SWS Power Solutions & SWS-PowerBox®

Net-zero cool chain logistics on rail with the SWS-PowerBox®

April 24

Table of Contents

1. Company
2. Cold Chain Transport
3. Product & Technology
4. Transport Examples

WHO WE ARE

Modern logistics requires 24/7-monitoring, using all modes of transport, and the most resource-efficient and cost-effective operation possible. In refrigerated logistics, energy efficiency is the key to success.
Until now, there has been no solution to these challenges for transport by rail.

The origins of **SWS Power Solutions** lie in a **group of experts** from various fields related to logistics.

Driven by the problem of no solution, we have developed the **SWS-PowerBox®** over the last several years. It is a unique, global and almost maintenance-free system, which enables climate-neutral energy supply of cooling units on rail freight wagons as well as their complete digital monitoring.

With the **SWS-PowerBox®**, the shift of climate-neutral refrigerated logistics to rail can now begin worldwide.

1. Company

COMPANY:

- **Headquarter:** Graz, Austria
- **Foundation:** October 28th, 2020
- **Company:** SWS PS Power Solutions
- **Legal form:** GmbH (Limited)

- **IP protection rights:**

  ⇨ International patent for the SWS-PowerBox®

  ⇨ Trademark rights SWS-PowerBox®

OUR TEAM:

Patrick Sluga
CEO

Hannes Sobitsch
COO

Beat Wegmüller
ENGINEERING & TECHNICAL DEVELOPMENT

Hanspeter Schweizer
ENGINEERING & TECHNICAL DESIGN

Annamaria Prgic
PROJECT MANAGER

Sebastian Bichler
PROJECT MANAGER

1. Company

PRODUCTS:

RAIL

SWS-PowerBox®

⇨ since 2021

rXp-InterRegio Cargo

⇨ coming in 2025

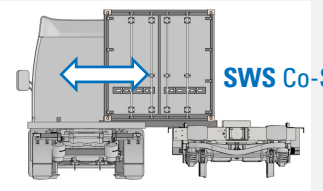
ROAD

SWS-PowerDrive

⇨ coming in 2024

SWS-CoSlider

⇨ coming in 2024



PARTNERS:

- **ATP Hydraulik AG**, Switzerland
  ATP HYDRAULIK ⇨ Manufacturer
- **Phoenix Battery Corporation**, Taiwan
  昇陽電池 PHOENIX BATTERY CORPORATION ⇨ Battery supplier
- **Zugkraft-kN GmbH,** Austria
  Zugkraft-kN Digitalisierung nach Maß ⇨ Maintenance software
- **optiMEAS GmbH**, Germany
  OPTIMEAS ⇨ Device software / Monitoring

Challenges of the cold chain transport

- Increasing demand of refrigerated transport but lack of answers to environmental pollution problems, such as
  - CO_2 emission
  - tire wear
  - noise pollution
- Reputational risk for providers as no ESG conformity can be met with current solutions
- High cost in providing refrigerated transport services
  - ⇨ LCC: fuel price and maintenance cost
  - ⇨ CO_2 emission cost
- Refrigerated transport demand cannot be met by road transport due to lack of truck drivers
- Lack of real time information on reefer status, utilization, etc.

- SWS-PowerBox® is an innovative 100% eco-friendly solution:
  - Use of existing kinetic energy ⇨ no diesel = no CO_2 emission
  - No tire wear = no microplastic
  - No noise pollution
- SWS-PowerBox® is an invention which fulfills all the ESG criteria and can be seen as a 100% green investment.
- Utilisation of the SWS-PowerBox® kinetic energy results in an LLP*:
  - ⇨ With **low** maintenance costs & **long** maintenance **intervals**
  - ⇨ **Without** fuel consumption **=** no emissions cost
- No lack of staff/drivers ⇨ **1 train = 1 driver = several wagons**
- Every SWS-PowerBox® is equipped with 24/7 monitoring system

*long life product

2. Cold chain transport

How is refrigerated cargo transported especially on rail today?

