OPEN.

FOR BUSINESS.

OCP SUMMIT

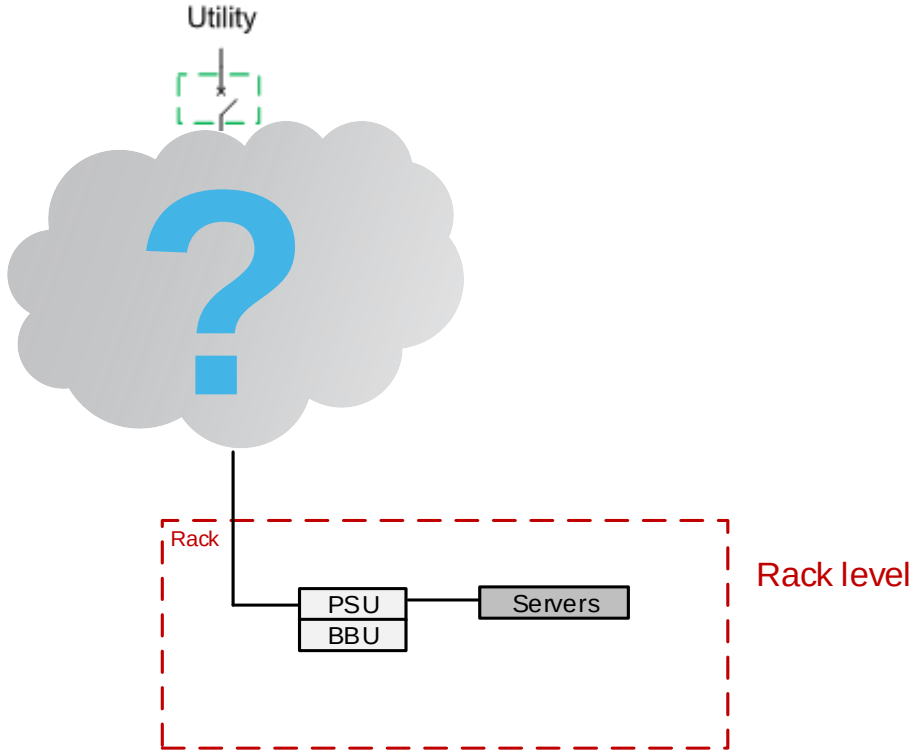
Analysis of Data Center Electrical Architectures Supporting OCP

Robert Bunger
Schneider Electric

Critical questions arise about what is upstream of the rack…

- If I adopt Open Compute, what does my power architecture look like?
- Can I get N+1, 2N, 2(N+1) (i.e. tier 3) redundancy levels like I have today?
- How do I support traditional and Open Compute IT loads in the same data center?

Answering these questions will broaden adoption…



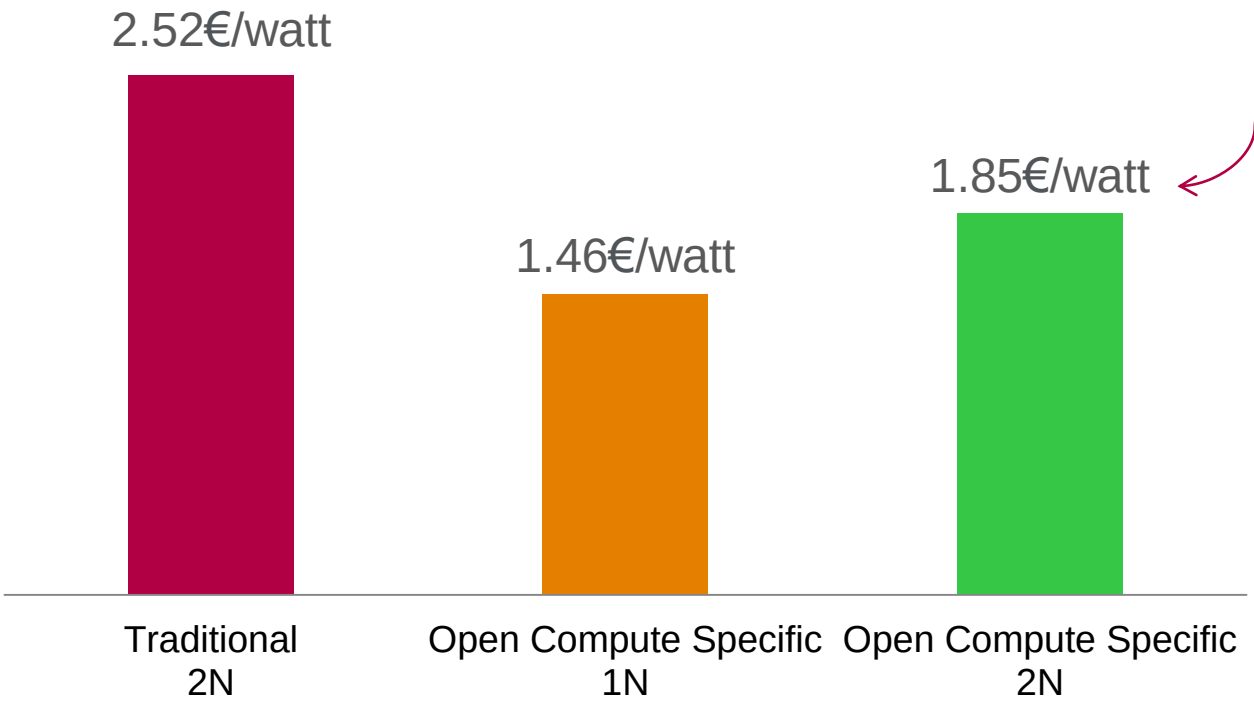
Important to understand the cost trade-offs

Analysis Assumptions

- Analyzed capital cost (material cost only)
- Compared traditional and Open Compute specific architectures
- From MV switchgear down to (and including) IT power supply
- Key assumptions:
  - OCP PSU/BBU/shelf costs based on design by Schneider Electric
  - Traditional server PSU costs & sizing based on various IT vendors/suppliers
  - Models based on 9.6MW data center, 10 kW/rack
  - Costs normalized to €/Watt

Based on the content of white paper 228, Analysis of Data Center Architectures Supporting Open Compute Project (OCP)

Traditional vs. OCP-based designs



We think most will want to maintain 2N (Tier 3) redundancy

"Tiers" in a nutshell

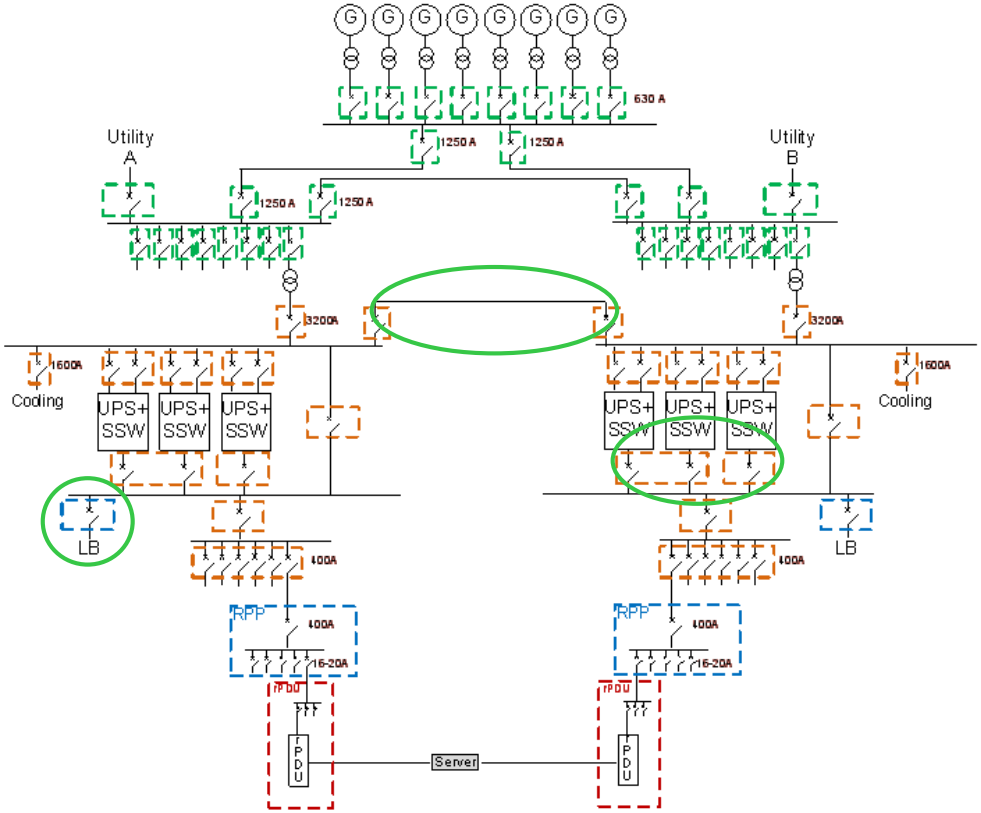
Tier 1: Single power path to IT load; single points of failure

