

Nachhaltige Digitalisierung durch Green IT

Stefan Rotsch
AOE GmbH

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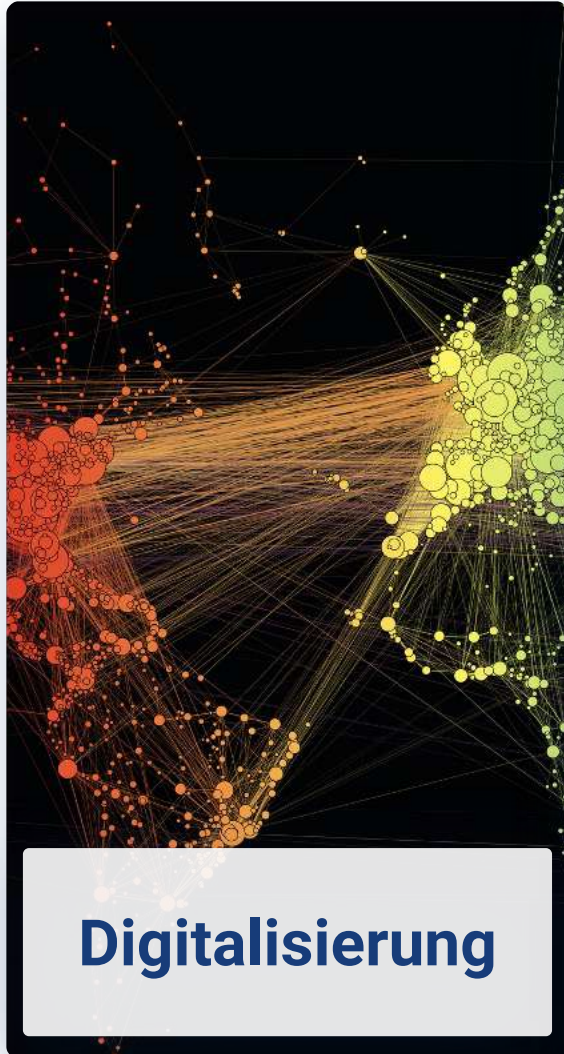


Nachhaltigkeit im IT-Bereich hat für 90% der befragten Unternehmen Priorität

IDG-Studie im Auftrag von Google (2021)



Agenda





Rohstoffe



Emissionen



Hardware



Arbeit



Digitalisierung

A black and white photograph of Marshall McLuhan sitting in a chair, surrounded by several vintage televisions. The televisions display the phrase "THE MEDIUM IS THE MESSAGE" or a portrait of McLuhan. The background is dark, and the overall composition emphasizes the concept of media as the message.

Das Medium ist die Botschaft

– Marshall McLuhan (1964)



Bored Apes Yacht Club (BAYC)

Blockchain & NFTs

Blockchain (Ethereum)



Ökologische Kosten BAYC

1 Single-Edition NFT

Energieverbrauch: **340 KWh**
Emissionen: **211 kgCO2**

Zum Vergleich:

-  Energiebedarf eines EU-Bürgers für **1 Monat**
-  Flugreise von **2 Stunden**
-  Autofahrt von **1.000 km**

