WHITE PAPER:

SUSTAINABILITY AS THE FIFTH TENET

A Practical Guide to Sustainability for the OCP Community

Version 1.0

Author (s) :

Jonmichael Hands, Chia Network

Jordan Tse, Meta

Alex Rakow, Schneider Electric

Tiffany Jin, OCP

Executive Summary

As a follow-up to the 2021 OCP Sustainability Whitepaper call to action, sustainability is now an official top-level project and the 5th tenet of OCP. Sustainability was a large part of 2022's OCP Global Summit, and the OCP sustainability project leadership team had an opportunity to discuss how it fits into the overall OCP strategy and projects. This whitepaper describes how the OCP Sustainability Project defines sustainability for our community and what OCP member companies can do to make their products more sustainable. Specifically, you will learn the guiding principles of transparency that will help members consider incorporating sustainability as one of the tenets when making OCP contributions.

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Introduction

The standard approach to sustainability is minimizing the environmental impact of products and services, measured by GHG (greenhouse gas) emissions, energy, material, water, waste, and other environmental impacts. This is the “do less bad” view of sustainability. A more comprehensive approach that the Open Compute Project (OCP) is taking is for companies to have an opportunity to be “more good” by operating responsibly and positively impacting the world. This involves collaboration and sharing of best practices and leveraging the other strengths of OCP in openness and efficiency. Sustainability in the ICT industry is moving beyond “carbon footprint” and energy efficiency to include transparency of other externalities, product circularity, and true interoperability.

1 Transparency, Reporting, and Metrics

The first step in a sustainability strategy for companies and products is transparency by reporting and disclosing environmental impacts, metrics, and improvements over time. The Greenhouse Gas (GHG) Protocol is the most widely used greenhouse gas accounting standard for companies. Notably, the GHG Protocol guides on how to draw boundaries around what’s defined at Scope 1, 2 and 3. While reporting Scope 1 (direct) and Scope 2 (indirect associated with energy production) emissions are becoming common, Scope 3 (all other indirect) is much harder to calculate and requires transparency of all emission-causing activities across the value chain. IDC (International Data Corporation) predicts by 2024, 80% of G2000 companies will capture their carbon data and report their enterprise wide carbon footprint using quantifiable metrics compared with 50% today. [1] The OCP Community is made up of all value chain actors of the data center, including equipment manufacturers and data center operators. Below, we will describe how to consider carbon impacts for each type of company.