NOW

The majority of cold chain transport today takes place via sea and road.

Air transport is used only for very time-critical and expensive goods such as pharmaceuticals.

SHIFT DUE

The SWS-PowerBox® removes each of **these obstacles** opening up refrigerated rail transport.

FUTURE

Today, railroads are of minor importance for the transport of temperature-controlled goods.

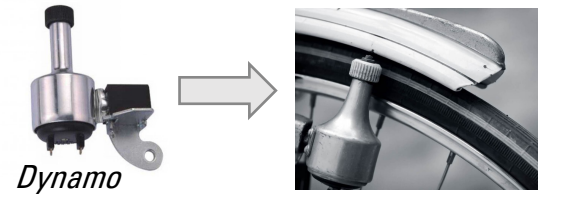
Diesel generators of various types serve as a source of energy.

The high operational expense, regulations, and the heavy environmental impact have made refrigerated transport by rail unattractive until NOW.

The basic principle of SWS-PowerBox®

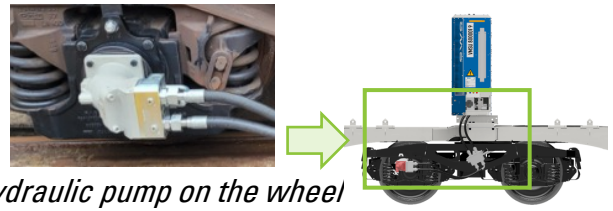
GENERATOR

Like a bottle dynamo used on bicycles from the beginning of the 20th century, SWS-PowerBox® is using **existing kinetic energy to produce electricity**



Dynamo

Our "dynamo" is a **hydraulic axle generator**

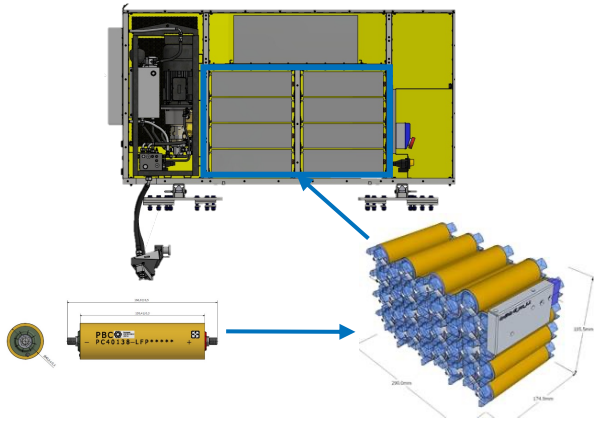


Hydraulic pump on the wheel

STORAGE

The still existing problem of bicycle dynamos only providing electricity during movement (acceptable on a bicycle as it rarely needs light while not in motion), is addressed by adding a **rechargeable battery** storage to the system

Converted existing kinetic energy can now be **stored**

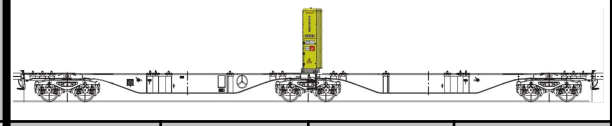
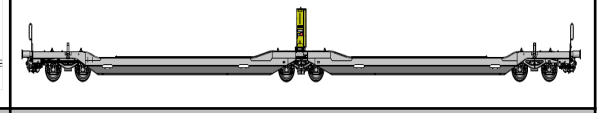
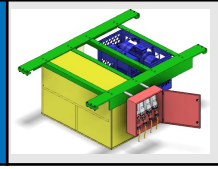


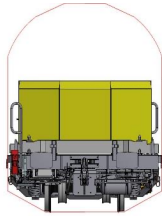
CURRENT SUPPLY

Therefore, **movement energy** and **continuously recharged** batteries **ensure electricity** needed to provide cooling for refrigerated transport units