Tier 3: Dual (redundant) power paths to IT load, concurrently maintainable

Traditional 2N power architecture today…

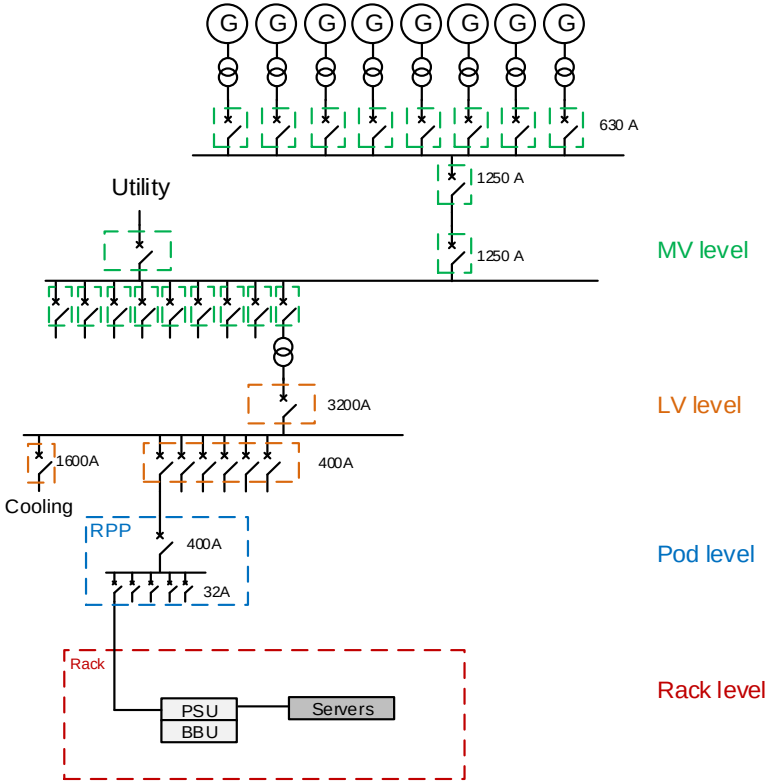
Typical 2N design for traditional IT loads

- 2N power paths from utility to load, Tier 3(ish)
- Adds complexities (“Belts & suspenders”):
  - Load bank
  - Ties
  - Additional UPS output breakers
- Concurrently maintainable



Open Compute Specific 1N architecture

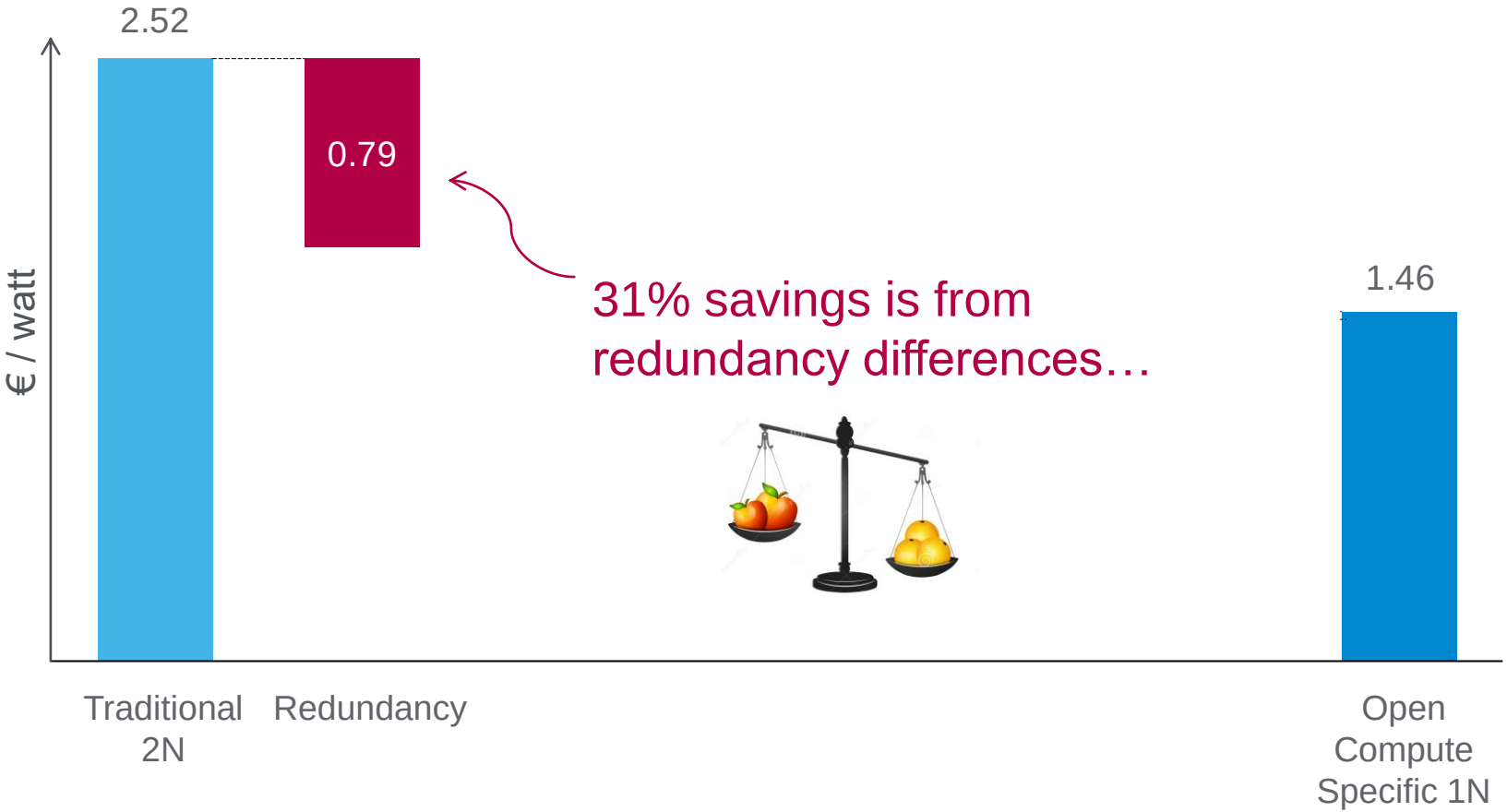
An example of a **cost-reduced** architecture to support OCP loads



