



Carbon Calculation Basics

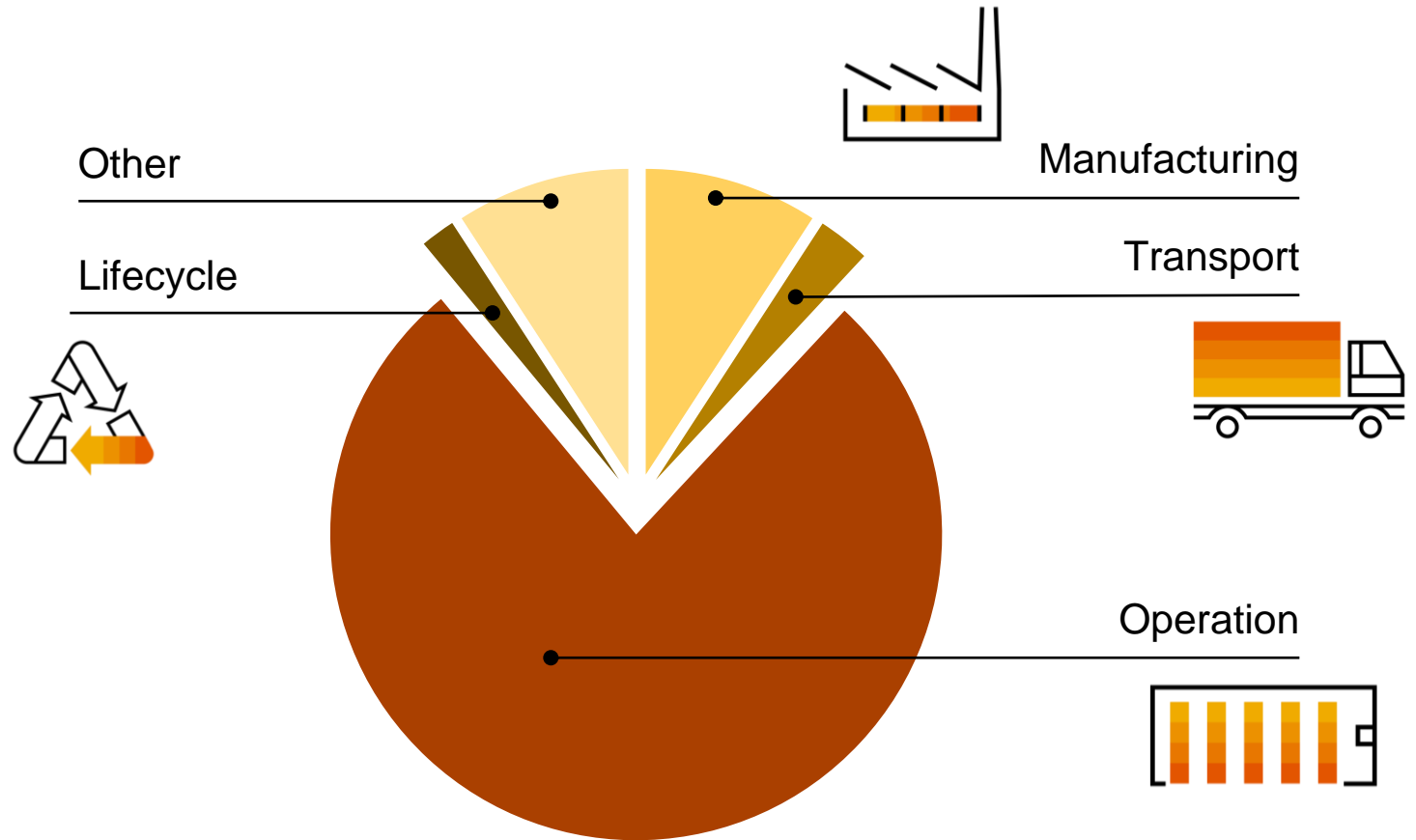
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PUBLIC

Carbon footprint of software usage: symbolic overview

Contributions to carbon footprint

- Manufacturing
- Transport
- Operation
- Lifecycle
- Other



Carbon Calculation Basics

Power consumption to carbon footprint

Direct consumption: compute and storage servers provide resources, require electrical energy