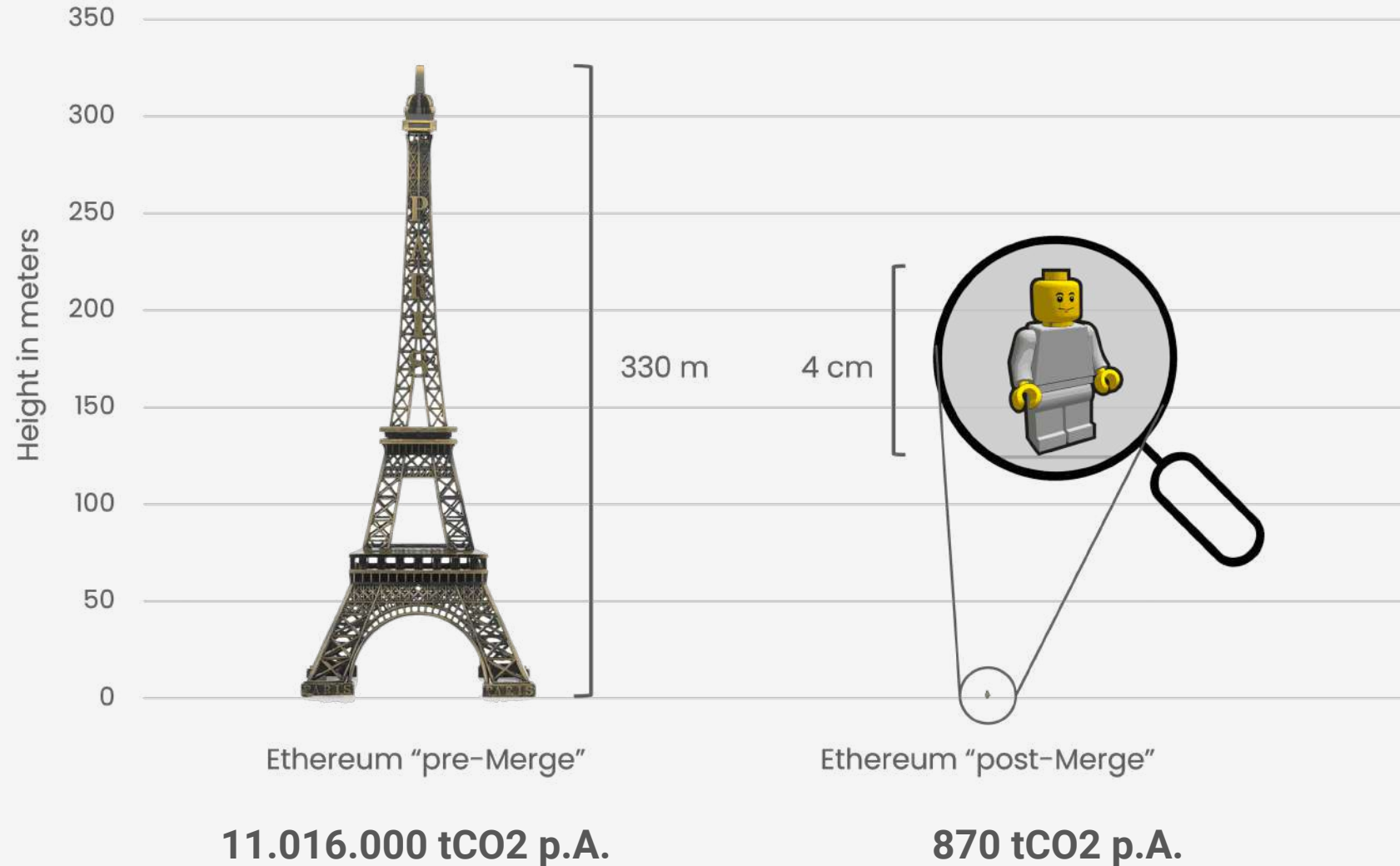
10.000 Single-Edition NFTs

Energieverbrauch: **3.400 MWh**
Emissionen: **2.110 tCO2**

Zum Vergleich:

-  Energiebedarf eines EU-Bürgers für **833 Jahre**
-  Flugreise von **20.000 Stunden**
-  Autofahrt von **10.000.000 km**

Proof-of-Work – Proof-of-Stake



Cambridge Bitcoin Electricity Consumption Index



Belgien

83,4

TWh
p.A.



Finland

83,7

TWh
p.A.



Bitcoin

86,7

TWh
p.A.



Kasachstan

96,6

TWh
p.A.



Philippinen

98,5

TWh
p.A.

Machine Learning – 4 Ms (Google)



Model

3x–10x



Machine

2x–5x



Mechanization

1,4x–2x



Map Optimization

5x–10x



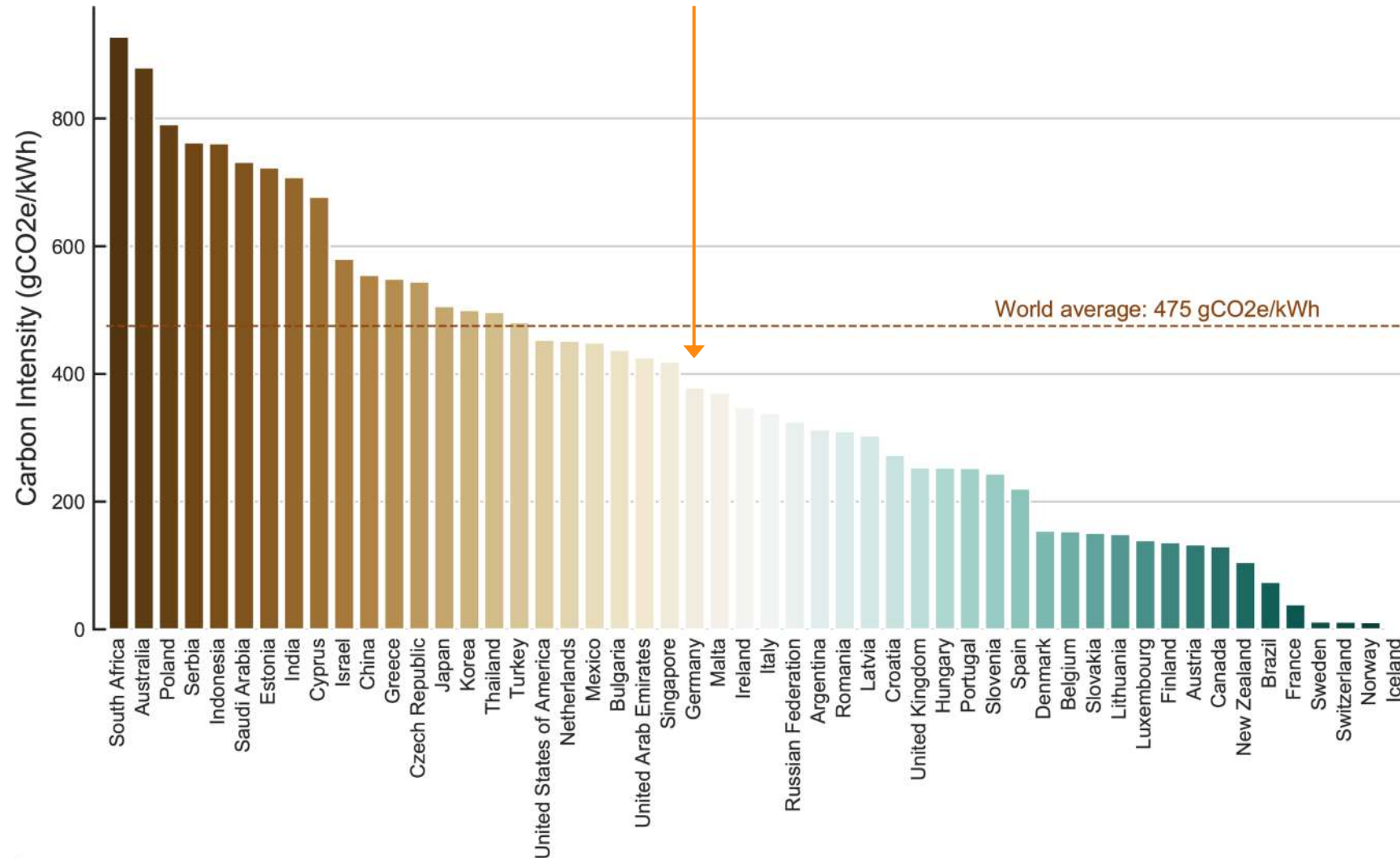
Cloud

Energieverbrauch der Rechenzentren in Frankfurt:

1,3 tWh/Jahr
(20% des Gesamtbedarfs)