SWS-PowerBox® is a **net-zero, rechargeable power bank** on a freight wagon

Product overview

Product		Cooling unit			Wagon type				
									
		Reefer-Container	Swap bodies	Cool trailer	60' Flat wagon	80' Flat wagon	90' Flat wagon	104' Flat wagon	Pocket Wagon
SWS-PowerBox® V-4.2 NP		~	~	~	x	✓	✓	✓	✓
SWS-PowerBox® V-4.2 HP		~	~	✓	x	✓	✓	✓	✓
SWS-PowerBox® V-5.0 UF/NP		✓	✓	x	✓	✓	✓	✓	x

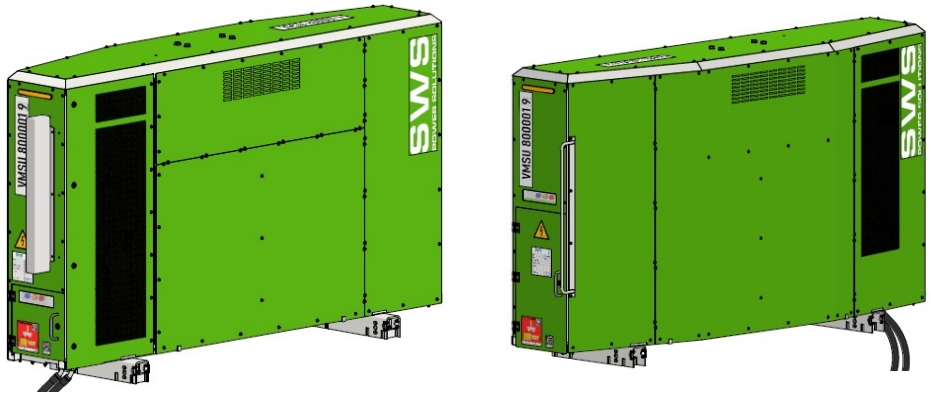


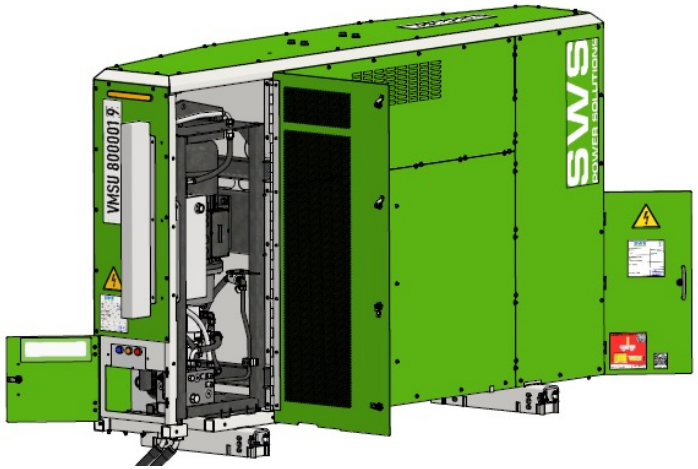
⇨ **Clearance Gauge G1**

✓ *Ideal set-up*
~ *Possible*
x *Not Compatible*

Model design / basic specifications

SWS-PowerBox® V-4.2 NP (Normal-Power)





SWS E-Box:	Steel construction with painted exterior panelling
Power output:	• 3x400 V (for the cooling units) • 1x24 V for additional wagon sensors
Power input:	18.0 kW at 120 km/h
Load socket outlets:	• 4 x CEE 32A 4-pole 3h
Charging socket:	• 2 x type 2 EN 62196 for mains operation
Operating system:	• Standard interval operation → Parallel operation with up to 2 containers
Power storage:	High-performance lithium iron phosphate batteries ($LiFePO_4$) 9.0 kWh battery strings
Storage capacity:	Modular design from 18 to 72 kWh with the SWS 9.0 kWh battery strings
Power generation / consumption:	Via recuperation during the journey or via the grid in the terminal or railway siding
Recuperation capacity:	From the wheelset hydraulic pump from 4.5 to 18.0 kW from 30 km/h to 120 km/h
Mains charging mode:	With 10.0 kW mains charger
Mounting on the wagon:	On centre bogie for articulated wagons Wagon types: 80' / 90' / 104' standard wagon
Weight:	1,835 kg (63 kWh), 1,923 kg (72 kWh) – dependent on the number of batteries installed