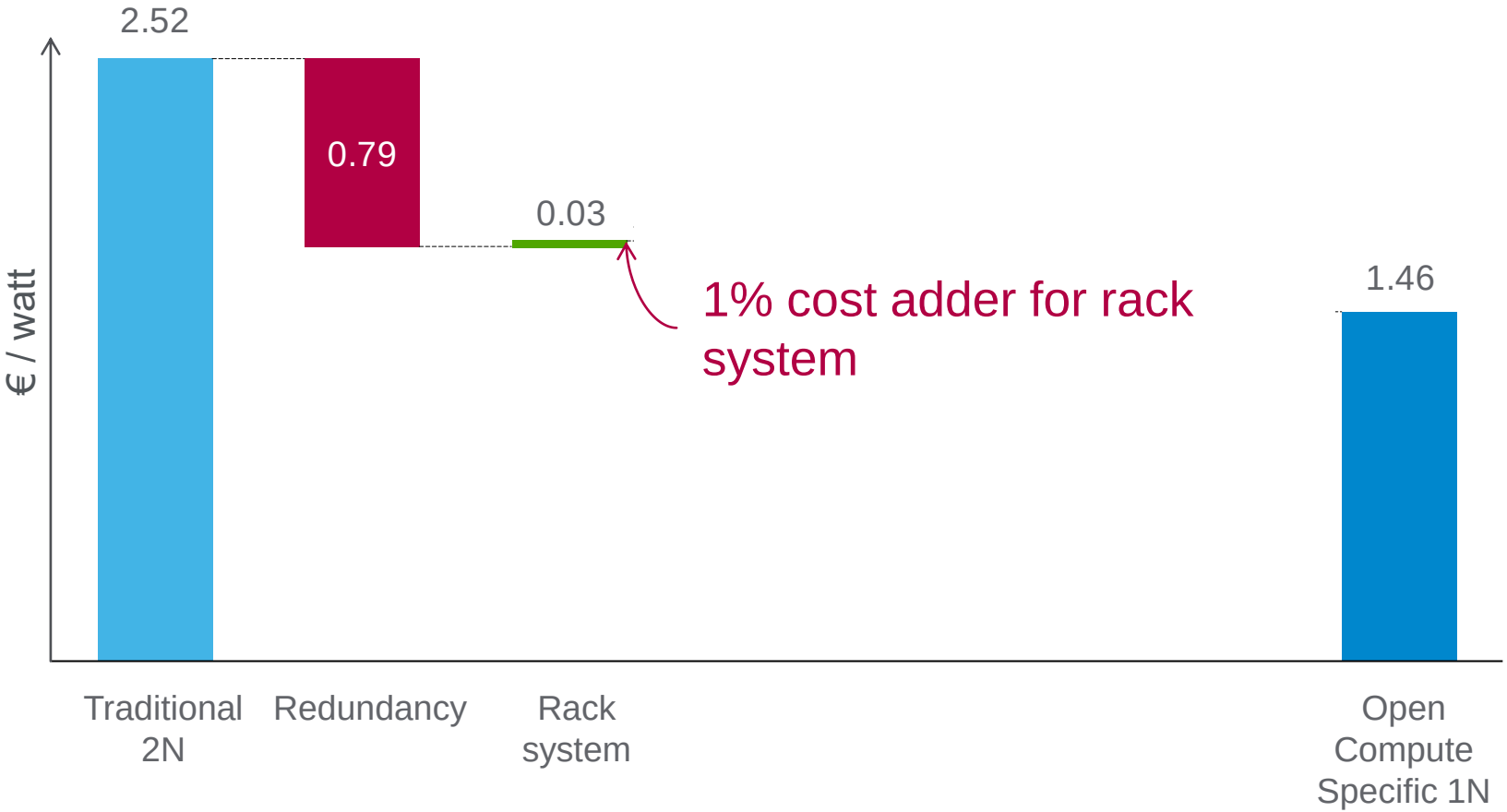
- Aligns with the simplicity and cost-reduction mindset of OCP
- Open Compute servers with one PSU path
- Single path to the IT load
  - with rack-based battery backup
  - no centralized UPS
- Minimal breaker count

Traditional 2N vs. Open Compute Specific 1N

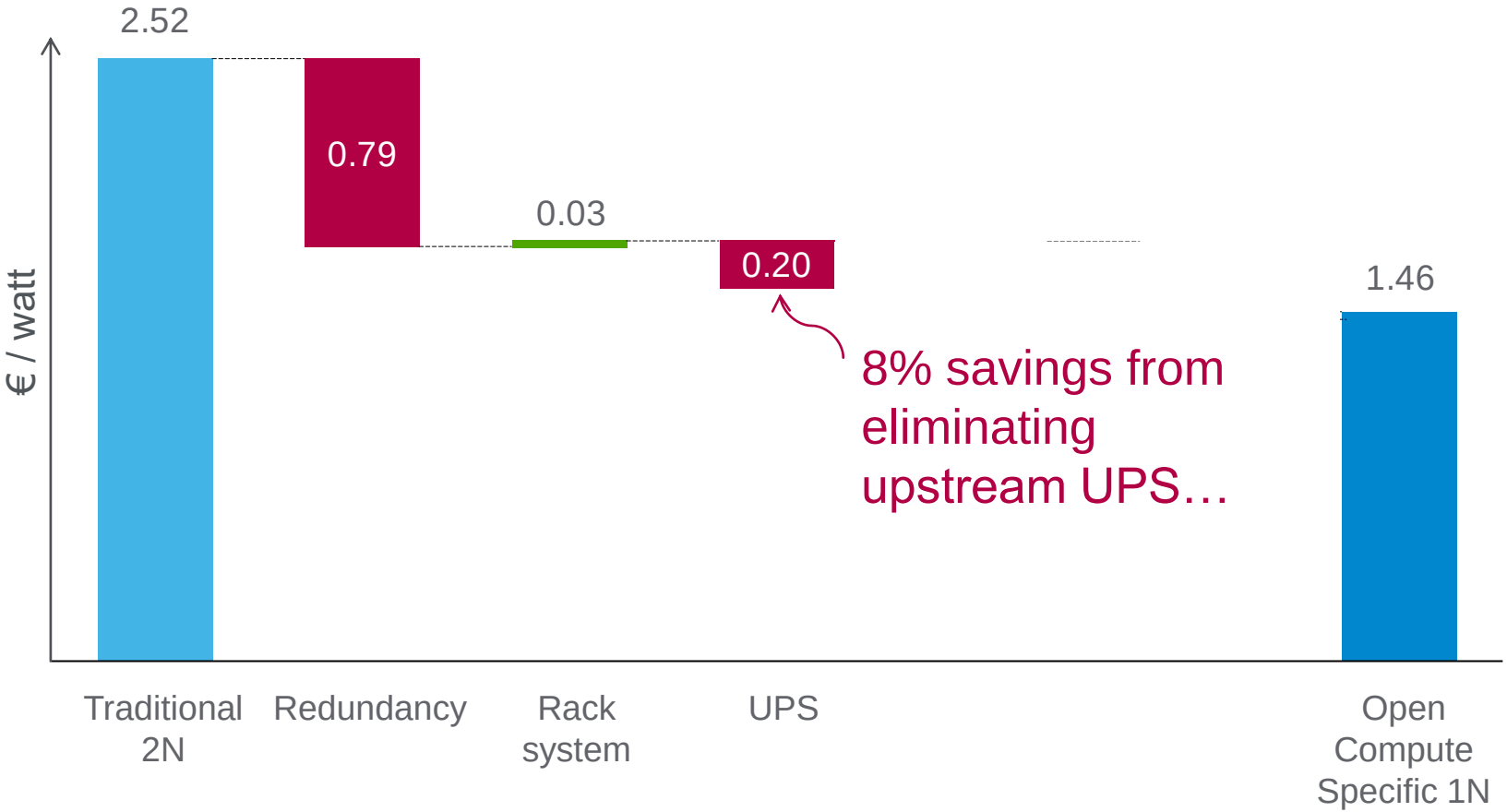
Traditional 2N vs. Open Compute Specific 1N