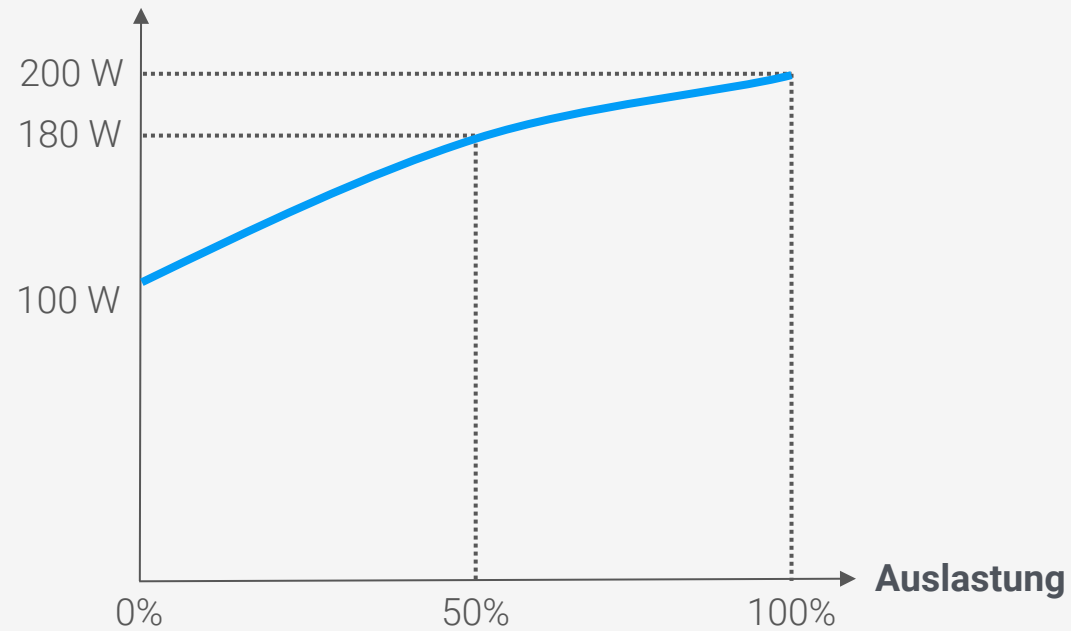


Standortfaktor Energieerzeugung

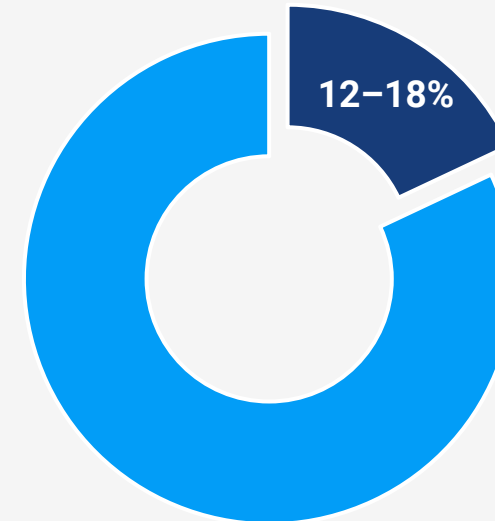


Energieverbrauch & Serverauslastung

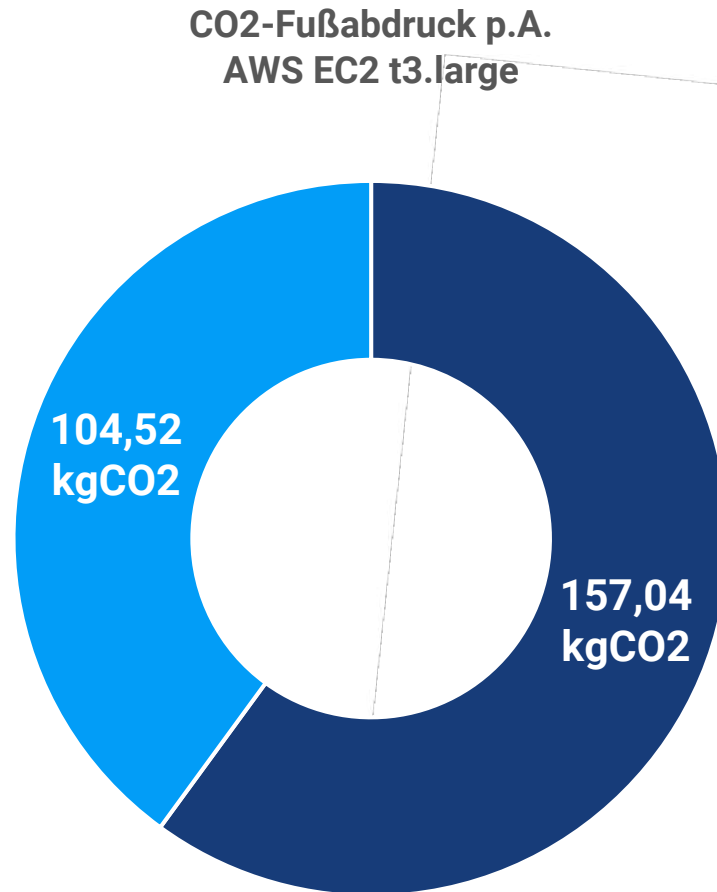
Energieverbrauch



Durchschnittliche Serverauslastung
(On-Premise)