Model design / basic specifications

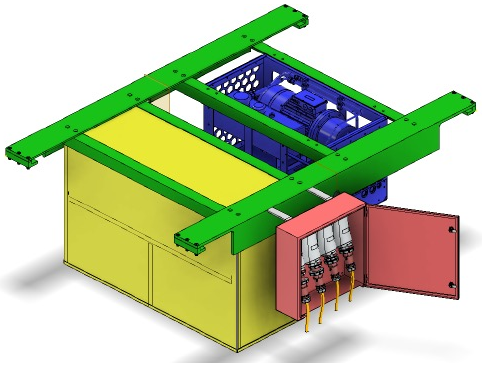
SWS-PowerBox® V-4.2 HP (High-Power)

SWS E-Box:	Steel construction with painted exterior panelling
Power output:	• 3x400 V (for the cooling units) • 1x24 V for additional wagon sensors
Power input:	**18.0 kW maximum at 80 km/h**
Load socket outlets:	• 4 x CEE 32A 4-pole 3h
Charging socket:	• 2 x type 2 EN 62196 for mains operation
Operating system:	• **Standard parallel operation 2 containers** → **Interval up to 4 containers**
Power storage:	High-performance lithium iron phosphate batteries ($LiFePO_4$) 9.0 kWh battery strings
Storage capacity:	Modular design from 18 to 72 kWh with the SWS 9.0 kWh battery strings
Power generation / consumption:	Via recuperation during the journey or via the grid in the terminal or railway siding
Recuperation capacity:	From the wheelset hydraulic pump from 4.5 to 18.0 kW from 30 km/h to 140 km/h
Mains charging mode:	With 10.0 kW mains charger
Mounting on the wagon:	On centre of a bogie for flat wagons Wagon types: **Pocket wagon for cool trailers**
Weight:	1,835 kg (63 kWh), 1,923 kg (72 kWh) – dependent on the number of batteries installed

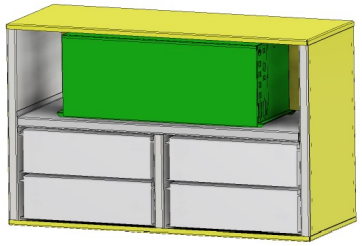
Model design / basic specifications

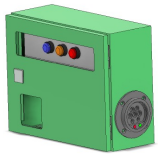
SWS-PowerBox® V-5.0 UF/NP (Normal-Power)

