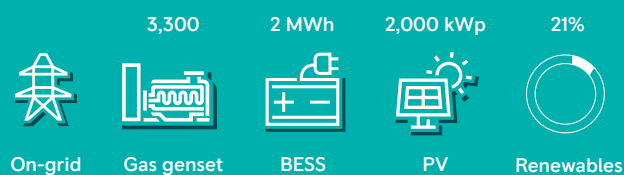




Use case I Germany Industrial Manufacturing

Configuration for the self-sufficiency case



Benefits: microgrid vs. conventional

CAPEX (in € millions)



OPEX (in k€/p.a.)



Levelized cost
of energy (€/kWh)

4

Years

Break even compared
to conventional costs

HOW TO CUT ENERGY COSTS BY UP TO 30%

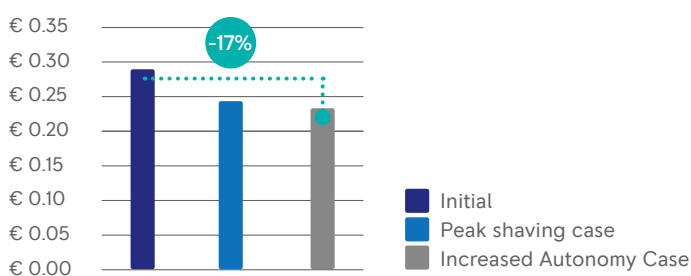
Two microgrid scenarios for peak shaving and increased grid autonomy

Executive summary

For energy intensive businesses such as manufacturing plants, saving on the energy bill can be a decisive factor for commercial competitiveness. This German manufacturing use case provides two scenarios on how to significantly reduce energy costs:

- by producing and using cheaper energy from photovoltaics (PV) and a battery energy storage system (BESS) for up to 23% savings (peak shaving case)
- by adding gas gensets to achieve grid independence and highest savings of up to 30% (self-sufficiency case)

Levelized cost of energy (€/kWh)



What:

Manufacturing plant with three-shift operations leading to a load profile with a daily peak during office hours. Annual electricity demand 37.000 MWh and peak electricity demand 9.3 MW.

Where:

Germany

Why:

Germany has among the highest rates for on-grid energy in the world. Energy savings of up to 30% can be a decisive factor for commercial success.

Main Benefits:

- Energy cost optimization
- Reduction of CO₂ emissions
- Increased grid independence



A Rolls-Royce
solution

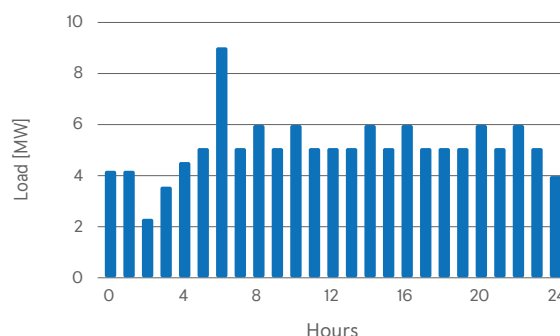
OPTIMIZING ENERGY COSTS WITH MICROGRIDS

To demonstrate the potential for savings with microgrids, we have calculated two business case scenarios for a manufacturing plant in Germany using HOMER Grid® simulation software.

Continuous plant operation

Because the manufacturing plant in this example employs three shift operations, the load profile is continuous with a peak during office hours. As a result, uninterrupted electric power is vital for the success of the plant's operations and a strong reliability on the energy system is just as important as the costs of the energy itself. In this example, reliability is provided through the continuity of energy guaranteed from a back-up grid connection.

Daily load profile



Initial situation

Manufacturing plant in Germany.
All of the power is sourced from the grid.

Grid power: 100%

Annual electricity demand: 37,000 MWh

Peak electricity demand: 9.3 MW

Levelized cost of energy*

€ 0.29 per kWh

Costs per year:

€ 254k

Microgrid Solution:
Peak shaving case

-23% OPEX

Energy cost savings from PV combined with peak shaving by the battery energy storage system (BESS).