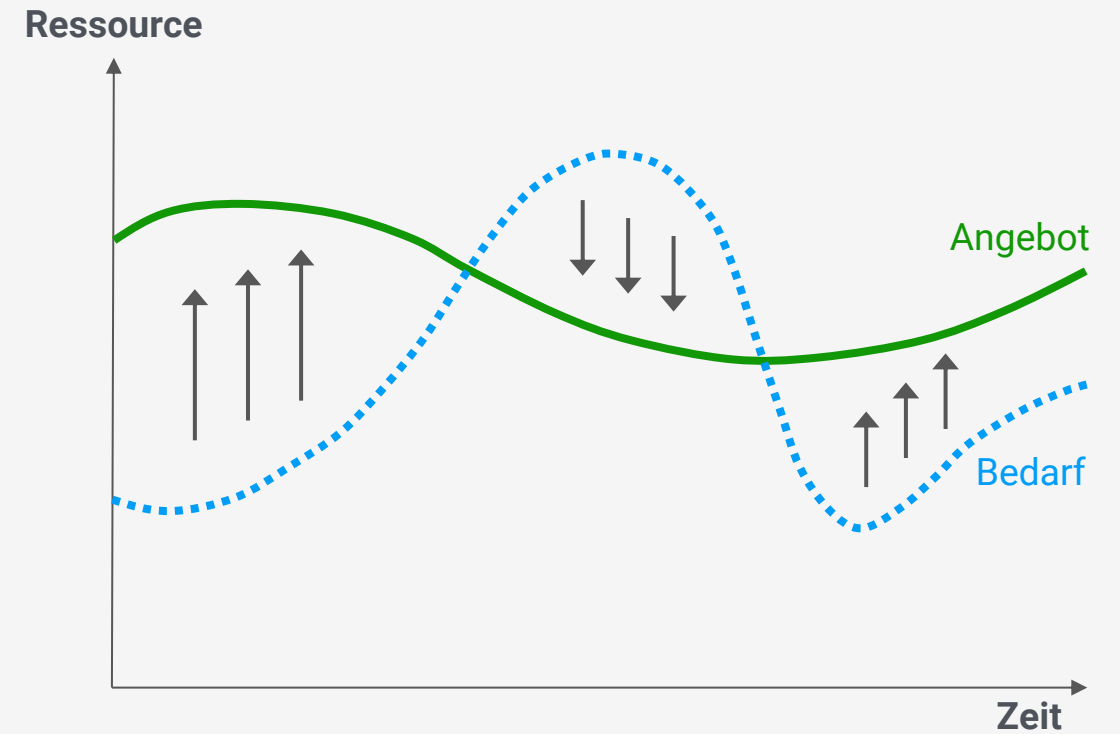
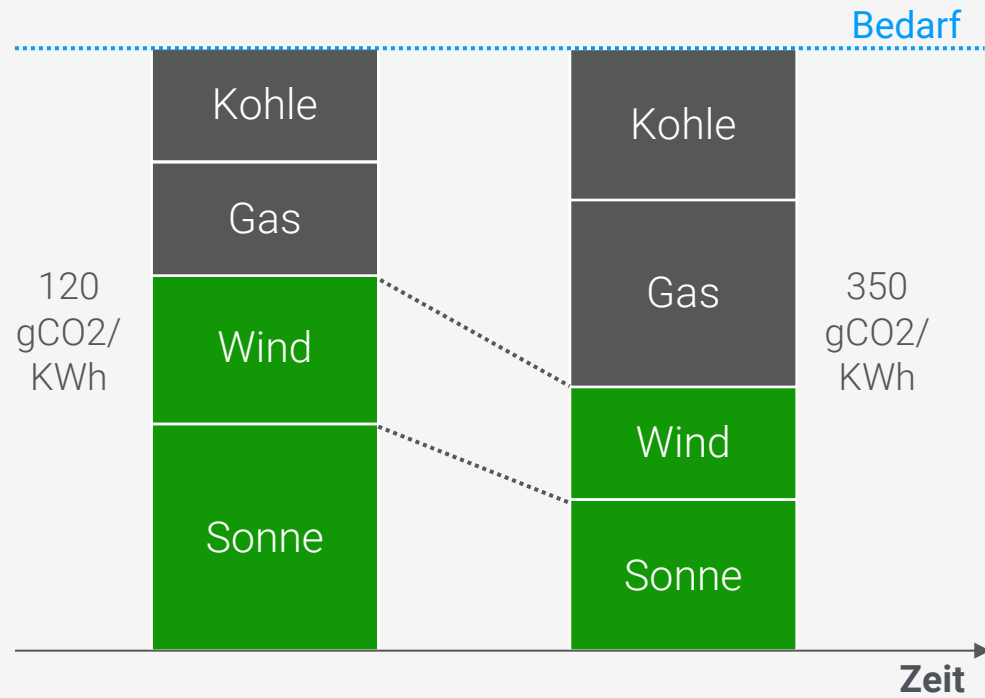
Nachtbuildverbot