SWS-PowerBox® V-5.0 UF

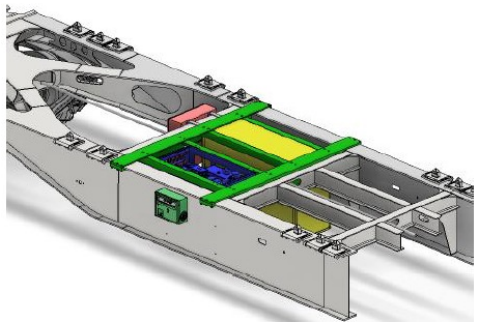


SWS E-Box with control unit PCU-30 and 4 battery strings

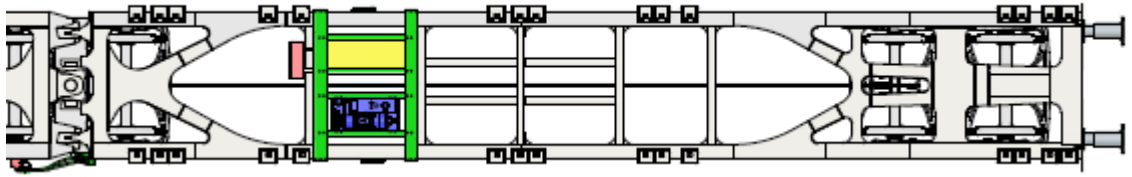




Operating and charging socket box



Mounting position on the wagon

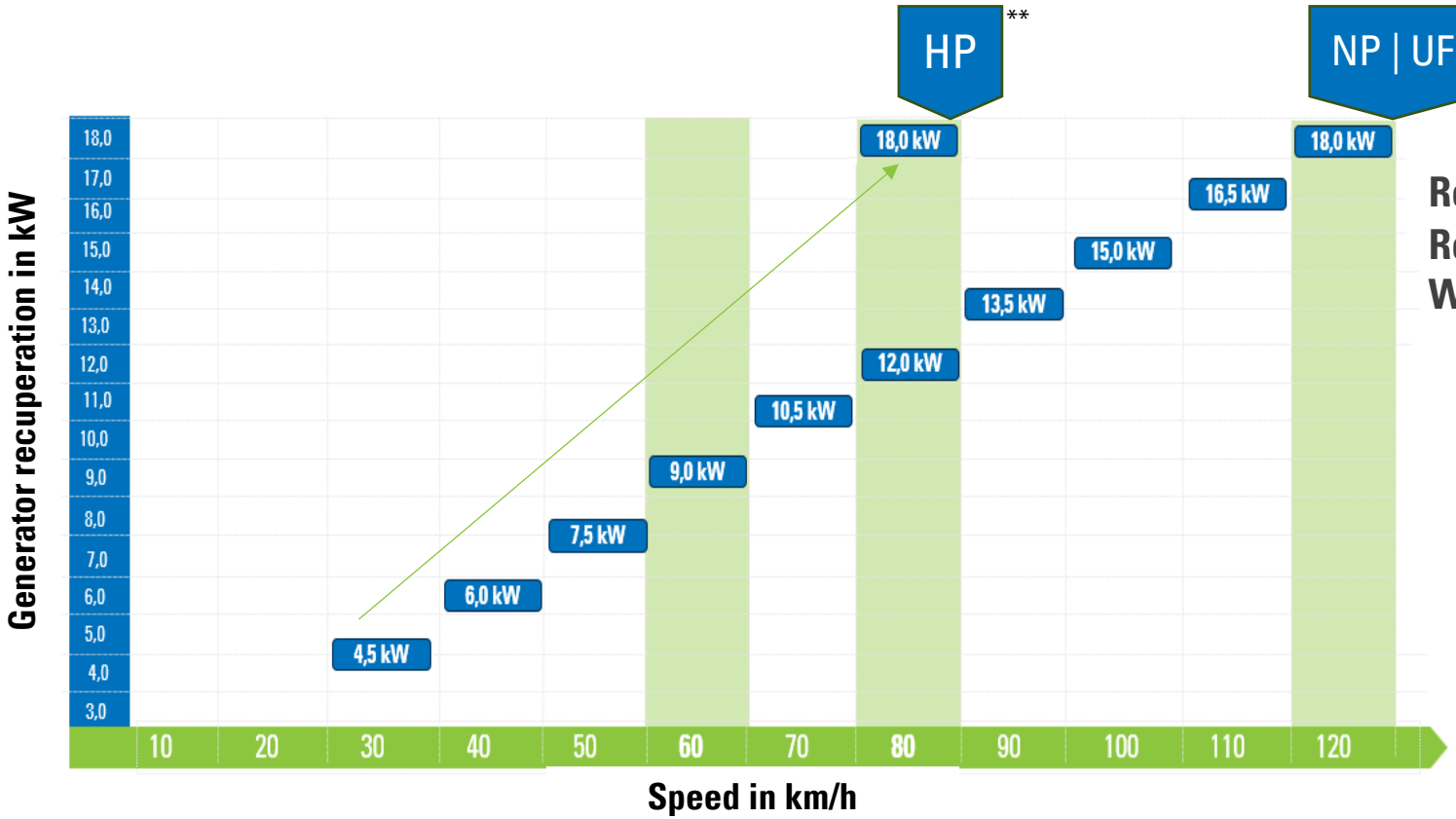


Note: The following technical depictions are schematic representations, subject to change.