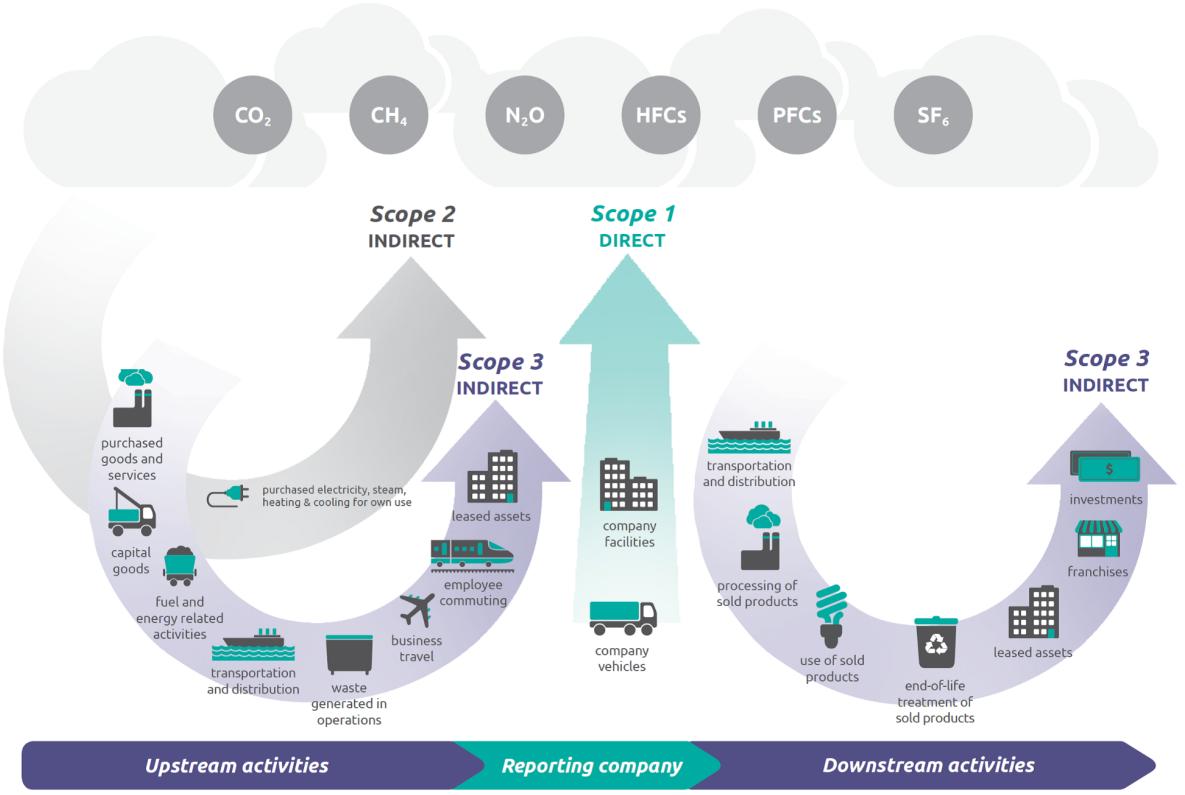

Figure 1. Overview of GHG Protocol scopes and emissions across the value chain, Source: Scope 3 Standard

Metrics and reporting for data center operators

For companies that operate data centers, Scope 1 emissions are limited to those created within the data center during operation, such as emissions from backup generators and any vehicles that are used onsite. Scope 2 emissions are those associated with purchased power, whether from the utility or through a power purchase agreement. A single occupant data center typically counts the emissions related to powering the entire data center load as Scope 2. A multi-tenant data center may choose to assign IT loads as their tenant's Scope 2, but there is no consensus in the industry on when and how to do this. Scope 3 emissions include (but are not limited to) all of the embodied carbon in the materials and equipment that go into constructing a data center, including racks, servers, and electrical equipment. Scope 3 also includes emissions associated with the end-of-life treatment or waste from the data center. [1]

[1] **Disclaimer**: These are subject to change and should be viewed as high-level guidance; please consult the GHG Protocol and your company's own operations before deciding what is and is not included in each of these emissions scopes. The following is a helpful diagram to show the delineation between operational emissions and Scope 3 emissions for data center operators.