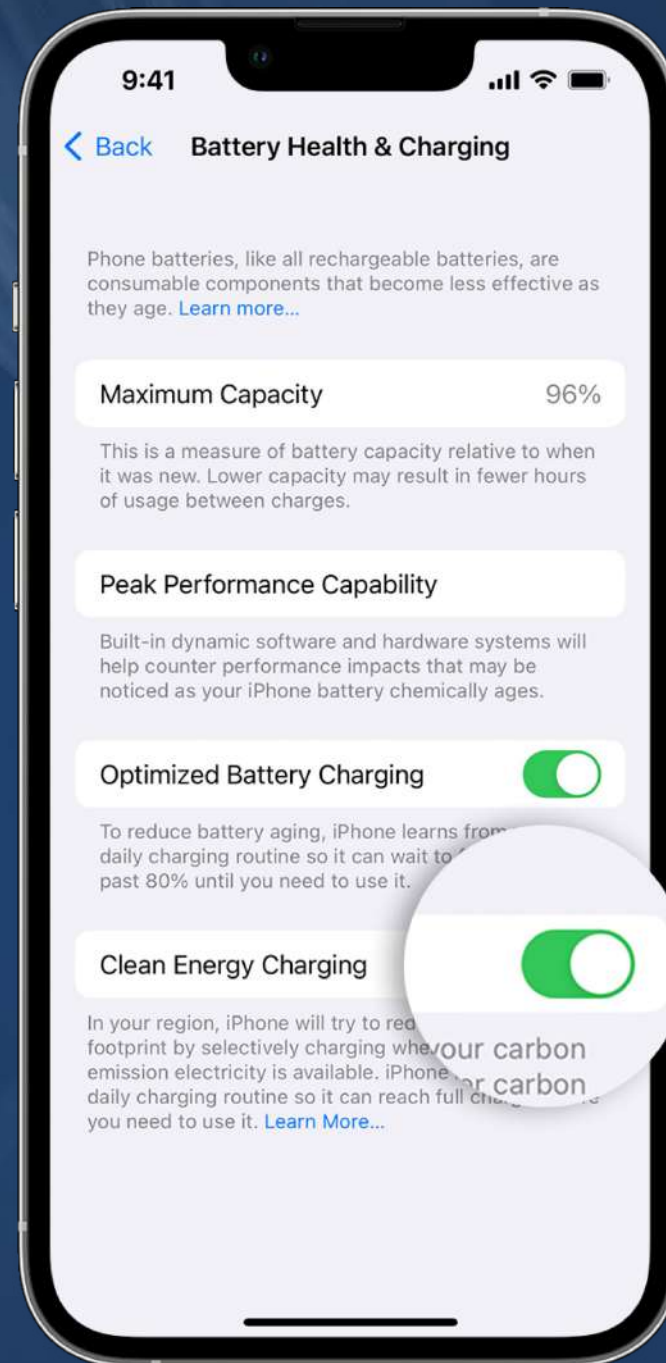


Betriebs-/Ruhezeiten

Pro Woche:	168 Stunden
Wochenende:	2x 24 Stunden
Nacht:	5x 4 Stunden
Betrieb:	100 Stunden
Ruhe:	68 Stunden
Ersparnis:	40%

Demand Shaping





9:41



[< Back](#) Battery Health & Charging

Phone batteries, like all rechargeable batteries, are consumable components that become less effective as they age. [Learn more...](#)

Maximum Capacity 96%

This is a measure of battery capacity relative to when it was new. Lower capacity may result in fewer hours of usage between charges.

Peak Performance Capability

Built-in dynamic software and hardware systems will help counter performance impacts that may be noticed as your iPhone battery chemically ages.

Optimized Battery Charging ☒

To reduce battery aging, iPhone learns from your daily charging routine so it can wait to charge your battery past 80% until you need to use it.

Clean Energy Charging ☒

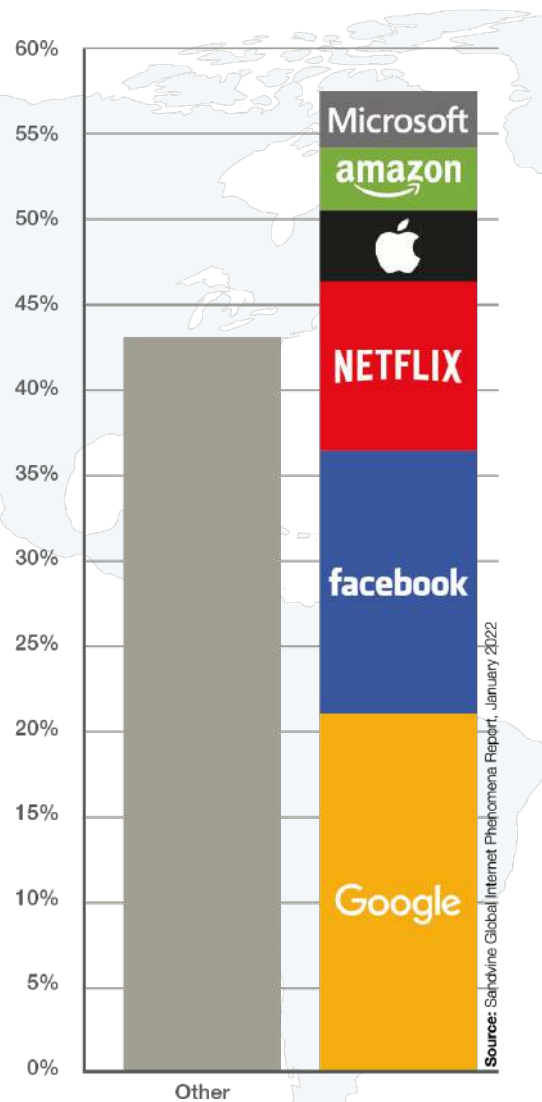
In your region, iPhone will try to reduce your carbon footprint by selectively charging when low-carbon emission electricity is available. iPhone will learn your daily charging routine so it can reach full charge when you need to use it. [Learn More...](#)