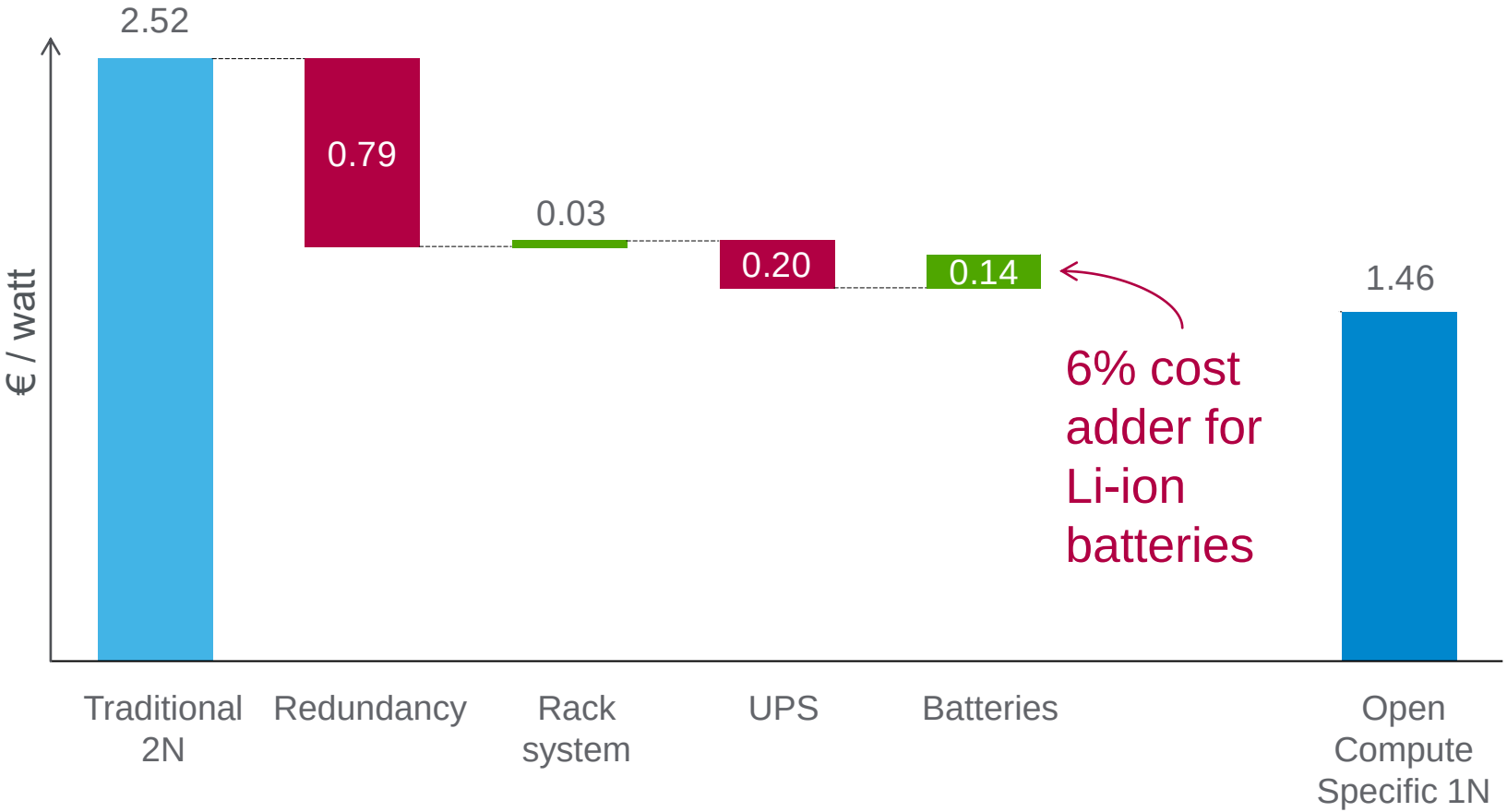
Traditional 2N vs. Open Compute Specific 1N



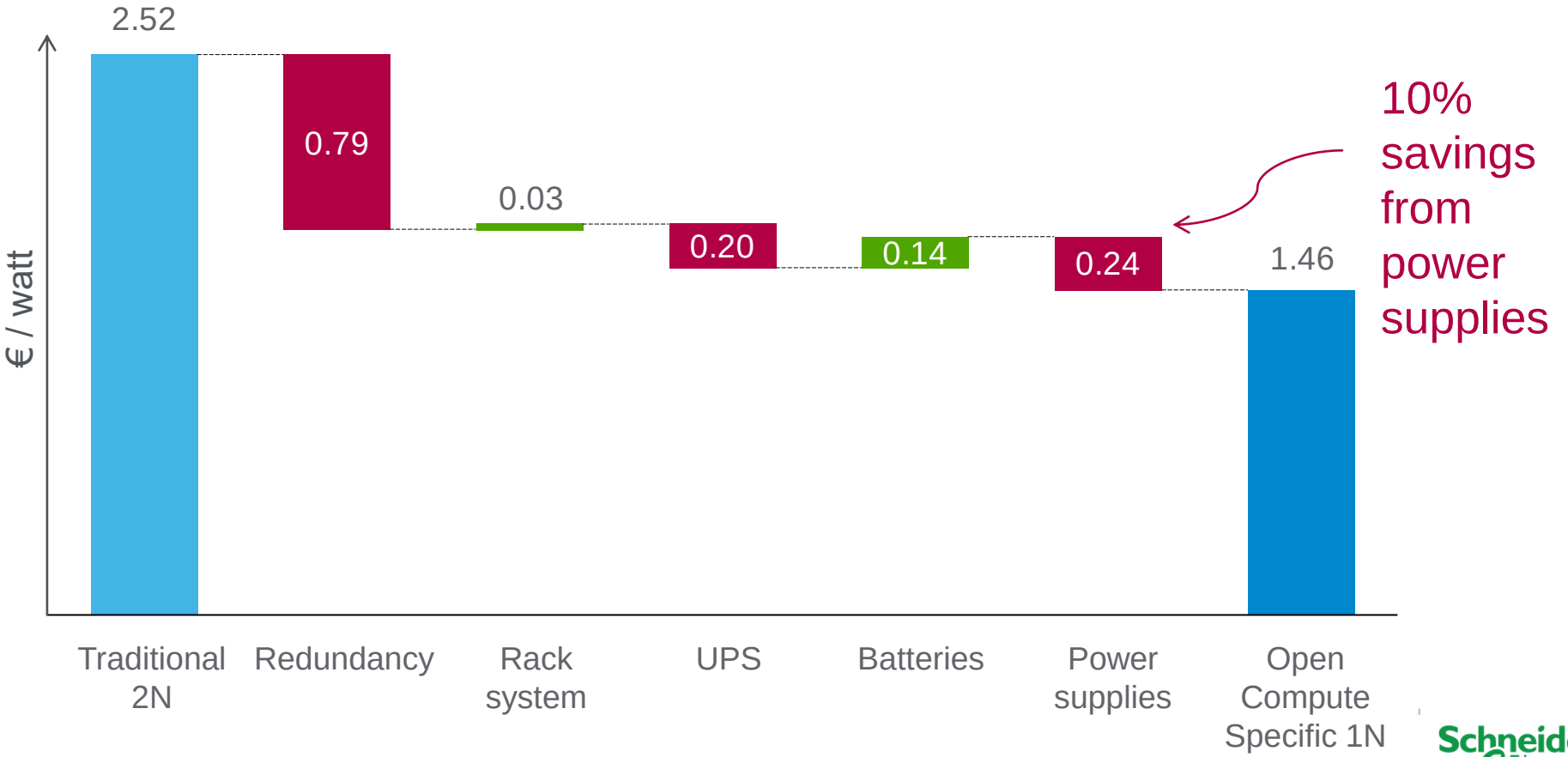
Traditional 2N vs. Open Compute Specific 1N



