**Feasibility Report: Upgrading from SiC431 (87% Efficiency) to SiC450 (95% Efficiency)**

**Assuming 24/7 Continuous Operation**

**1. Introduction**

This report evaluates the technical and economic feasibility of upgrading a buck converter design from using the SiC431 IC (87% efficiency) to the SiC450 IC (95% efficiency). The application assumes a 1.2 V, 20 A output with continuous 24/7 operation. The analysis includes energy losses, thermal benefits, and return on investment based on IC price differences.

**2. System and Operation Assumptions**

|  |  |
| --- | --- |
| Parameter | Value |
| Output voltage Vout ​ | 1.2 V |
| Output current Iout​ | 20 A |
| Input voltage Vin​ | 12 V |
| Efficiency (SiC431) | 87% (0.87) |
| Efficiency (SiC450) | 95% (0.95) |
| Operation time | 24 hours/day |
| Operation days per year | 365 days/year |
| Switching frequency | 500 kHz |

**3. Power Calculations**

**3.1. Output Power**

**3.2. Input Power and Losses**

|  |  |  |
| --- | --- | --- |
| Metric | SiC431 | SiC450 |
| Input Power |  |  |
| Power Loss | 3.59 W | 1.26 W |
| Power Saved | — | **2.33 W** less |

**3.3. Daily and Annual Energy Loss**

|  |  |  |
| --- | --- | --- |
| Metric | SiC431 | SiC450 |
| Daily Loss (Wh) |  |  |
| Annual Loss (Wh) | 86.16⋅365=31,436.4 |  |
| Annual Loss (kWh) | 31.44 kW | 11.04 kW |
| Annual Energy Saved | — | **20.4 kW** |

**3.4. Cost Savings (Assuming €0.30/kWh)**

**4. Thermal Considerations**

* The SiC450 reduces power loss by 2.33 W.
* This can lower PCB surface temperatures, reduce cooling requirements, and potentially improve product reliability and lifespan.
* For dense or passively cooled systems, the thermal advantage may justify the upgrade independently of energy cost.

**5. Return on Investment**

|  |  |
| --- | --- |
| Item | Value |
| Typical price difference (SiC450 – SiC431) | ~6.5€–2.5€ |
| Annual energy savings | ~6.12 € per unit |
| Simple payback time | **7–8 months** |
| Net gain after 1 year | ~2.12€ |
| Net gain after 3 years | ~14.36€ (per unit) |

The higher efficiency of the SiC450 becomes financially favorable in less than one year under 24/7 operation.

**6. Summary Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Metric | SiC431 | SiC450 | Gain (SiC450 – SiC431) |
| Efficiency | 87% | 95% | +8% |
| Input Power | 27.59 W | 25.26 W | –2.33 W |
| Power Loss | 3.59 W | 1.26 W | –2.33 W |
| Yearly Energy Waste | 31.44 kWh | 11.04 kWh | –20.4 kWh |
| Annual Energy Cost (at €0.30) | 9.43€ | 3.31€ | **6.12** € **saved** |
| Thermal Load | High | Lower | notable reduction |
| Payback Period | — | ~7-8 months | — |

While the SiC450 offers higher efficiency and reduced thermal loss, it comes at a slightly higher component cost—typically around **€4.00 more** than the SiC431. However, under continuous 24/7 operation, the **annual energy savings (~€6.12 per unit)** recover this cost in approximately **7.8 months**. This results in a **net gain of about €2.12 after one year**, and **~€14.36 after three years.** Therefore, even after factoring in the IC price difference, the upgrade remains **financially and technically beneficial** for systems with **long operating hours or thermal constraints.**