- CPU, Memory, Disk I/O, Network

Indirect consumption: data center infrastructure

- Cooling, lighting, other

Step 1: From data center power consumption to carbon footprint

Step 2: From hardware power consumption to carbon footprint

Step 3: From business requirements to carbon footprint

Step 4: Into the cloud



Step 1: From data center power consumption to carbon footprint

Carbon Emission Intensity (CEI)

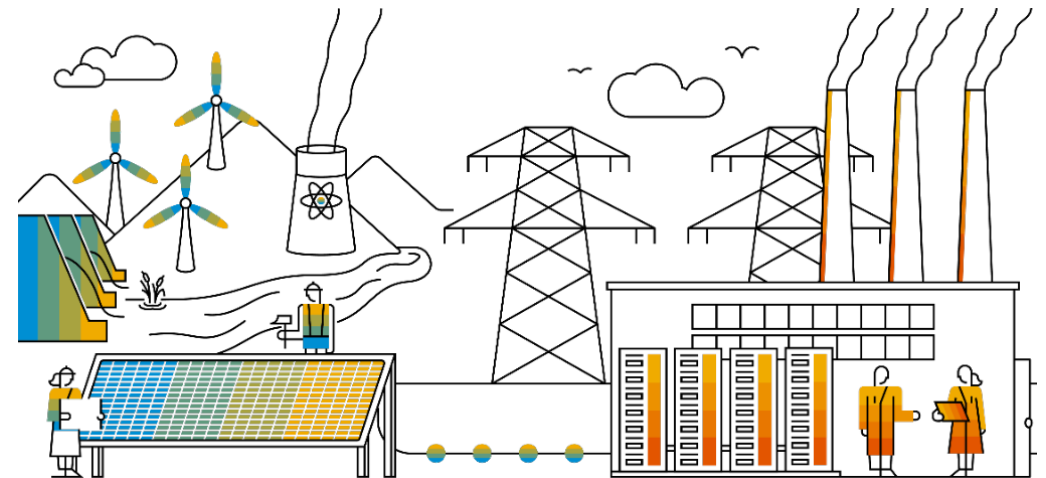
- Exclusive data center usage; data center electric energy consumption E_{total} is known

$$\text{Carbon footprint [g]} = E_{\text{total}} [\text{kWh}] \times (\text{carbon emission intensity (CEI) [g/kWh]})$$

- The value of the carbon emission intensity is determined from the mix of conventional and renewable energy sources used by the electricity provider

Global average*: 475 g/kWh

SAP data centers: 0 g/kWh by use of
100% renewable electricity:



* IEA (International Energy Agency) <https://www.iea.org/reports/global-energy-co2-status-report-2019/emissions>

Step 2: From hardware power consumption to carbon footprint

Power Usage Effectiveness (PUE)

- Dedicated hardware; the dedicated electric energy consumption E_{raw} is known

Total electric energy consumption E_{total} [kWh] = E_{raw} [kWh] x (power usage effectiveness PUE)

Carbon footprint [g] = E_{total} [kWh] x (electricity provider-specified carbon emission intensity [g/kWh])

- Power usage effectiveness (PUE) describes how efficiently a computer data center uses energy*
- Power usage effectiveness (PUE) = Total facility energy / IT equipment energy