your carbon
or carbon



Netzwerke

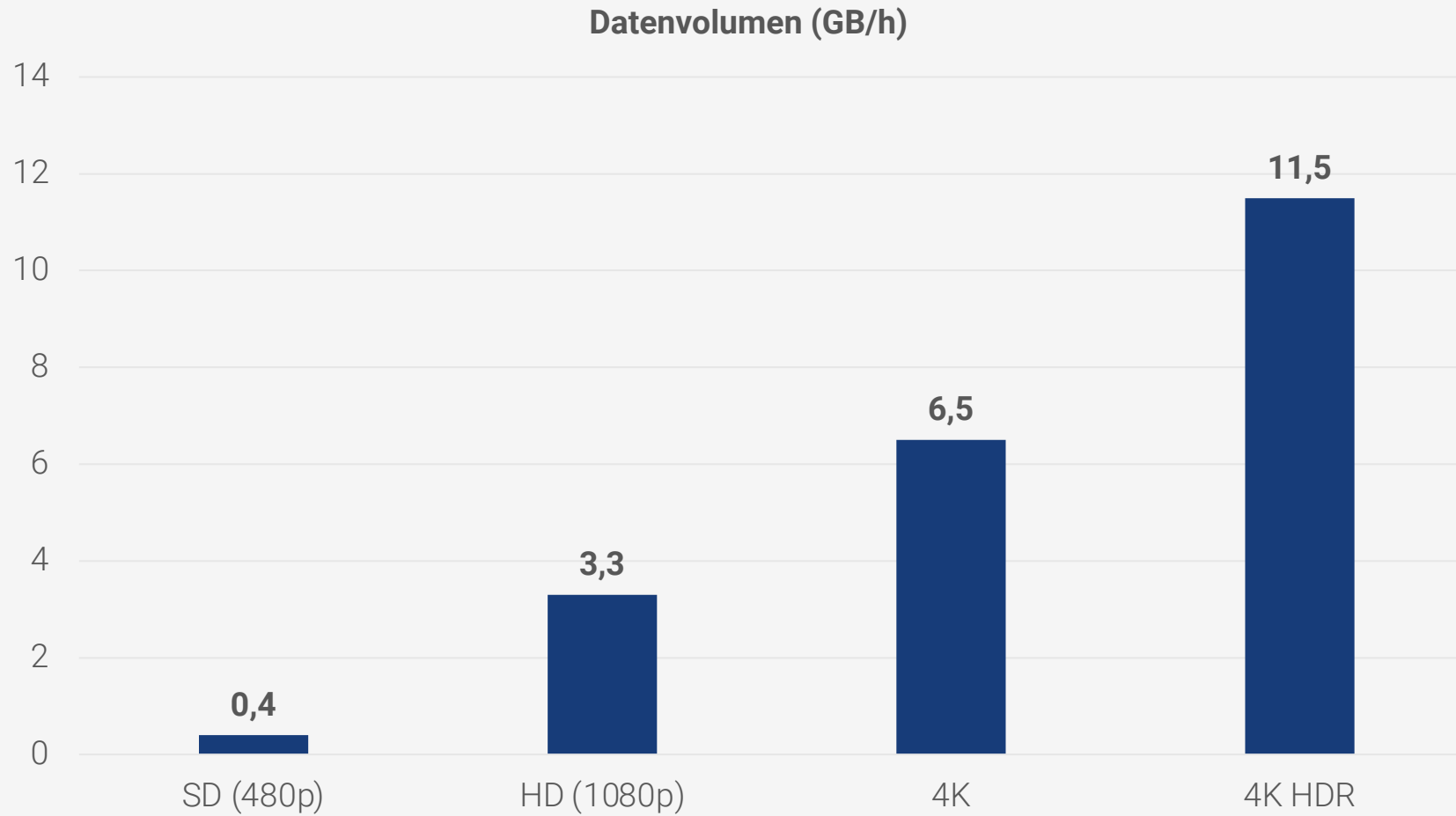
Verteilung Internet-Traffic (weltweit)



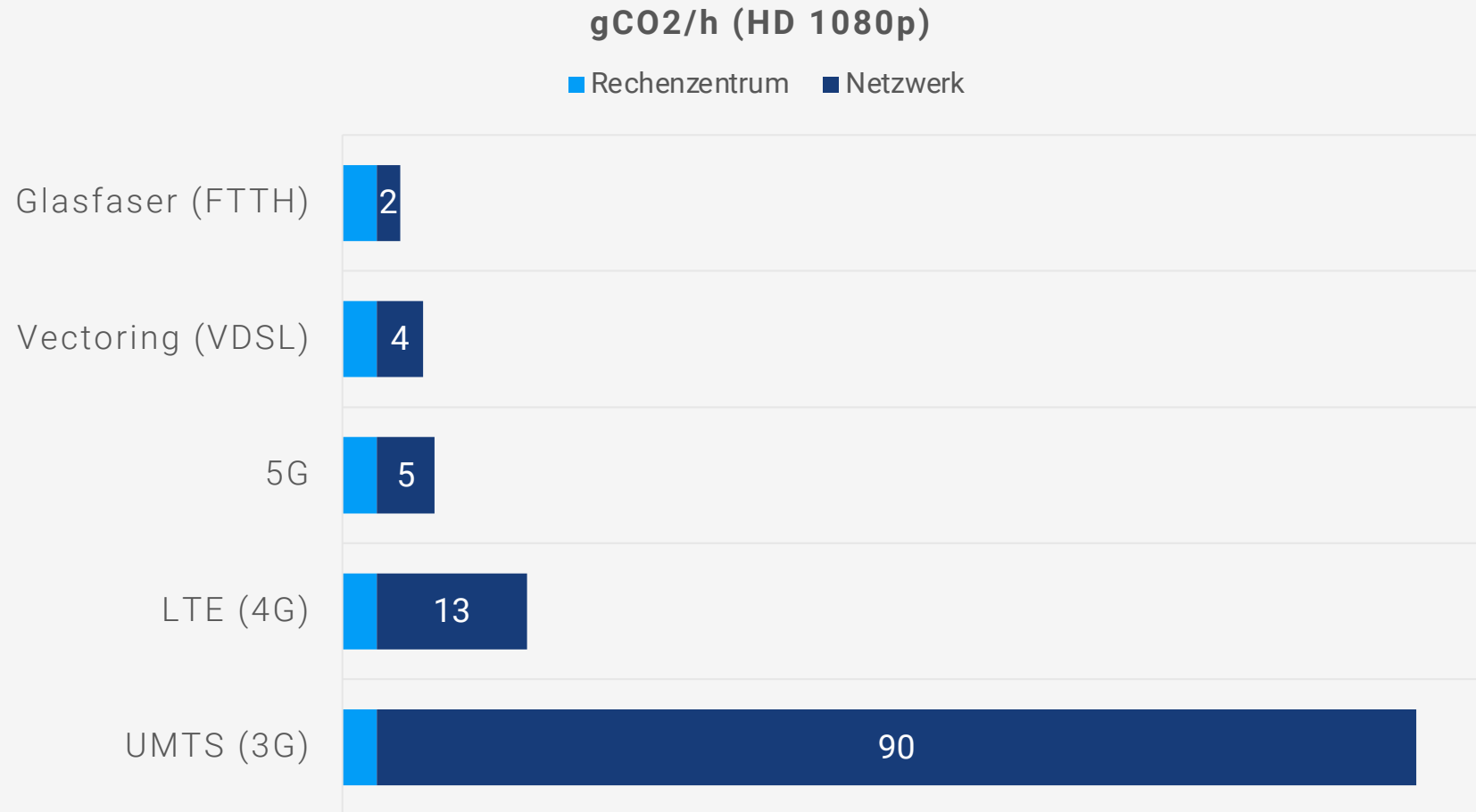
	Application Group	Total Volume
1	Google	20.99%
2	Facebook	15.39%
3	Netflix	9.39%
4	Apple	4.18%
5	Amazon	3.68%
6	Microsoft	3.32%
	TOTAL	56.96%