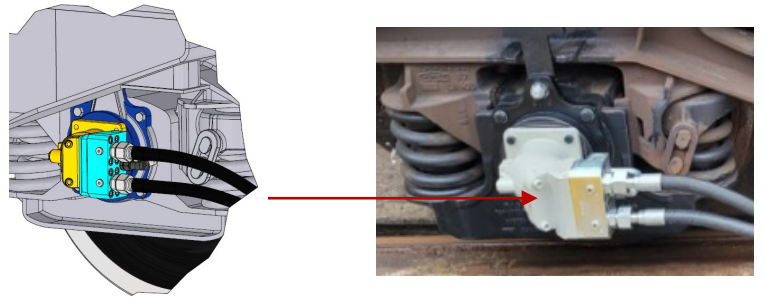
SWS E-Box:	Steel construction with painted external panelling
Power output:	• 3x400 V (for the cooling units) • 1x24 V for additional wagon sensors
Power input:	18.0 kW maximum at 120 km/h
Load socket outlets:	• 4 x CEE 32A 4-pole 3h
Charging socket:	• 2 x type 2 EN 62196 for mains operation
Operating system:	• Standard interval operation → Parallel operation with up to 2 containers
Power storage:	High-performance lithium iron phosphate batteries ($LiFePO_4$) 9.0 kWh battery strings
Storage capacity:	Modular design from 18 to 36 kWh (optionally up to 72 kWh) with the SWS 9.0 kWh battery strings
Power generation / consumption:	Via recuperation during the journey or via the grid in the terminal or railway siding
Recuperation capacity:	From the wheelset hydraulic pump from 4.5 to 18.0 kW from 30 km/h to 120 km/h
Mains charging mode:	With 10.0 kW mains charger
Mounting on the wagon:	Underfloor on the wagon body Wagon types: 60' / 80 / 90' / 104' standard wagons
Weight:	App. 950 kg

Recuperation by axle generator

Recuperation (power supply) while driving for battery charging and cooling unit operation



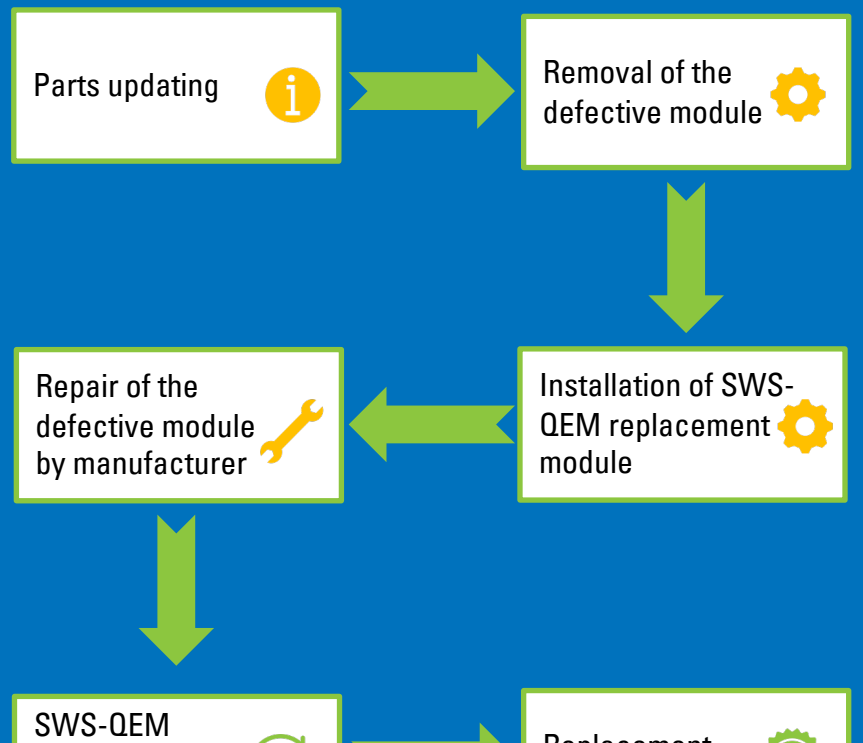
Recuperation power: 4,5 – 18 kW
Recuperation time: possible from 30 km/h
Wheel diameter: < 920 mm