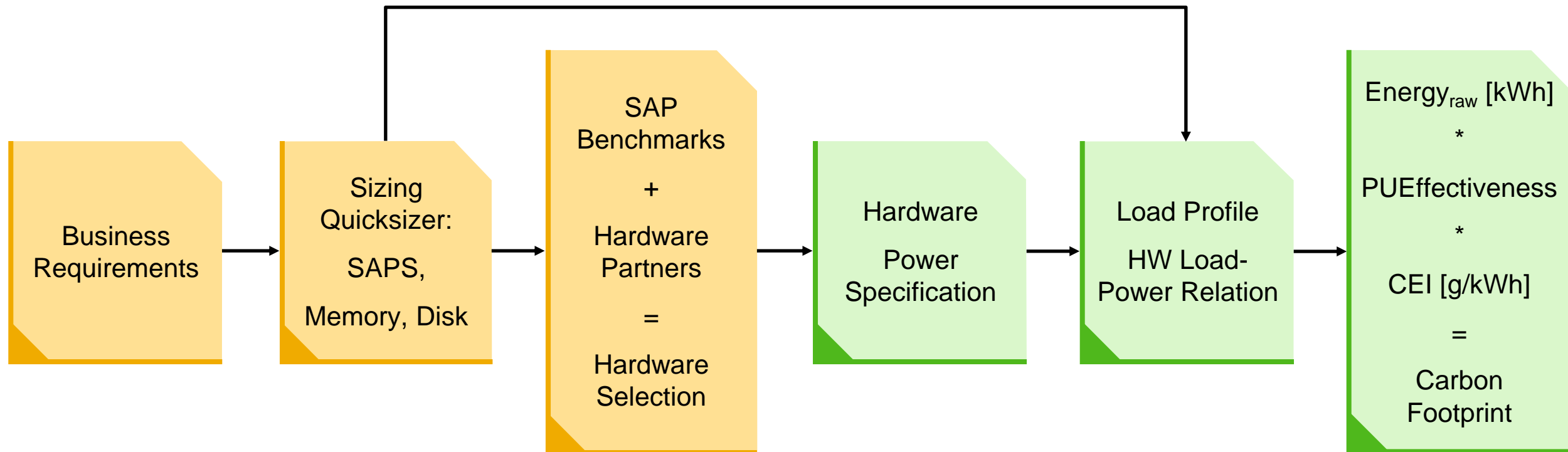
PUE was published in 2016 as a global standard under ISO/IEC 30134-2:2016 as well as a European standard under EN 50600-4-2:2016.

Values depend on many factors, e.g. location. Typical values are around 1.5

* https://en.wikipedia.org/wiki/Power_usage_effectiveness

Step 3: From business requirements to carbon footprint

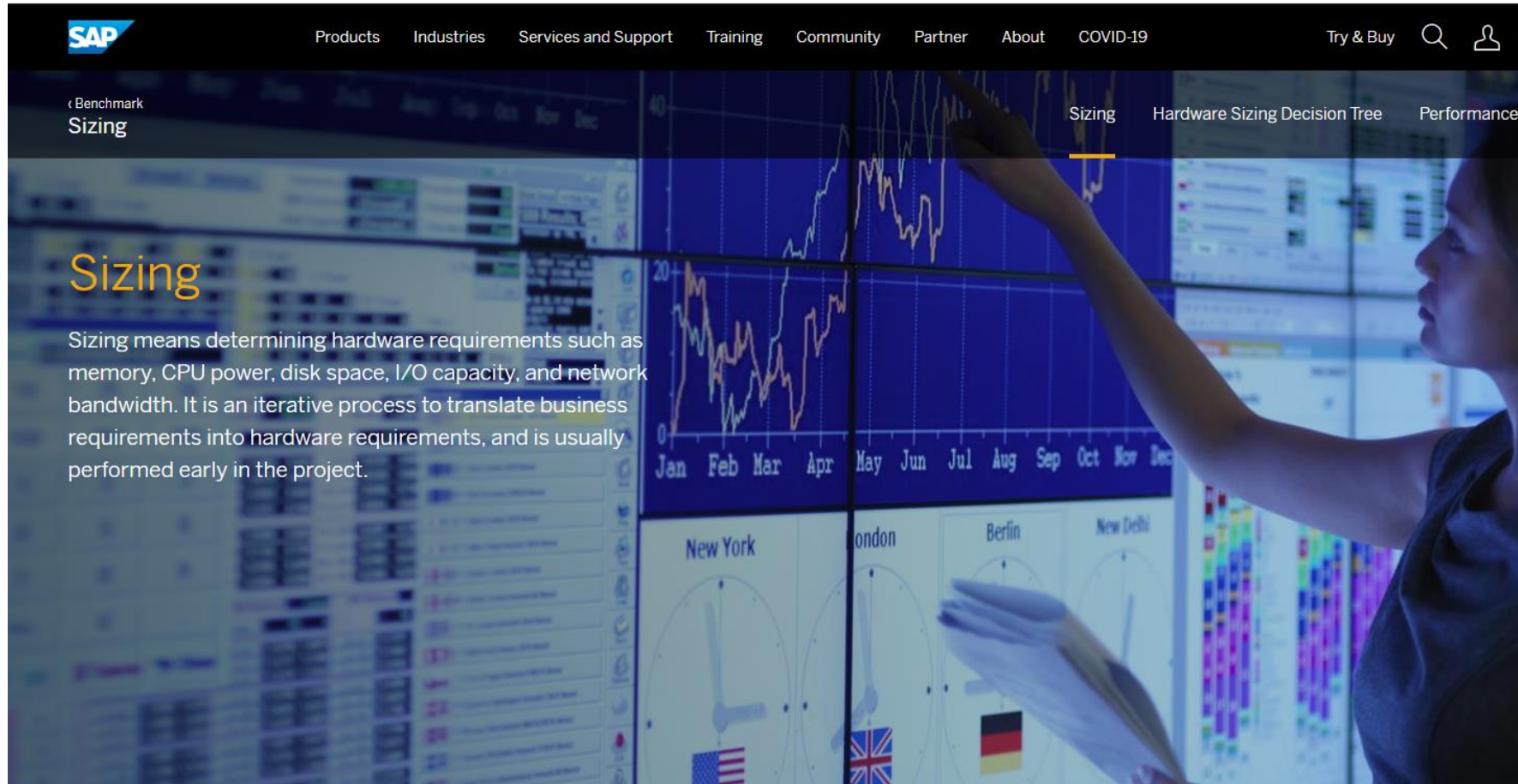
Business requirements are known. Carbon footprint estimate based on sizing information.