Grid power: 80%

PV plant: 2.0 MWp

BESS: 1 MW / 1 MWh

Levelized cost of energy*

€ 0.248 per kWh

Costs per year **Savings per year:**

€ 200k € 54k

Microgrid Solution:
Increased Autonomy Case

-30% OPEX

Gas is a complementary energy source, with additional savings from PV. The energy storage system optimizes the operation of the gas genset. The system is grid-connected for the remaining demand.

Grid power: 60%

PV plant: 2.0 MWp

BESS: 1 MWh / 2 MW

Gas gensets: 3.3 MW

Levelized cost of energy*

€ 0.240 kWh

Costs per year: **Savings per year:**

€ 180k € 74k

* Levelized cost of energy (LCOE) – the average, discounted cost of electricity (including CAPEX, OPEX and inflation, discounted at 8%) over 20 years

RESULTS OF THE USE CASE

For this use case, we compared two microgrid scenarios with a conventional case of on-grid power.

Investing in a microgrid

Conventional case

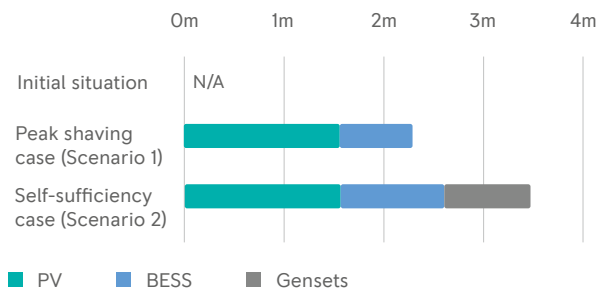
For the manufacturing plant in our example, investing less than one year of the energy bill allows for savings that will pay back the investment within 4 years.

Microgrid solution

The microgrid solution involves PV solution of 2000 kWp and a BESS of 1000 kWh. When considering energy optimization and improving the carbon footprint by medium capital investment, this configuration represents an optimal solution.

Total capital investment: € 2.34m

CAPEX (in €m)



Yearly operating savings

The energy costs of the manufacturing plant in the initial situation consists of following components: energy consumption charges (generation costs, grid costs, taxes and levies) and demand charges.

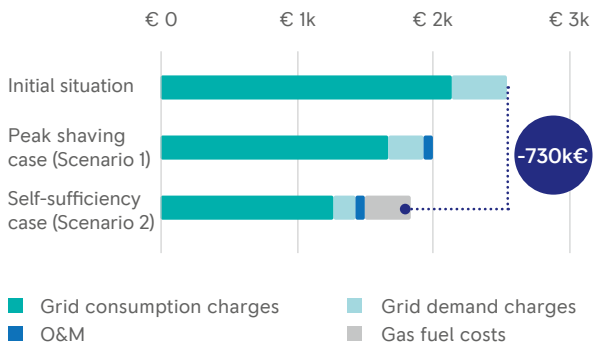
In the peak shaving case, the PV panels provide a reduction in the grid consumption charges, while the BESS reduces the peak load, thereby reducing demand charges.

This amounts to total savings of € 54k per year.

In the increased autonomy case, only a reduced grid consumption charge is due because a major share of the energy is generated on site. The new bulk of the costs comes from gas usage.

Total savings: € 74k per year.

OPEX (in k€/p.a)



Payback period

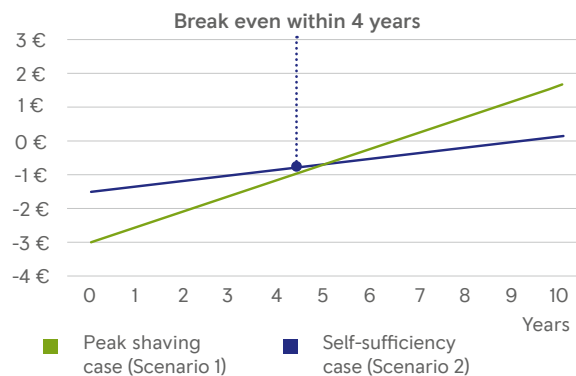
In scenario 1 (Peak shaving case), the manufacturing plant invests in PV for low-cost renewable energy and energy storage through peak shaving.

The payback period is 4.2 years.