Traditional 2N vs. Open Compute Specific 1N



Traditional 2N vs. Open Compute Specific 1N

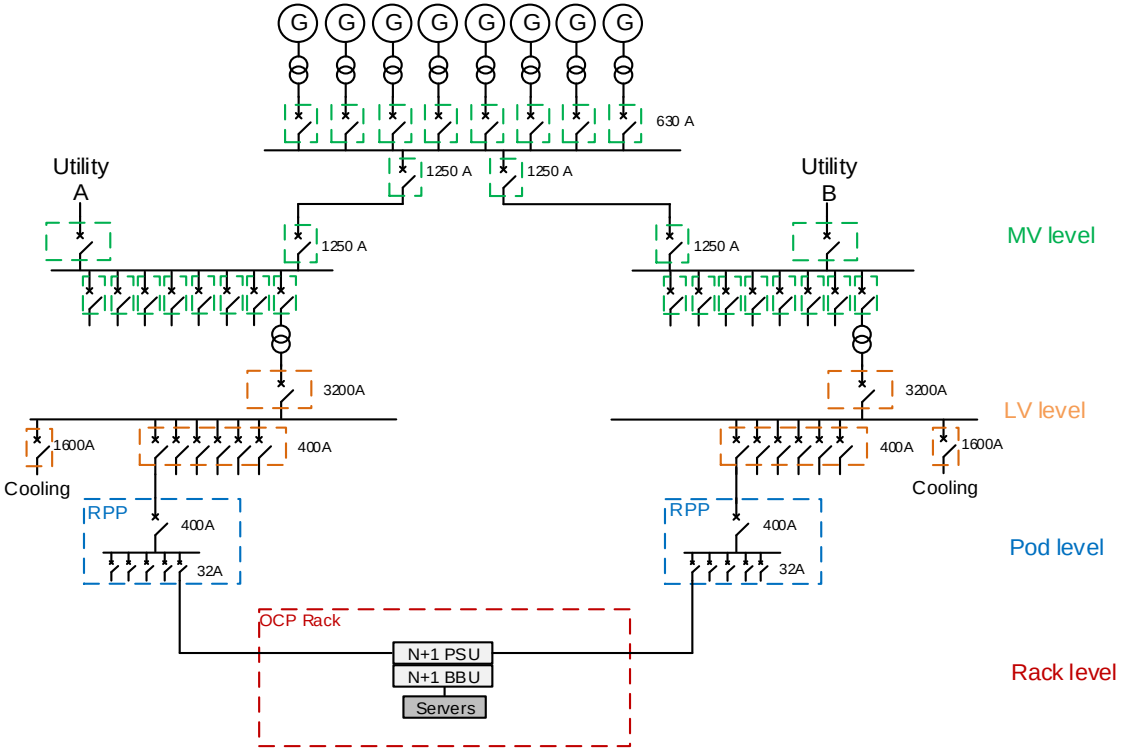


2N (or tier 3) is still important to many data centers

- Redundancy
- Concurrent maintainability

Open Compute Specific 2N architecture

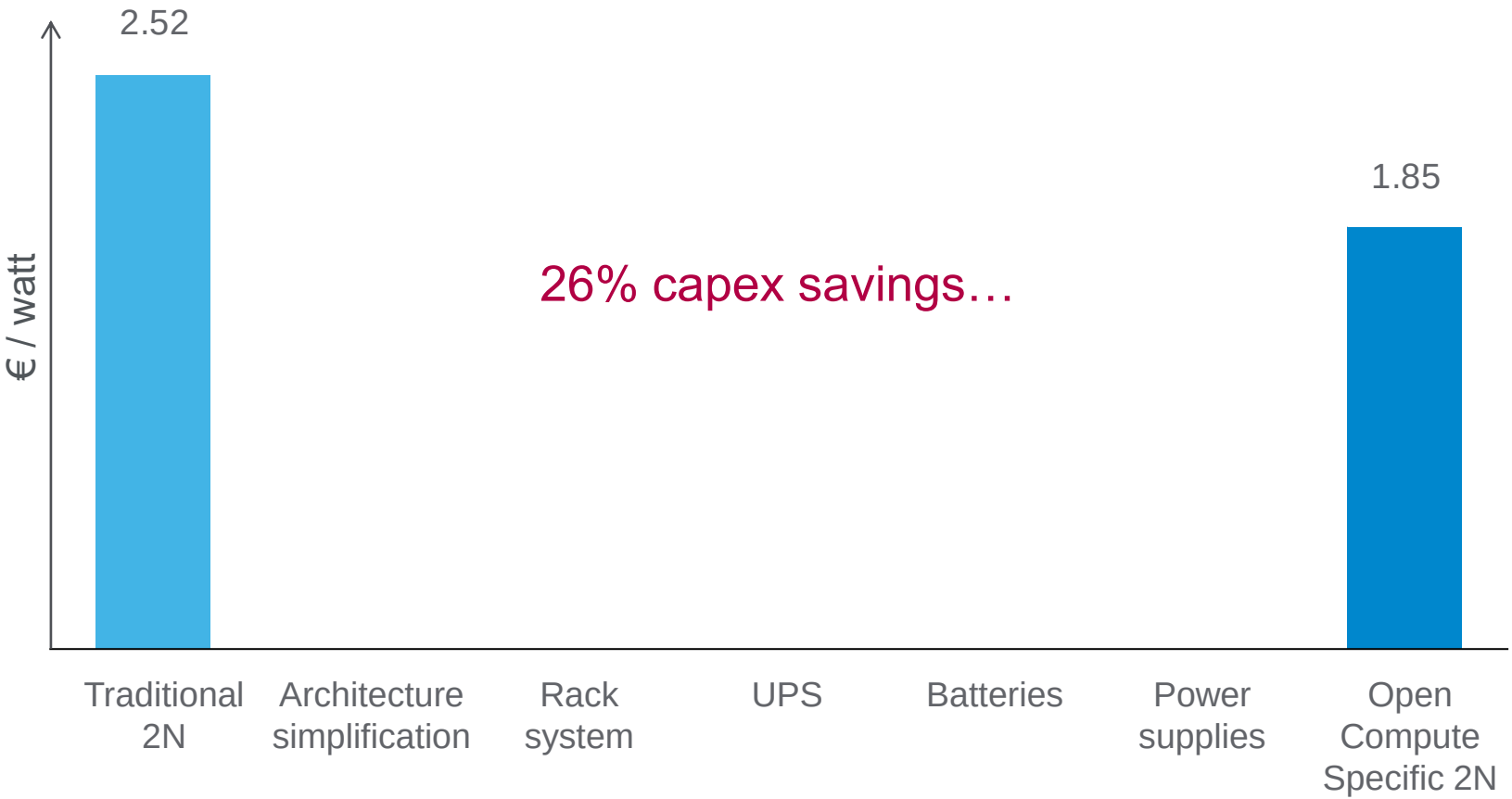
2N simple design to support OCP IT loads