Translating business to hardware requirements

Translating hardware usage to carbon footprint

Step 3: From business requirements to carbon footprint – SAP sizing resources



<https://www.sap.com/about/benchmark/sizing.html>

Carbon Calculation Basics

Step 3: From business requirements to carbon footprint – Quicksizer online tool

Input:

- Business requirements

Output:

- Compute power in **SAPS**
- Memory, disk I/O
- Daily usage profile

SAP Application Performance Standard (SAPS), hardware-independent unit of measure

The screenshot displays the SAP Quicksizer online tool interface. The left sidebar shows the 'Input Navigation Tree' with categories like SAP Business Solutions, SAP S/4HANA, and various SAP modules. The main area is titled 'Change project 'TECHED2019'' and contains input fields for Customer no. (188213), Project Name (TECHED2019), and System Business Startup time (30 minutes). Below these are buttons for 'Save', 'Print page', 'Calculate result', 'Set to 'GoingLive'', 'Set to 'Final'', and 'Feedback'. The 'Calculate result' button is highlighted. The main content area shows the 'SAP S/4HANA - Sales & Service: Change' configuration. It includes a 'Business growth rate' of 10% per year, 'Avg. workday' from 09:00 to 18:00, and 'Peak load' from 12:00 to 13:00. Below this are two tables: 'Table 1: Concurrent Users - Standard Sizing' and 'Table 2: Throughput - Standard Sizing'. Both tables have columns for Element, Element short text, A/P, TI, and various performance metrics. Table 1 shows user types (CS-USER, SD-USER) and their activity levels. Table 2 shows transaction types (CS-AG, SD-CUST, SD-BIL, SD-RIL) and their throughput. The tables are interactive, with buttons for 'Delete/Clear' and 'Insert'.

Element	Element short text	A/P	TI	No. of low activity users	No. of medium activity users	No. of high activity users	Residence time on disk (Archiving)	Data Archiving	Residence time in memory (Data Aging)	*Start time	*End time
CS-USER	User in Customer Service	A	S					<input checked="" type="checkbox"/>		09	18
CS-USER	User in Customer Service	P	S							12	13
SD-USER	User in Sales and Distribution	A	S	1,000	500	20	36	<input checked="" type="checkbox"/>	24	09	18
SD-USER	User in Sales and Distribution	P	S	5,000	1,000	80				12	13

