Symmetrical 2-Wire DC Distribution: The best Solution for Data Centers

Dr. Hartwig Stammberger, Eaton,
Chair of the Board of the Open Direct Current Alliance
04 Aug 2025

Abstract

As global energy demands surge – driven by the rapid expansion of data centers and AI applications – power distribution systems must evolve. Symmetrical two-wire Direct Current (DC) systems offer a compelling alternative to traditional three-wire configurations, delivering superior energy efficiency, simplified installation, and enhanced reliability. This whitepaper outlines the advantages of symmetrical DC systems and their role in enabling scalable, sustainable, and simple digital infrastructure.

1 The Growing Challenge

The global data center market is projected to grow from $527 billion in 2025 to $739 billion by 2030, representing a compounded annual growth rate (CAGR) of 6.98% [1]. This growth is driven by increasing demand for cloud computing, AI workloads, and digital services across industries. Key challenges include:

- **Energy Efficiency**: Reducing power loss is essential to maximizing computing output per watt.
- **Reliability**: Complex AC/DC conversion chains and numerous components increase the risk of failure.
- **Installation Complexity**: Frequent AC/DC conversions and three-wire systems require more components, resources, and labor.
- **Operational Control**: Managing multiple voltage levels complicates system stability and monitoring.

Figure 1 Image source: Microsoft Stock Images, used in accordance with the license terms for Microsoft 365 documents.

[1] https://www.statista.com/outlook/tmo/data-center/worldwide

2 The Symmetrical DC Solution

Symmetrical DC systems, as promoted by the Open DC Alliance (ODCA)[2], use only two active conductors: L+ and L-; thus, eliminating the midpoint conductor found in traditional three-wire systems; Figure 2 shows the schematic. The available maximum voltage is the same as in a three-wire system. **This streamlined architecture offers multiple benefits**:

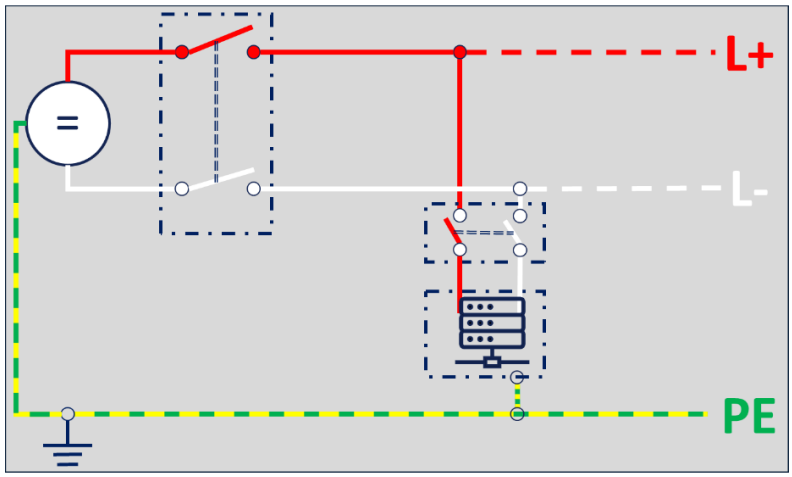

Figure 2 Two-wire symmetrical DC system of Open DC Alliance

1. **The ecosystem is available**
   - It is based on **standard industrial products.**
   - Commercial **applications already exist.**
2. **Efficiency**
   - **Resources**: 33% reduction in conductor material (copper or aluminum) by eliminating the midpoint wire compared to a three-wire DC installation.
   - **Energy**: Operation at a higher voltage level (800 V vs. 400 V) **reduces the power loss for electricity distribution by 75%** ($\boldsymbol{P_{\text{loss}} = i^2 \cdot R}$).
3. **Reliability**
   - **Fewer components** mean fewer potential points of failure.
   - No midpoint conductor, connectors, or terminals to maintain or replace.
4. **Simplified Installation**
   - Only two conductors to wire, **reducing installation time and risk of errors**.
   - **Protection devices are simpler** – only two poles required.
5. **Operational Simplicity**
   - **Single voltage level** simplifies power management and monitoring.
   - Easier integration of renewable energy sources, battery backup storages and loads. They also only use one single voltage each.

3 Conclusion

Symmetrical DC systems are available and **have been running for years in industrial environments**. They are an **easy, cost-efficient, and simple** way towards a more efficient, reliable, and scalable power distribution in data centers and other high-demand environments. By reducing material use, minimizing energy losses, and simplifying operations, they align perfectly with the goals of the energy transition and digital sustainability.

For more information, visit the Open DC Alliance at https://odca.zvei.org.

[2] https://odca.zvei.org/