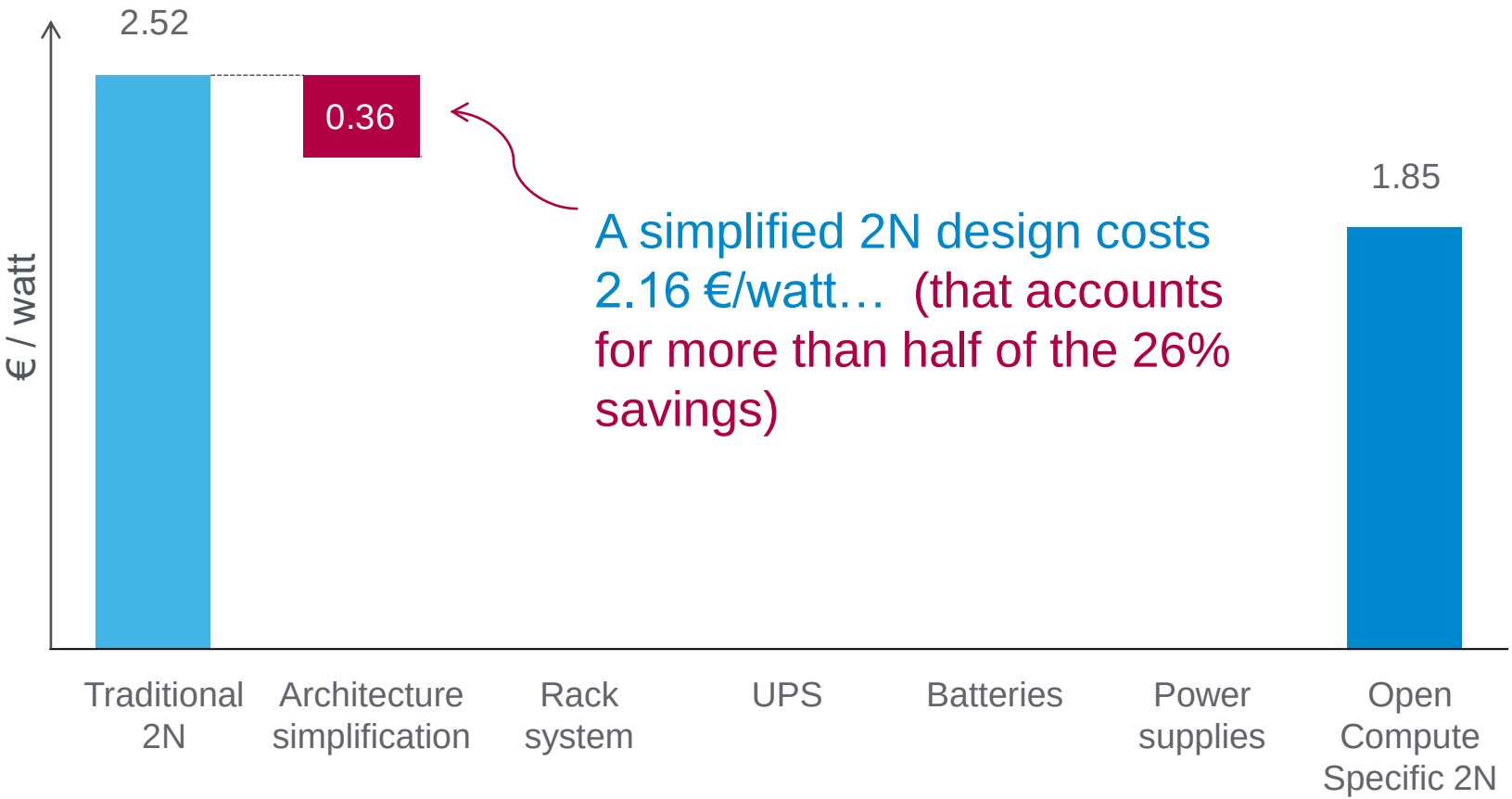
Compared to traditional 2N, this architecture….

- reduces complexity by eliminating unnecessary cross-ties, additional breakers
- saves cost with N+1 batteries and PSUs
- trusts the redundant server power supplies

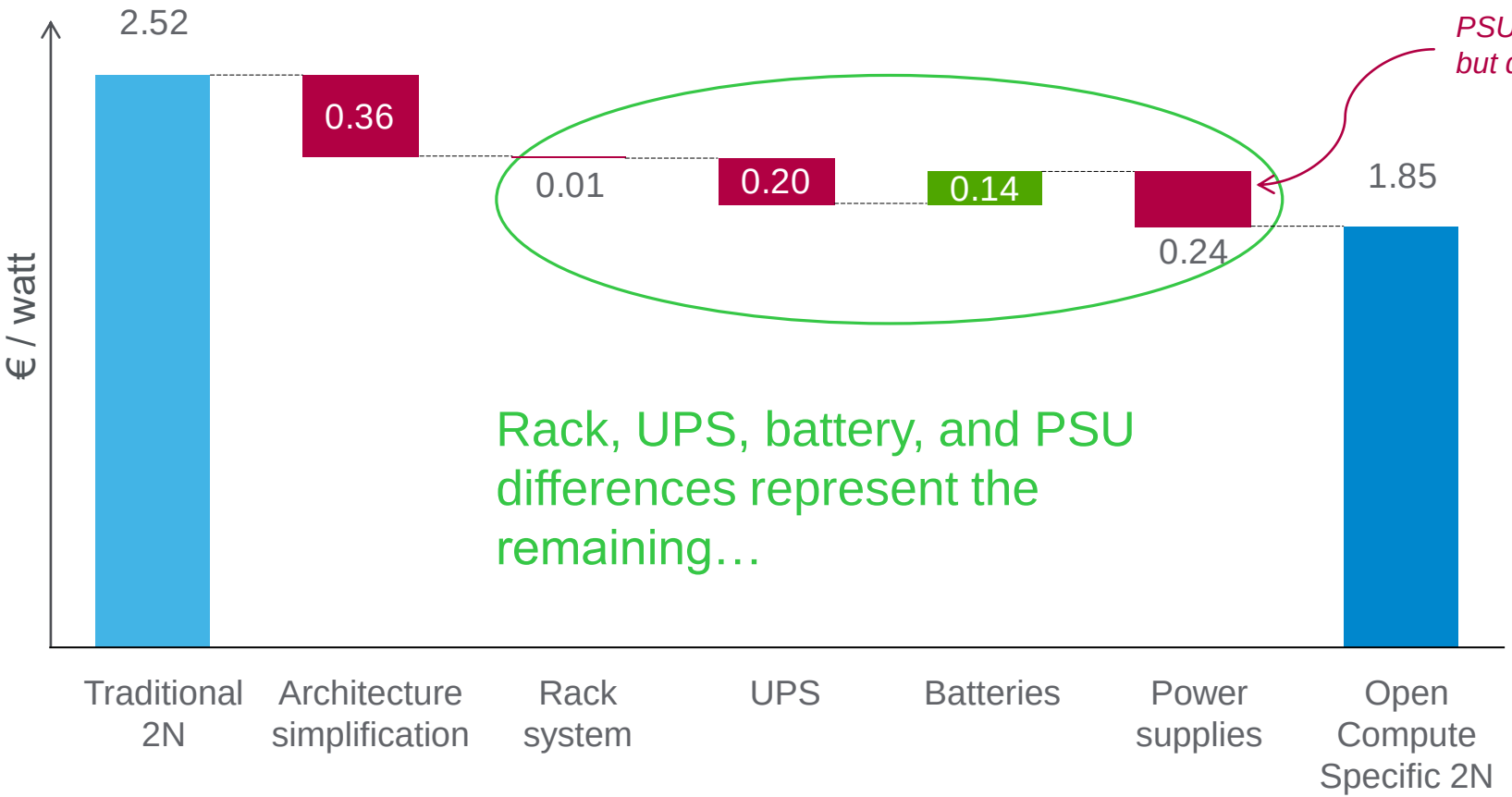
Cost difference of Traditional 2N vs. Open Compute Specific 2N