Source: Sandvine Global Internet Phenomena Report, January 2022

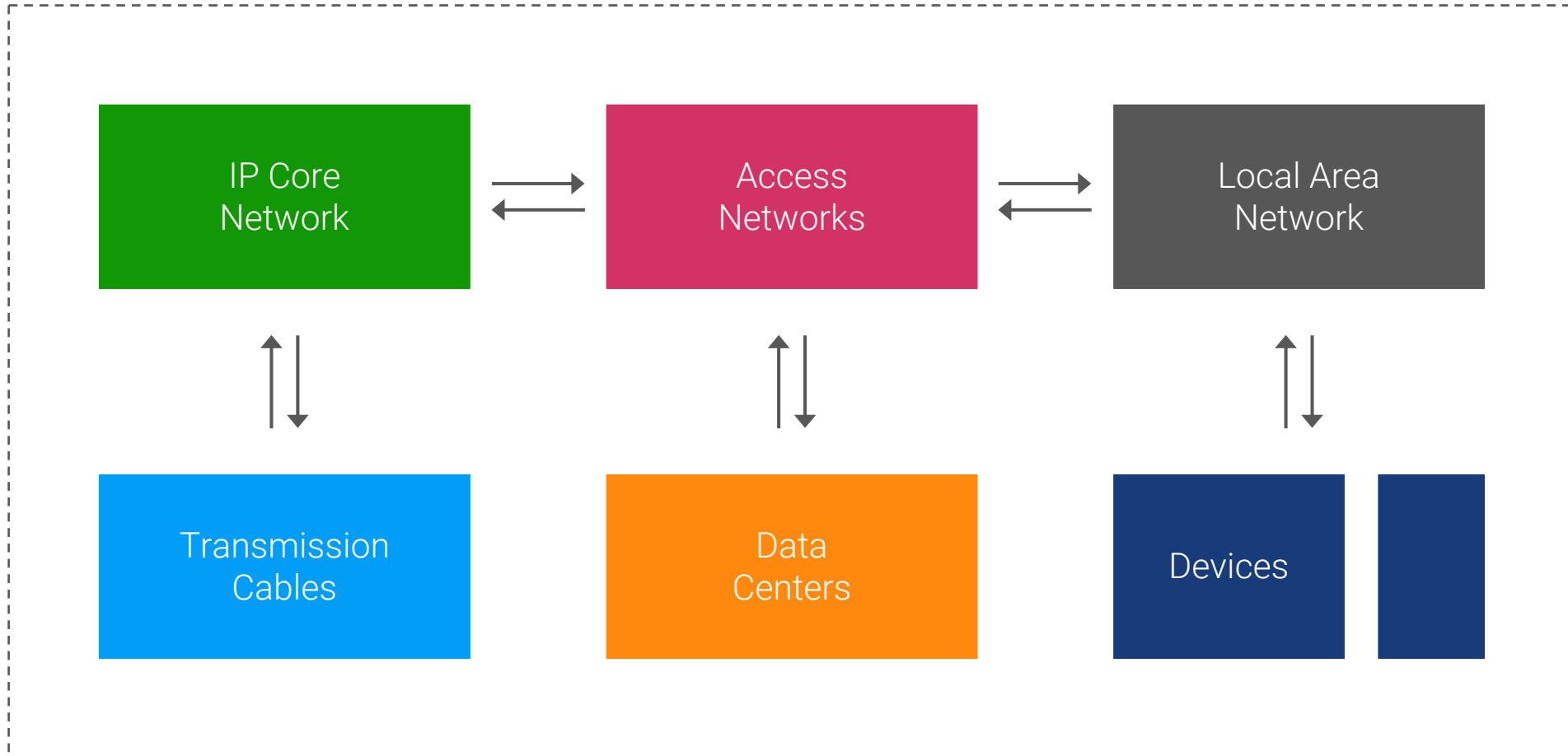
Datenvolumen Netflix-Streaming



Treibhausgasemissionen Video-Streaming

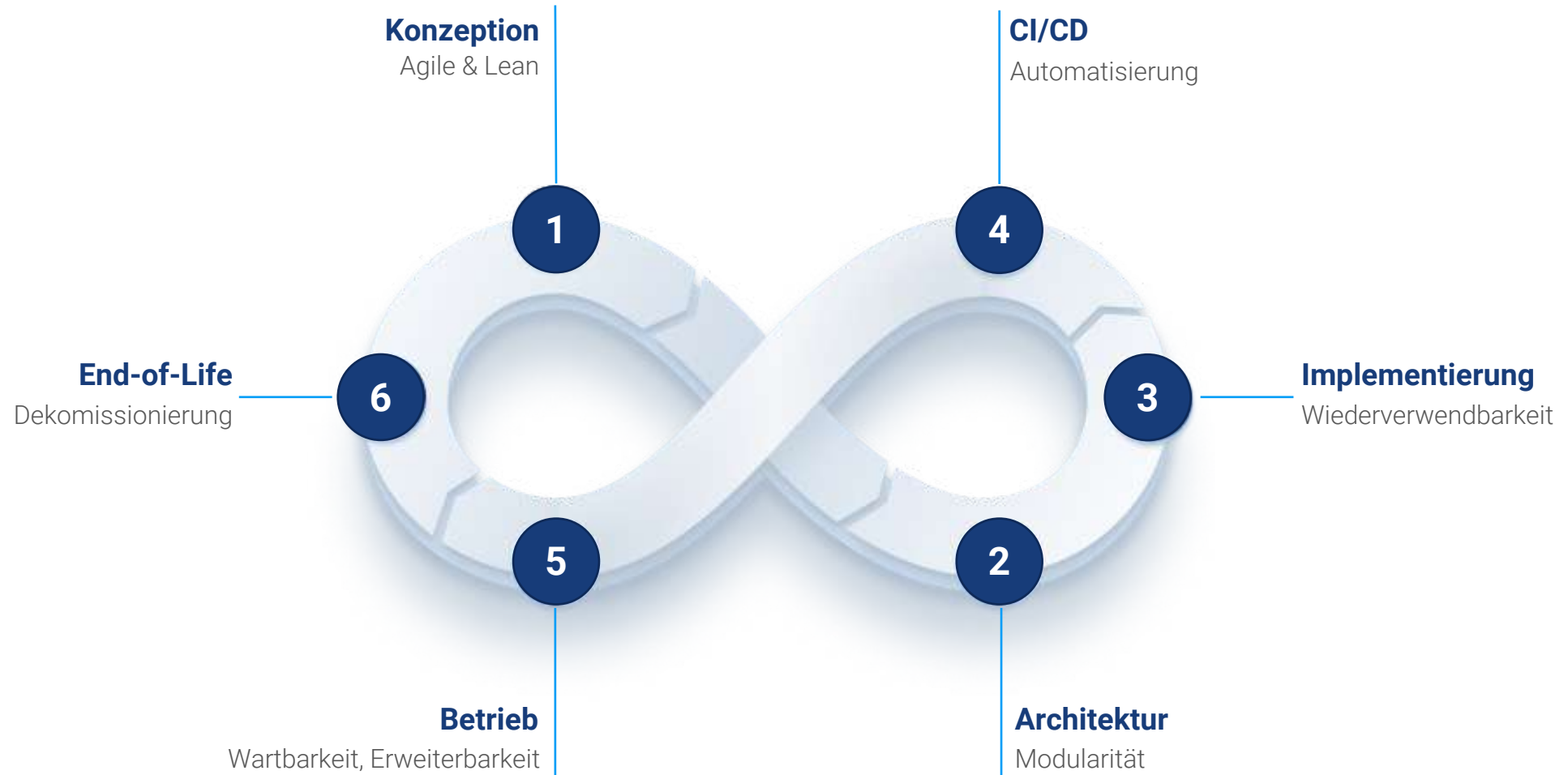


Herausforderung Gesamtperspektive



Software

Lifecycle



Effizienz von Programmiersprachen

		Energy		Time		Mb	
		(c) C	1.00	(c) C	1.00	(c) Pascal	1.00
		(c) Rust	1.03	(c) Rust	1.04	(c) Go	1.05
		(c) C++	1.34	(c) C++	1.56	(c) C	1.17
		(c) Ada	1.70	(c) Ada	1.85	(c) Fortran	1.24
(c)ompiled		(v) Java	1.98	(v) Java	1.89	(c) C++	1.34
		(c) Pascal	2.14	(c) Chapel	2.14	(c) Ada	1.47
		(c) Chapel	2.18	(c) Go	2.83	(c) Rust	1.54
		(v) Lisp	2.27	(c) Pascal	3.02	(v) Lisp	1.92
(v)m		(c) Ocaml	2.40	(c) Ocaml	3.09	(c) Haskell	2.45
		(c) Fortran	2.52	(v) C#	3.14	(i) PHP	2.57
		(c) Swift	2.79	(v) Lisp	3.40	(c) Swift	2.71
		(c) Haskell	3.10	(c) Haskell	3.55	(i) Python	2.80
		(v) C#	3.14	(c) Swift	4.20	(c) Ocaml	2.82
(i)nterpreted		(c) Go	3.23	(c) Fortran	4.20	(v) C#	2.85
		(i) Dart	3.83	(v) F#	6.30	(i) Hack	3.34
		(v) F#	4.13	(i) JavaScript	6.52	(v) Racket	3.52
		(i) JavaScript	4.45	(i) Dart	6.67	(i) Ruby	3.97
		(v) Racket	7.91	(v) Racket	11.27	(c) Chapel	4.00
		(i) TypeScript	21.50	(i) Hack	26.99	(v) F#	4.25
		(i) Hack	24.02	(i) PHP	27.64	(i) JavaScript	4.59
		(i) PHP	29.30	(v) Erlang	36.71	(i) TypeScript	4.69
		(v) Erlang	42.23	(i) Jruby	43.44	(v) Java	6.01
		(i) Lua	45.98	(i) TypeScript	46.20	(i) Perl	6.62