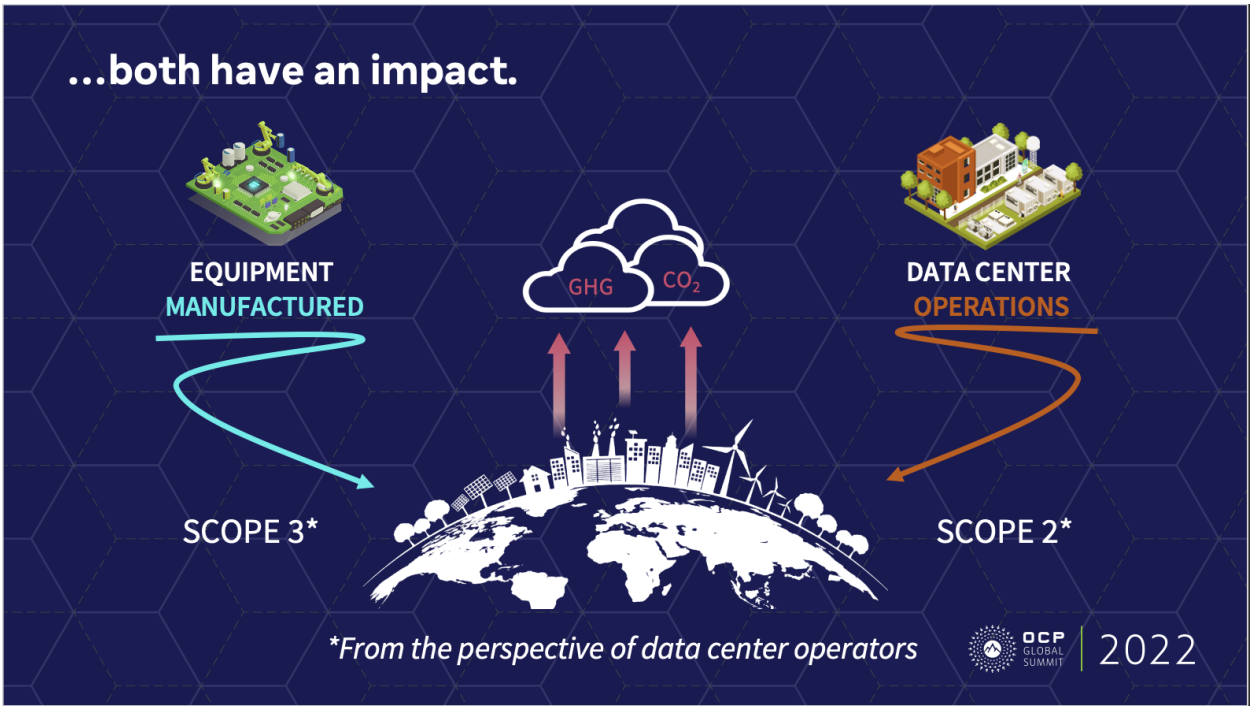

Figure 2: Operational and supply chain emissions from the perspective of a data center operator, Source: Dharmesh Jani, Sustainability keynote presentation at the 2022 OCP Global Summit

There are other important metrics and categories to consider beyond greenhouse gas emissions, including energy use, water, waste, land, and biodiversity. Some example metrics are listed below:

- Energy - Total energy consumption (Wh), Power usage effectiveness (PUE), renewable energy use
- GHG Emissions (carbon footprint) - Scope 1, Scope 2, Scope 3 (CO_2e), Carbon Usage Effectiveness (CUE), carbon offsets
- Water - water usage (m^3) and effectiveness
- Waste - waste generated (tons), diverted

Metric Category	Key Metrics	Unit	Recommended framework/standard
Energy	Total energy consumption	kWh	SASB
	Power usage effectiveness (PUE)	ratio	ISO/IEC 30134-2:2016
	Total renewable energy consumption	kWh	RE100
	Renewable energy factor (REF)	ratio	ISO/IEC 30134-2:2016
	Energy reuse factor (ERF)	ratio	ISO/IEC FDIS 30134-6
GHG Emissions	GHG emissions: (Scope 1)	mt CO2e	GHG Protocol or ISO 14064
	GHG emissions: (Scope 2) - Location based	mt CO2e	GHG Protocol or ISO 14064
	Annual GHG emissions: (Scope 2) - Market based	mt CO2e	GHG Protocol or ISO 14064
	Annual GHG emissions: (Scope 3)	mt CO2e	GHG Protocol or ISO 14064
	Location-based carbon intensity (Scope 1+ Scope 2)	mt CO2e/kWh	GHG Protocol or ISO 14064
	Market-based carbon intensity (Scope 1 + Scope 2)	mt CO2e/kWh	GHG Protocol or ISO 14064
	Carbon usage effectiveness (CUE)	mt CO2e/kWh	ISO/IEC DIS 30134-8
	Annual carbon offsets retired	mt CO2e	N/A see a White Paper on this topic
	Hour by hour supply and consumption matching	TBD	No frameworks or standards available
Water	Total site water usage	m3	ISO/IEC DIS 30134-9
	Total source energy water usage	m3	No frameworks or standards available
	Water usage effectiveness (WUE)	m3/kWh	ISO/IEC DIS 30134-9
	Total water use in supply chain	m3	No frameworks or standards available
Waste	Total waste generated	tons	GRI 300: Environmental - 306
	Waste landfilled	tons	GRI 300: Environmental - 306
	Waste diverted	tons	GRI 300: Environmental - 306
	Waste diversion rate	ratio	GRI 300: Environmental - 306
Land & Biodiversity	Mean species abundance	MSA/km2	N/A see a White Paper on this topic

Figure 2. Matrix between 23 key metrics, frameworks, and standards. Source: Guide to Environmental Sustainability Metrics for Data Centers, Schneider Electric