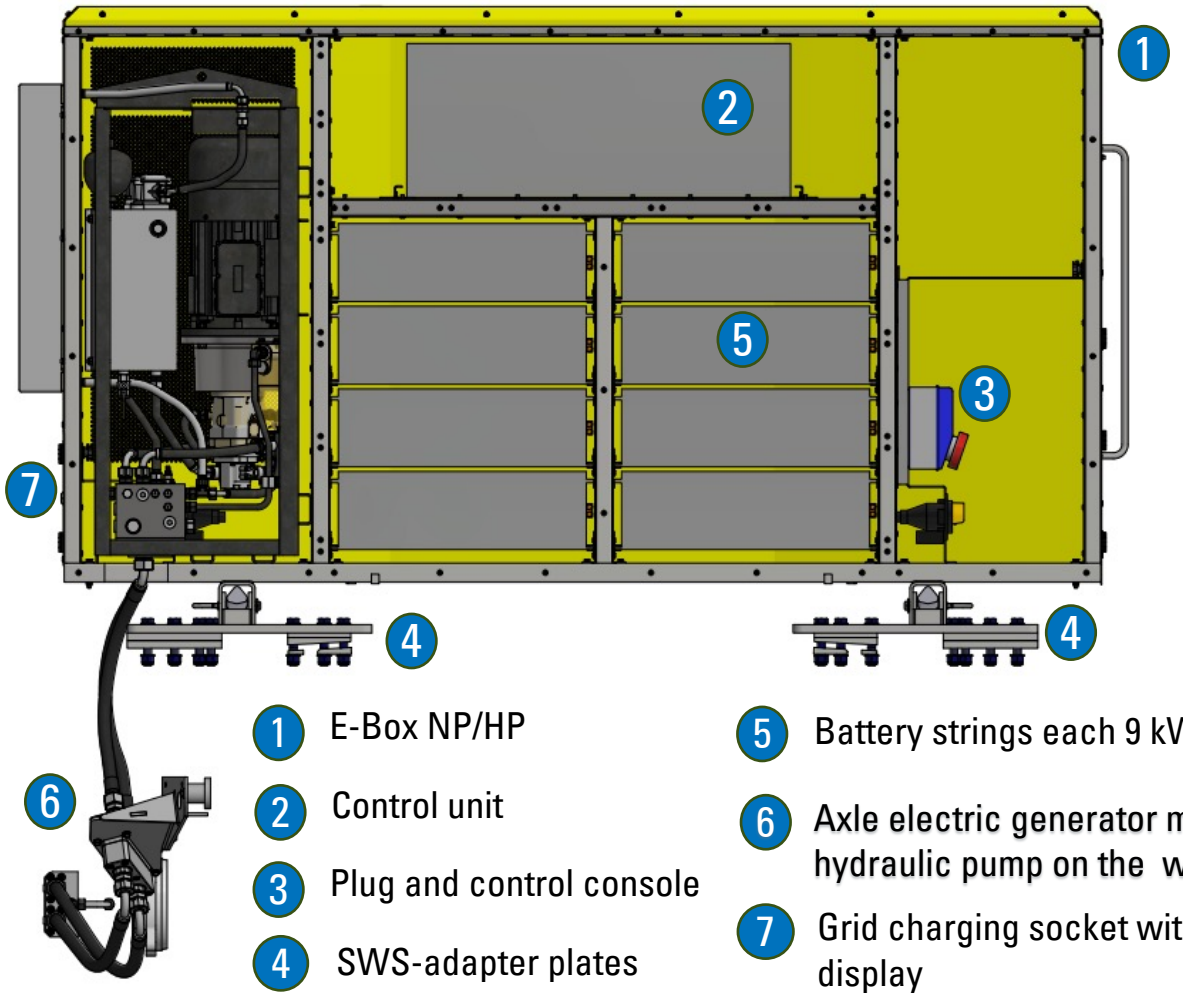
Maximum performance from the manufacturer's laboratory test (wheel diameter 920 mm). These may vary.

