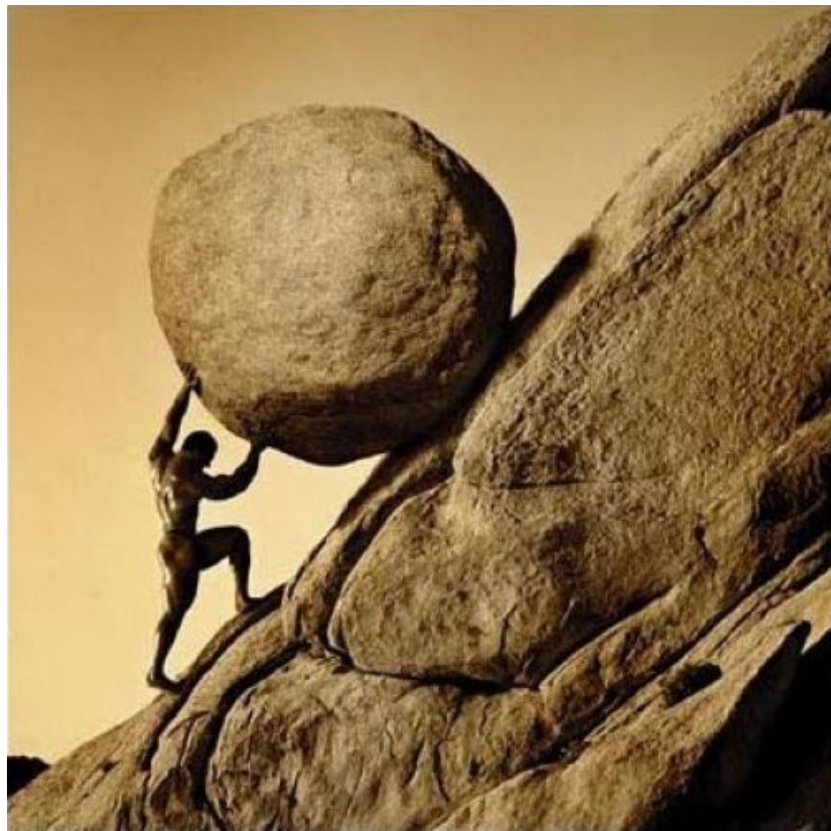
BoaviztAPI : api.boavizta.org/docs

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}
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    "unit": "MJ"  
  },  
  "adp": {  
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    "use": 0.000203,  
    "unit": "kgSbeq"  
  }  
}
```


Congratulations! You have the least bad evaluation



In the meantime

1. Refuse
2. Reduce
3. Reuse
4. Recycle
5. Return