Element	Element short text	A/P	TI	* Sizing objects in time frame	* Line items	Changes in %	Displays in %	* Residence time on disk (Archiving)	Data Archiving	Residence time in memory (Data Aging)	*Start time	*End time
CS-AG	Customer Service	A	Y						<input checked="" type="checkbox"/>		09	18
CS-AG	Customer Service	P	P								12	13
SD-CUST	Customer contracts	A	Y						<input checked="" type="checkbox"/>	24	09	18
SD-CUST	Customer contracts	P	P								12	13
SD-BIL	Billing documents	A	Y						<input checked="" type="checkbox"/>	24	09	18
SD-RIL	Billing documents	P	P								12	13

[Link: Sizing for SAP S/4HANA, SAP TechEd Lecture](#)

Carbon Calculation Basics

Step 3: From business requirements to carbon footprint – Hardware selection

SAP benchmark certification gives **SAPS** for tested hardware or IAAS server

SAP Standard Application Benchmarks

Find Results for:

- SD – SAP Sales and Distribution Benchmark
- BWH – SAP BW edition for SAP HANA benchmark
- BWAML – SAP BW Advanced Mixed Load Standard benchmark

Filter by

Technology Partner

CPU

Operating System

DB

More

Q

CSV

SD-Benchmarks (1129)

sorted by Certification Date

☒ descending

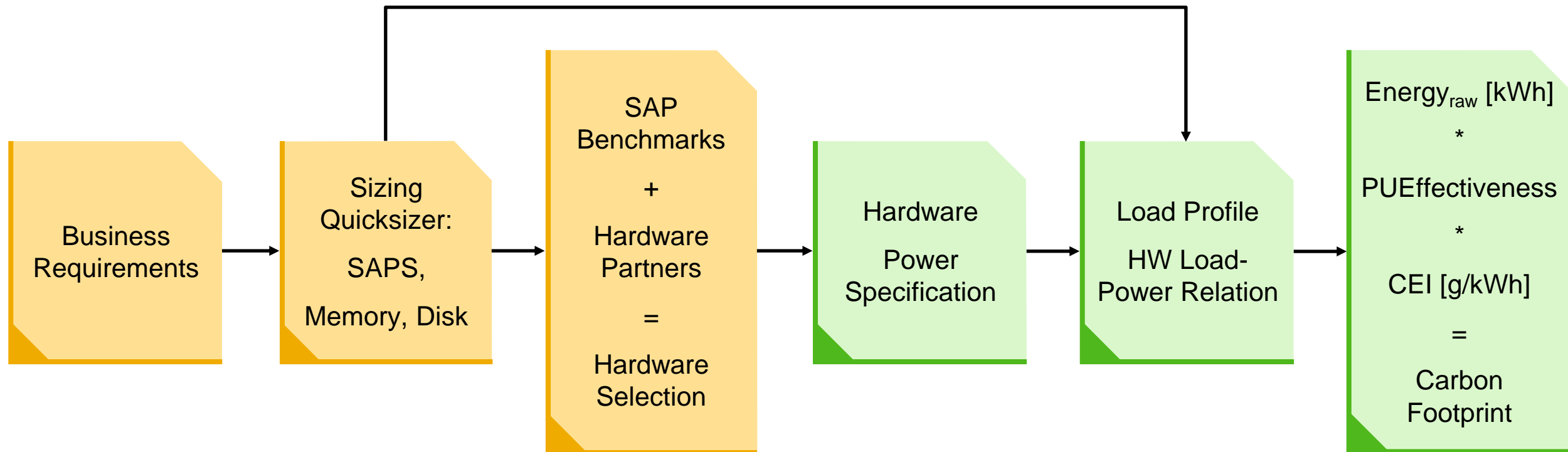
Find SD benchmarks below.