		(i) Jruby	46.54	(i) Ruby	59.34	(i) Lua	6.72
		(i) Ruby	69.91	(i) Perl	65.79	(v) Erlang	7.20
		(i) Python	75.88	(i) Python	71.90	(i) Dart	8.64
		(i) Perl	79.58	(i) Lua	82.91	(i) Jruby	19.84



Zusammenfassung

Nachhaltige Digitalisierung durch Green IT



**Nachhaltige
Nutzung**



**Kein
Rebound-Effekt**



**Ende-zu-Ende
denken**



**Jede:r kann
beitragen**



Vielen Dank

Stefan Rotsch, Senior Solution Architect, stefan.rotsch@aoe.com



Quellen / Weiterführende Links

Einführung

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- (2) <https://cloud.google.com/blog/de/topics/forschung/neue-studie-corona-pandemie-beschleunigt-digitalen-wandel>
- (3) https://commons.wikimedia.org/wiki/File:Airports_Network_Map.png
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- (23) <https://www.umweltbundesamt.de/en/press/pressinformation/video-streaming-data-transmission-technology>
- (24) <https://sustainablewebdesign.org/calculating-digital-emissions/>

Code

- (25) <https://pxhere.com/de/photo/910940>
- (27) <https://greenlab.di.uminho.pt/wp-content/uploads/2017/10/sleFinal.pdf>

Quellen / Weiterführende Links

Zusammenfassung

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- (29) [https://commons.wikimedia.org/wiki/File:Hand_Putting_Deposit_Into_Piggy_Bank_\(5737295175\).jpg](https://commons.wikimedia.org/wiki/File:Hand_Putting_Deposit_Into_Piggy_Bank_(5737295175).jpg)
- (30) https://commons.wikimedia.org/wiki/File:Thank_You_-_3768979925.jpg