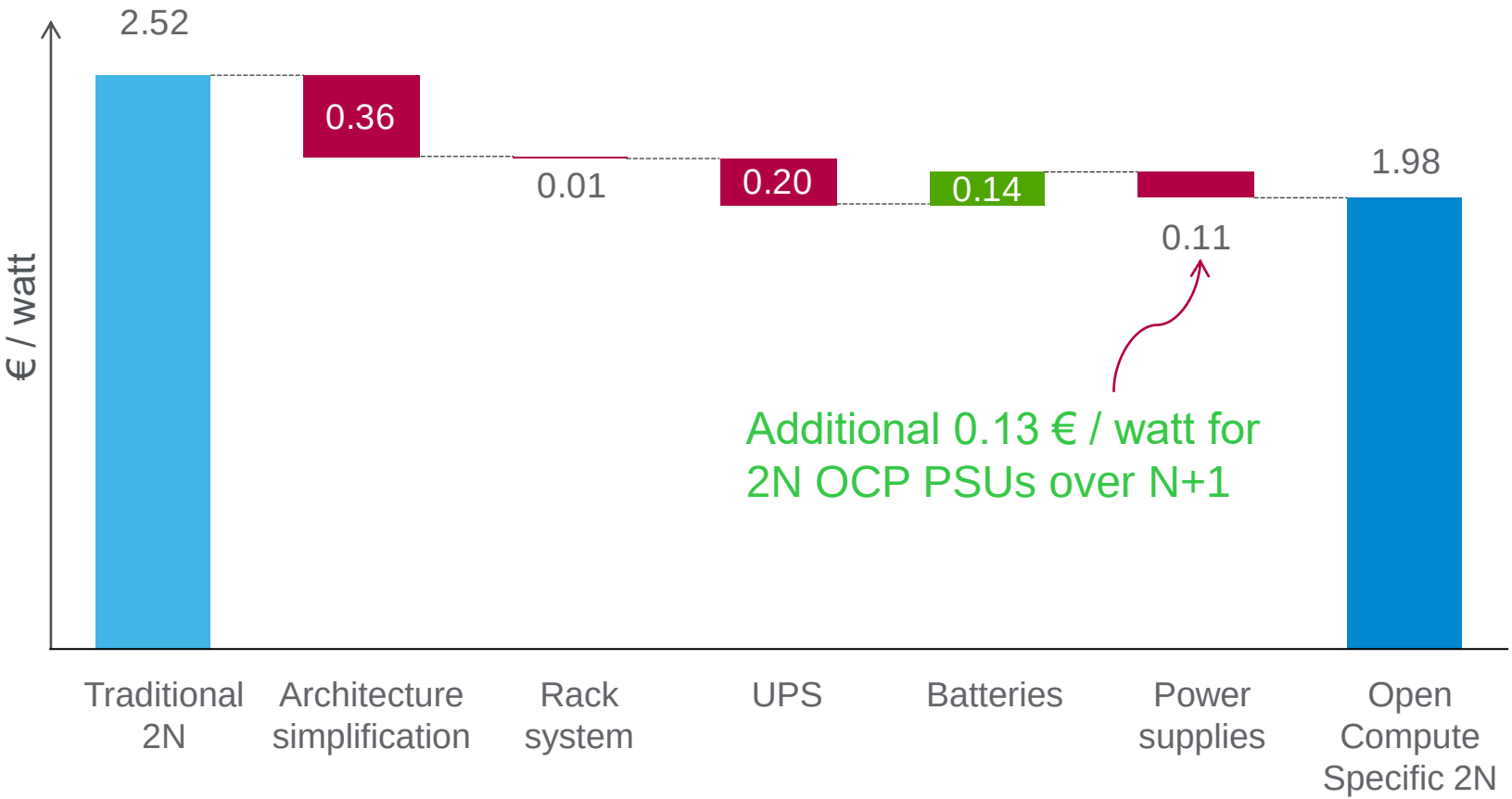
Cost difference of Traditional 2N vs. Open Compute Specific 2N



Cost difference of Traditional 2N vs. Open Compute Specific 2N

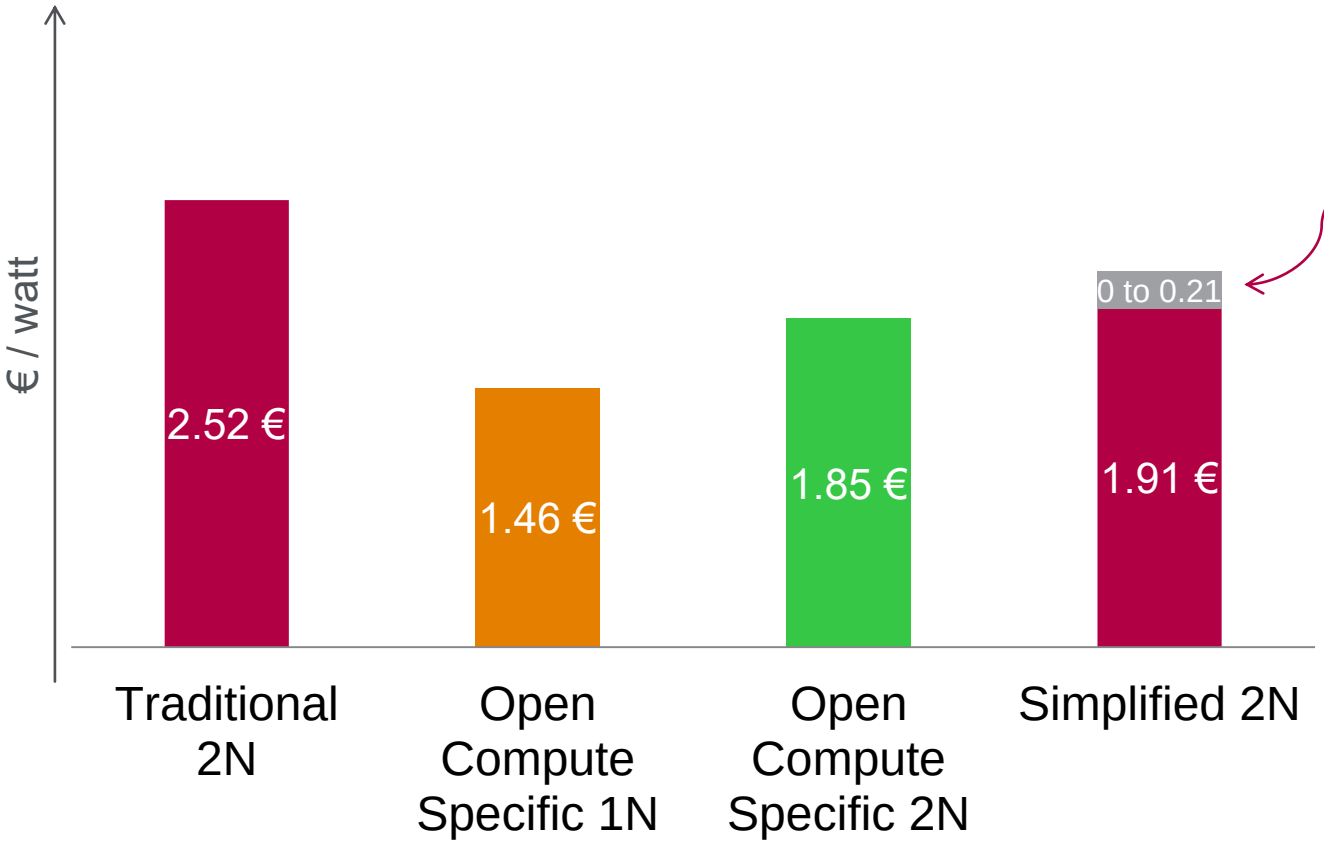


Cost difference of Traditional 2N vs. Open Compute Specific 2N



What if I have a mix of Open Compute and traditional IT loads?

A design that accommodates both types of loads

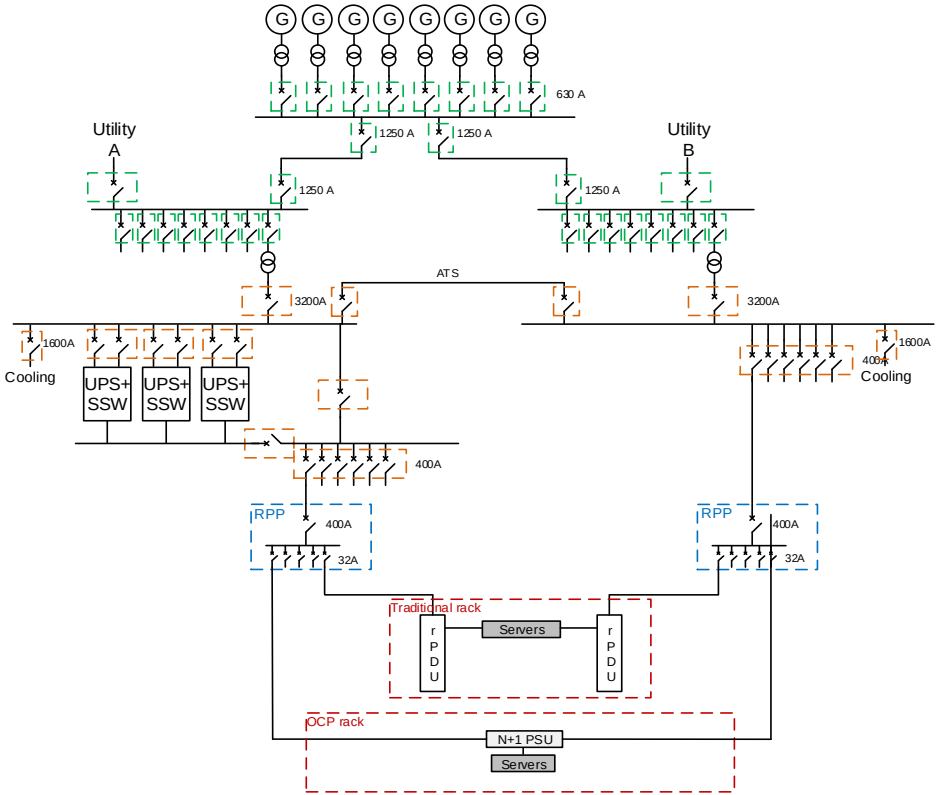


Premium for traditional power supplies (PSUs) depends on mix of loads

Assumes 0.42€ traditional PSU cost per watt of IT load

Example of a Simplified 2N design that accommodates both types of loads

- Flexible architecture that allows for mix of traditional IT loads and OCP loads
- UPS is upstream to support both traditional and OCP loads
- To minimize cost, one power path with UPS, one without
- OCP loads have dual PSUs without BBUs, but this could be an N+1 PSU with dual input.