Certification Date	Certification Number	Technology Partner	Server	Benchmark Users	Operating System	Database Release	SAPS
2021-01-28	2021012	Dell	Dell EMC PowerEdge MX340c	58,504	Windows Server 2016	Oracle 11.1	319,700
2021-01-26	2021009	Dell	Dell EMC PowerEdge MX340c	66,666	Red Hat Enterprise Linux 8.3	SAP ASE 16	363,880
2021-01-25	2021008	Google Cloud Platform	Google Cloud Bare Metal - c2-ultramem-8096-metal	157,000	Windows Server 2019	Microsoft SQL Server 2017	892,270
2021-01-25	2021006	HPE	HPE Superdome Flex 280	122,300	Windows Server 2016	Microsoft SQL Server 2012	670,830
2021-01-25	2021005	HPE	HPE Superdome Flex 280	63,800	Windows Server 2016	Microsoft SQL Server 2012	349,670
2021-01-12	2021002	Hitachi	Hitachi Advanced Server DS2080	106,500	Windows Server 2016 Datacenter	Microsoft SQL Server 2012	593,000

<https://www.sap.com/dmc/exp/2018-benchmark-directory/#/sd>

Step 3: From business requirements to carbon footprint

Business requirements are known. Carbon footprint estimate based on sizing information.



Translating business to hardware requirements

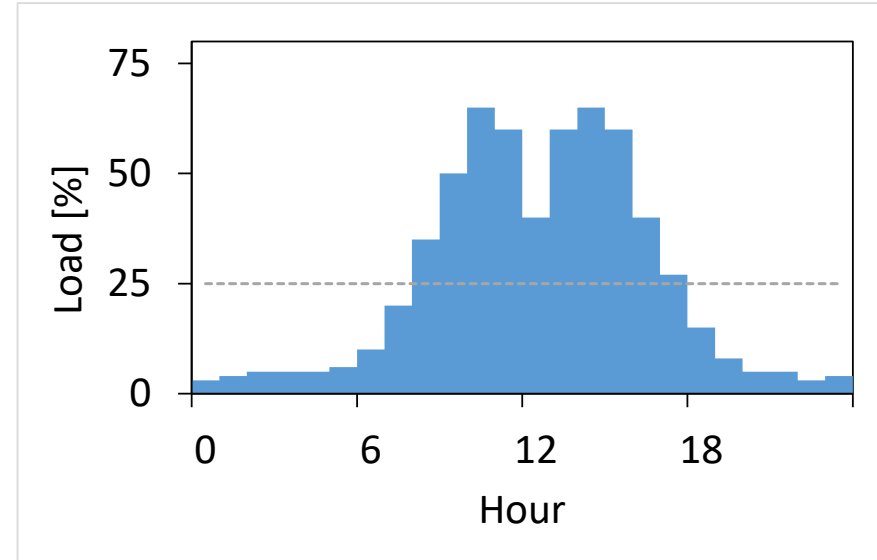


Translating hardware usage to carbon footprint

Step 3: From business requirements to carbon footprint – Load profile

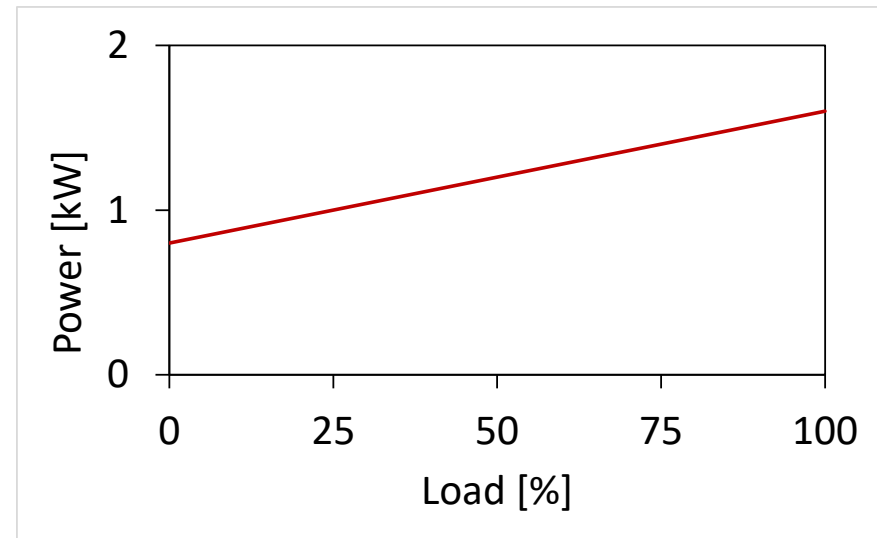
Load profile

- Example daily load distribution
- Business profile reflected in QS output
- In this example: avg. daily load = 25%