Metrics and reporting for data center equipment and hardware suppliers

Companies who produce physical products that are used within a data center, such as equipment suppliers, servers, storage, network, or component manufacturers, will have different profiles of Scope 1, 2, and 3 emissions. Unless manufacturing of those products is outsourced, Scope 1 and 2 emissions will primarily come from any manufacturing activities in addition to office space; Scope 3 emissions will include (but are not limited to) the upstream commodity and component supply chain, logistics, and downstream use of those products (e.g. at the data center, or the Scope 2 of data center operators allocated to their products).[2]

A powerful way to understand and communicate the environmental impacts associated with the goods produced is through a Life Cycle Assessment (LCA). To understand the impact of a product, an analysis needs to be performed on the full life-cycle of the device, including manufacturing and production, transportation, use, and end of life. OCP released a GUIDELINES: LIFE CYCLE ASSESSMENT document for cloud providers that can serve as a good starting point. Specific definitions of Scopes 1, 2, and 3 may differ depending on the stakeholder and their position in the ecosystem.

Prominent data center operators have plans to make embodied carbon disclosures mandatory for their vendors as part of the RFP response. However, the utility of the embodied carbon data generated through LCA is limited by a lack of standardization across the industry. The same piece of equipment could generate different figures for embodied carbon depending on the product modeling rules, software and database used to perform the LCA. To help drive the data center industry toward standardization, it's important for equipment vendors to follow international standards such as ISO 14040 when conducting LCAs, report results through an Environmental Product Declaration that also follows standards (e.g. ISO 14025), and finally to disclose the software, database, product modeling rules, and third party program that was used in the process. The OCP Sustainability Project published a presentation on the topic of LCA standardization for the data center industry that can be found here.

[2] **Disclaimer**: These are subject to change and should be viewed as high-level guidance; please consult the GHG Protocol and your company's own operations before deciding what is and is not included in each of these emissions scopes.

2 Circularity (Circular Economy)

Circularity keeps resources in use for as long as possible, designing waste out of the system, and maximizing efficiency through strategies such as reuse, repair, and remanufacturing, rather than being used once and then discarded. Circular products are designed to extend the use period of a product and consider the next use, ensuring materials are fully recoverable with no waste generated at end-of-life. Products that are no longer functioning can be broken down into raw materials that go back into manufacturing future products. Circularity efforts have a varying impact, and prioritization should be given to extension of use (life), reuse, repair, recycling, and disposal - in that order. Circular economy principles include:

- **Use (life) extension** - keep products in use for as long as possible, e.g., firmware upgrades in the field to improve reliability and decrease failures
- **Reuse** - most often the highest value flow, where a second or third user uses a product after the first deployment. Reuse requires a secure transfer of ownership and data sanitization to ensure no private data is recoverable.
- **Sharing** - resource sharing between organizations and divisions can be an effective way to enable reuse at a local scale
- **Repair** - Replace parts on a damaged product to allow it to continue to function. Hardware testing and verification should identify if all key functions are working.
- **Refurbish** - Products with all functionality tested and verified, no major defects, and loaded a known working version of firmware or software. Refurbished products may be from product returns or a configuration change.
- **Remanufacture** - Taking a product that has some damage or use, and turning it into a new product at a different class. E.g., a hard drive with one bad disk platter, or a remanufacturing process could use the drive at a smaller user capacity
- **Disassembly, Recycle and Reuse Components** - Disassemble the product. E.g., removing valuable components from the PCB (printed circuit board) for reuse in another product or segment
- **Recycle Raw Material** - Often not as impactful as other areas of circularity, it does prevent material from turning into e-waste and properly disposed of or directed to recycling facilities. This is especially important for rare earth elements such as tin, tungsten, tantalum, gold, cobalt, etc.

Design for circularity guide

The design for circularity guide offers practical examples where companies can disclose ways they have designed circular economy principles into the products. Categories include ease of serviceability and easy disassembly, product use, materials, and packaging.

Figure 3. Categories of designing products for circularity

Interoperability

The Open Compute Project was started on the stance of open source hardware and the tenet of openness is undoubtedly tied to the principles behind promoting sustainability. One of the keys to a circular economy and preventing waste is to create products that have compatibility and interoperability. This allows easy reuse and disassembly of subcomponents and effective value recovery.