In scenario 2 (Self-sufficiency case), the manufacturing plant invests in gas gensets as well as PV and energy storage to become entirely self-sufficient.

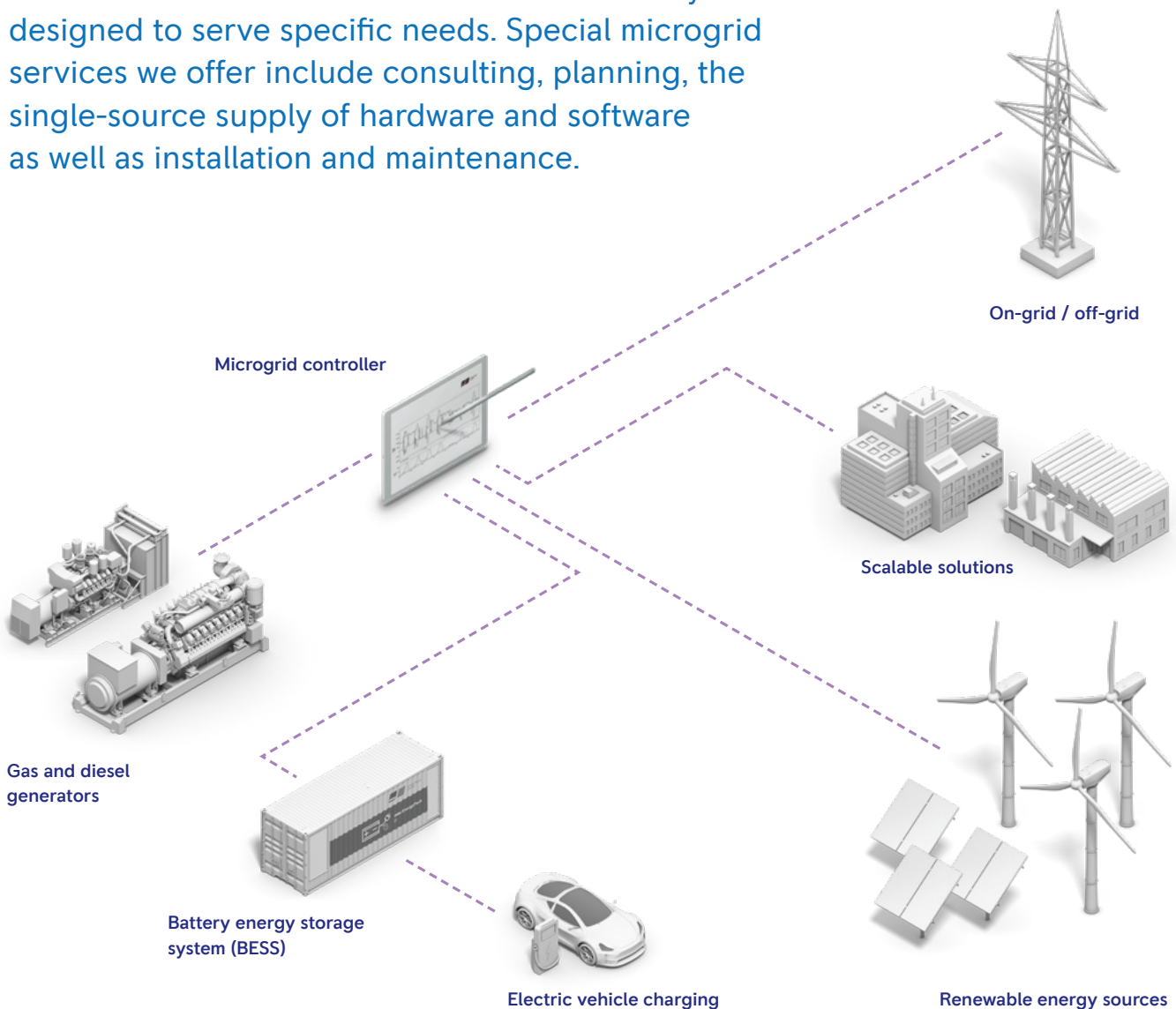
The payback period is 4.8 years.

CAPEX and savings (in €m)



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