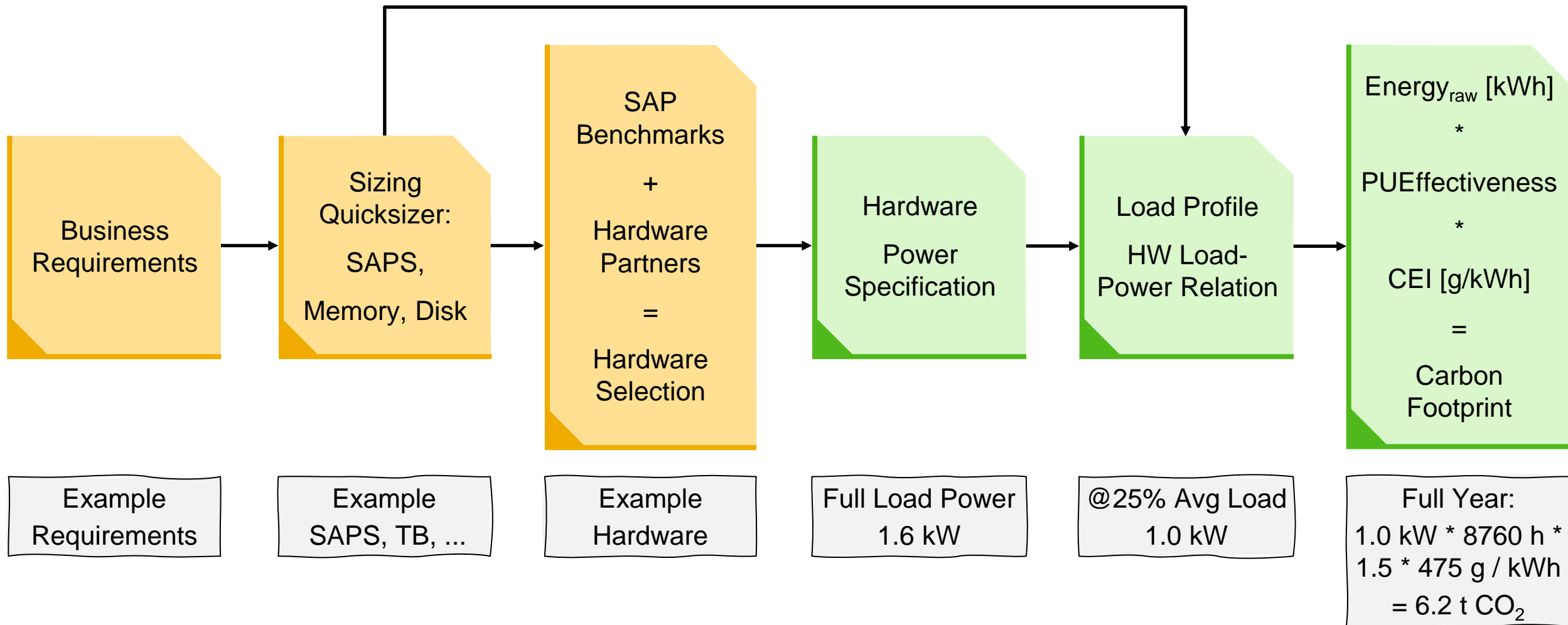


Power-load relation

- Example relation shown
- Linear within reasonable accuracy
- Constant and increasing contributions
- Specific relation depends on type and number of CPUs, type and amount of memory, and other factors



Step 3: From business requirements to carbon footprint



Step 4: Into the cloud

Advantage of scale: sharing of resources

- Higher, more uniform utilization can be reached
- Net energy saving for service consumers

Advantage of choice: cloud provider sustainability

- In SAP Cloud, **carbon footprint is 0** by use of 100% renewable electricity



Power consumption to carbon footprint

Step 1: From data center power consumption to carbon footprint – Carbon emission intensity CEI

Step 2: From hardware power consumption to carbon footprint – Power usage effectiveness PUE

Step 3: From business requirements to carbon footprint – Carbon sizing

Step 4: Into the cloud – Advantage of scale



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