Some great examples of OCP interoperability include:

- OCP DC-MHS (Data Center Modular Hardware System) interoperable building blocks for servers to support various compute, storage, and networking options.
- Open Rack flexible and industry-standard rack configurations lower the barrier of entry to reusability and secondary markets at end of life
- OCP storage specifications (cloud NVMe SSD, boot, SATA/SAS HDD) will allow for common firmware and requirements for storage devices between hyperscale and OEM customers that enable faster time to market, but more importantly easy reuse and the end of first use through secure media sanitization.
- OAI (Open Accelerator Infrastructure) defines physical modules including logical aspects such as electrical, mechanical, thermal, management, and hardware security to produce solutions compatible

with existing/traditional operating systems and frameworks to run heterogeneous accelerator applications. This standardization encourages interoperability between multiple modules and vendors.

3 Efficiency

Efficiency is an important aspect of sustainability, and its own OCP tenet. Making data centers and products more efficient is a way to reduce energy consumption, but there are opportunities for existing and future efficiency metrics to more fully consider environmental impact.

At the data center level, Power Utilization Effectiveness (PUE) has been the industry standard metric for communicating efficiency at the data center operator level. The drive towards optimizing PUE has been highly effective at making cooling technologies more efficient for data centers. However, PUE does not shed much light on the carbon intensity of the power that's being used, hence the development of metrics such as CUE; nor does it provide insights beyond the data center envelope, e.g. into how efficiently the 'IT power' is utilized.

OCP is committed to creating, adopting, and promoting new IT efficiency metrics. There are a lot of industry efforts in this area, including CNDCP (EU Climate Neutral Data Center Pact), TGG (the Green Grid), EED (EU Energy Efficient Datacentre), and iMasons Climate Accord. Example metrics like HUE have been presented at OCP, Hardware Utilization Effectiveness Studies can show how measuring idle power consumption, thermal leakage, and fans and pumps can improve delivering more energy to the IT equipment and less wasted energy.

Product efficiency impacts can be quantified as an improvement over an industry average, or over a previous generation of the same product (e.g. product delivers 30% higher performance at 20% less energy consumption compared to the previous generation). One of the best ways to document energy efficiency is with an LCA, which includes figures on energy use by lifecycle phase, and associated GHG emissions. For energy efficiency, we are typically most concerned with Scope 2 emissions produced during the "use" phase. Additionally, if you are able to generate more compute or storage capacity with less energy, you can do "more with fewer" servers in the entire data center. This will impact Scope 3, and any upstream environmental impacts that occur when we manufacture and use products. Marketing against the competition is standard practice in the ICT industry, but extra caution should be taken when comparing the sustainability claims of a product, per FTC Green Guides and other global regulatory guidance. Responsible sustainability is about making changes to make a global impact and sharing best practices.

4 Sustainability as the 5th OCP Tenet: Three Guiding Principles

In addition to being named a Top-Level Project, Sustainability is now officially the 5th OCP Tenet, along with Openness, Efficiency, Scale, and Impact. Those submitting specifications and designs to the OCP Incubation Committee should be prepared to have their proposal evaluated on all five of these criteria. Reviewing this document and familiarizing yourself with OCP's perspective on sustainable computing is a good place to start. Next, think about how the specification or design you're proposing contributes to progress in sustainability for your product category.

Instead of being prescriptive about how new solutions submitted to OCP must demonstrate sustainability, the organization is focused on transparency. It is up to each submitting party to decide how to demonstrate the sustainability of their solution, within the framework of three guiding principles:

Meaningful

Submissions to OCP must demonstrate meaningful contributions to sustainability, such as a leap forward in efficiency or circularity. Although measuring and reporting on efficiency is always helpful, if that efficiency is below the industry average, the product may not represent a meaningful contribution to sustainability.

Relevant

It is up to each submitter to determine what aspects of sustainability performance are most relevant to their products. Metrics should be selected based on their potential to demonstrate progress in sustainability.

Data Driven

All sustainability claims that accompany OCP submissions should be data driven. Submitters should select relevant metrics, and measure meaningful data to demonstrate high performance in the selected aspect of sustainability. This will allow sustainability claims to be verified, and prevent green-washing.