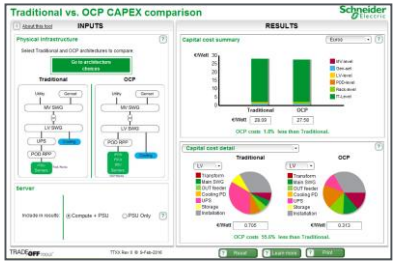


Life Is On Schneider Electric

Freely available resources to help with planning decisions

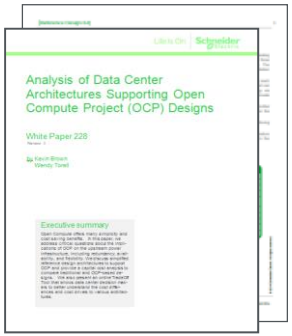
Reference Designs

- Designs to support OCP (Ref Design 101.0, 56MW)
- One-line diagrams, bill of materials, layout drawings
- www.schneider-electric.com/datacenterdesigns



TradeOff Tools

- OCP vs. traditional cost comparison tool
- Li-ion vs. VRLA TCO tool
- tools.apc.com



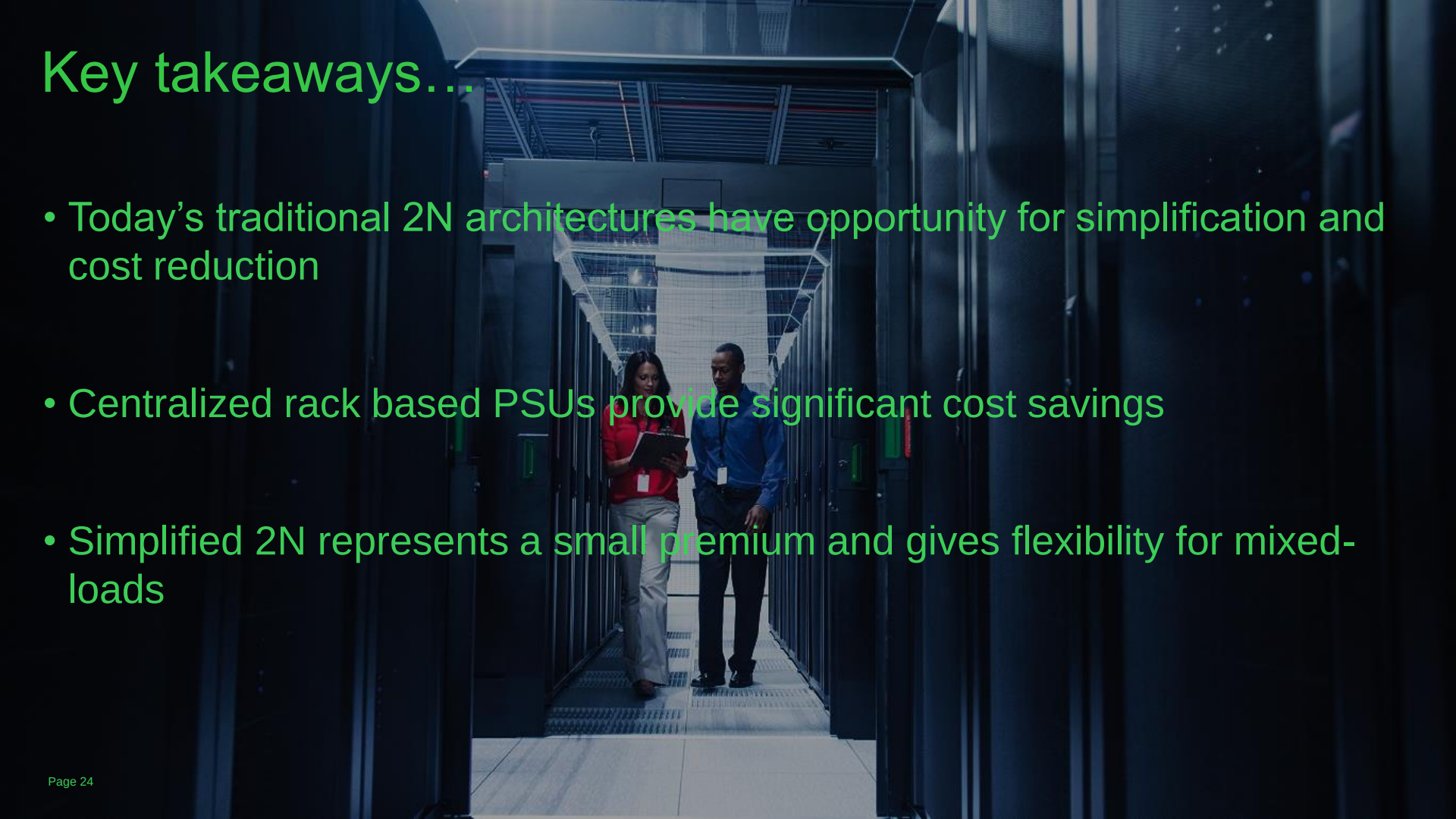
White Papers

- WP228, Analysis of Data Center Architectures Supporting OCP Designs
- WP229, Battery Technology for Data Centers: VRLA vs. Li-Ion
- whitepapers.apc.com

Life Is On Schneider Electric

Key takeaways…

- Today’s traditional 2N architectures have opportunity for simplification and cost reduction
- Centralized rack based PSUs provide significant cost savings
- Simplified 2N represents a small premium and gives flexibility for mixed-loads




OPEN.
FOR
BUSINESS.
OCP
SUMMIT

PSU Assumptions

Variable	Traditional data center	OCP-style data center
PSU price per PSU watt	0.07€	0.08€
PSU shelf price per PSU watt	Not applicable	0.05€
PSU redundancy factor	2	1.17 (5+1) for 1N OCP and mixed-loads 2 for 2N OCP
PSU oversizing factor	3	1.2
PSU price per IT load watt	0.07 x 2 x 3 = 0.42€	(0.08+0.05) x 1.17 x 1.2 = 0.18€ (0.08+0.05) x 2 x 1.2 = 0.31€

PSU cost is a highly sensitive variable...

Our baseline assumption for traditional PSUs:

0.071€ per PSU watt X 2 PSUs per server X 3 PSU oversizing = 0.42€ per IT load watt

Sensitivity analysis:

We varied the PSU oversizing down to 2 and up to 4.5, or 0.28 € to 0.63€ / IT load watt

Battery Assumptions

Variable	Traditional data center	OCP-style data center
Battery type	VRLA	Lithium-ion
Battery run time	5 minutes	4 minutes
Battery placement	Centralized UPS	Rack-based
Battery cost per watt	0.06€ for 1N UPS 0.11€ for 2N UPS	0.17€
Battery shelf watt	Not applicable	0.03€
Operating temperature	25ºC	25ºC

OCP SUMMIT

OPEN.

FOR BUSINESS.