5 Conclusion

Major focuses for the OCP Sustainability project have been on transparency, thorough and standardized reporting, quantifiable metrics, and circularity. Efficiency remains an important lever in sustainable growth, as well as a major focus for OCP, but often by itself mistaken for sustainability. Sustainability in the ICT industry comes with many challenges, such as privacy and data security, interoperability for hyperscale efficiency, and

scale. The OCP sustainability project is here to help guide OCP members through continuous improvement on the sustainability journey.

6 Glossary

- **Circularity (Circular Economy)**: In a circular economy, resources are kept in use for as long as possible, through strategies such as reuse, repair, remanufacturing, and recycling rather than being used once and then discarded.
- **EPD (Environmental Product Declaration)**: An EPD is a verified and registered document that communicates the environmental performance of a product or service based on a life cycle assessment. It provides transparent and comparable information about a product or service's environmental impact, such as carbon footprint, energy use, and water consumption. EPDs can be used to support environmental labeling and sustainable procurement, among other applications.
- **GHG (Greenhouse Gas)**: GHGs contribute to the greenhouse effect, which causes global warming and climate change. The most common GHGs are carbon dioxide, methane, and nitrous oxide, which are emitted by human activities such as burning fossil fuels, deforestation, and agriculture. GHG emissions can be measured and reported in various units, such as carbon dioxide equivalents (CO2e), to facilitate comparisons between different gasses and sources.
- **LCA (Life Cycle Assessment)**: A technique used to evaluate the environmental impact of a product or a system throughout its entire life cycle. It considers the environmental impact from all stages, from raw material extraction, manufacturing, use phase, to end-of-life and disposal.
- **Scope 1 Emissions**: Scope 1 emissions refer to direct GHG emissions that are produced by an organization's own activities or facilities. Examples of Scope 1 emissions include emissions from on-site combustion of fossil fuels, such as natural gas or diesel, or from industrial processes that release GHGs.
- **Scope 2 emission**s refer to indirect GHG emissions that are generated by the production of energy that an organization purchases or consumes. These emissions are associated with the generation of electricity, steam, or heat that an organization uses.
- **Scope 3 emissions** refer to all other indirect emissions that are generated by an organization's activities, but are not included in Scope 2. These emissions are often associated with the entire life cycle of the goods and services that an organization produces or consumes, including emissions from the extraction of raw materials, transportation, and disposal. Examples of Scope 3 emissions may include emissions from business travel, employee commuting, and purchased goods and services.
- **ICT**, or information and communications technology (or technologies), is the infrastructure and components that enable modern computing.

7 References

1. IDC FutureScape: Worldwide Sustainability/ESG 2023 Predictions, Oct 2022 - IDC FutureScape - Doc # US48709922
2. WHITE PAPER: Data Sanitization for the Circular Economy
3. GUIDELINES: LIFE CYCLE ASSESSMENT, LCA GUIDELINES FOR CLOUD PROVIDERS
4. Schneider Electric White Paper: A guide to environmental sustainability metrics for data centers
5. Corporate value chain (scope 3) standard: Greenhouse gas protocol (no date) Corporate Value Chain (Scope 3) Standard | Greenhouse Gas Protocol. Available at: https://ghgprotocol.org/standards/scope-3-standard

8 License

- Creative Commons

  OCP encourages participants to share their proposals, specifications and designs with the community. This is to promote openness and encourage continuous and open feedback. It is important to remember that by providing feedback for any such documents, whether in written or verbal form, that the contributor or the contributor's organization grants OCP and its members irrevocable right to use this feedback for any purpose without any further obligation.

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9 About Open Compute Foundation

At the core of the Open Compute Project (OCP) is its Community of hyperscale data center operators, joined by telecom and colocation providers and enterprise IT users, working with vendors to develop open innovations that, when embedded in product are deployed from the cloud to the edge. The OCP Foundation is responsible for fostering and serving the OCP Community to meet the market and shape the future, taking hyperscale led innovations to everyone. Meeting the market is accomplished through open designs and best practices, and with data center facility and IT equipment embedding OCP Community-developed innovations for efficiency, at-scale operations and sustainability. Shaping the future includes investing in strategic initiatives that prepare the IT ecosystem for major changes, such as AI & ML, optics, advanced cooling techniques, and composable silicon. Learn more at www.opencompute.org.