***This information is based on results from testing, product is still in the development phase.*

Spare parts concept of modules



SWS-Quick Exchange Modules (SWS-QEM) on example V-4.2



1. E-Box NP/HP
2. Control unit
3. Plug and control console
4. SWS-adapter plates
5. Battery strings each 9 kWh
6. Axle electric generator module incl. hydraulic pump on the wheel set
7. Grid charging socket with display

Total Cost of Ownership over 8 years with 20.000hrs operational time

SWS-PowerBox®	16,5k VS 391k	DIESEL GENERATOR
• Fuel cost = **EUR 0** • Maintenance costs = EUR 14,8k ➢ **Results in EUR 14,8k costs per SWS-PowerBox®**	**Fuel & Maintenance**	• Fuel cost = EUR 185k* • Maintenance costs = EUR 40k*** ➢ **Results in EUR 225k costs per Generator** >15x
Fueling: 0 times Maintenance: 3 times Crane movements: 0 times Organization (calls, mails etc.): 5 times per activity Man hours: 15hrs ➢ **Results in EUR 1.7k costs per SWS-PowerBox®**	**Operational effort**	Fueling: >300 times Maintenance: 40 times*** Crane movements: >300 times Organization (calls, mails etc.): 5 times per activity Man hours: >1300hrs ➢ **Results in EUR 140k costs per Generator** >80x
No CO_2 emissions/netzero **No** noise pollution ➢ **Results in EUR 0 costs per SWS-PowerBox®**	**Emissions**	Diesel generator consumption: 6.15 l per hour Total consumption: 123,077 liters of diesel Equivalent** to: 326 metric tons of CO_2 emissions PRICE PER TON ~80 EUR ➢ **Results in EUR 26k costs per Generator** >26.000x

*400L tank, EUR 1.5 p/L, 6.15L p/hr
***Source: German Bundestag 2,65 kg CO_2 emissions p/L diesel*
**** Empirical & OEM data*

SWS-PowerBox® compared to other solutions

	SWS-PowerBox®	Diesel generator	Heat-end power*
APPROVAL	✓ **Not significant** Auxiliary loading unit (ILU-Code)	● n/a	X **Certification obligatory** (Country specific approval required)
REQUIREMENTS	✓ None	X Requires refuelling facilites	X Locomotive with electric train heating
SAFETY CONCEPT	✓ Complies with all EN standards	● Refueling is subject to safety regulations	● High voltage system > 1.000 V?
COSTS OF OPERATION	✓ Low	X High operating costs (Diesel/Maintenance)	● n/a
OPERATING SYSTEM	✓ Uninterruptible power system	✓ Uninterruptible power system	X Dependence on other systems

** In rail transport, head-end power (HEP), also known as electric train supply (ETS), is the electrical power distribution system on a (passenger) train. The power source, usually a locomotive at the front or 'head' of a train.*

Monitoring

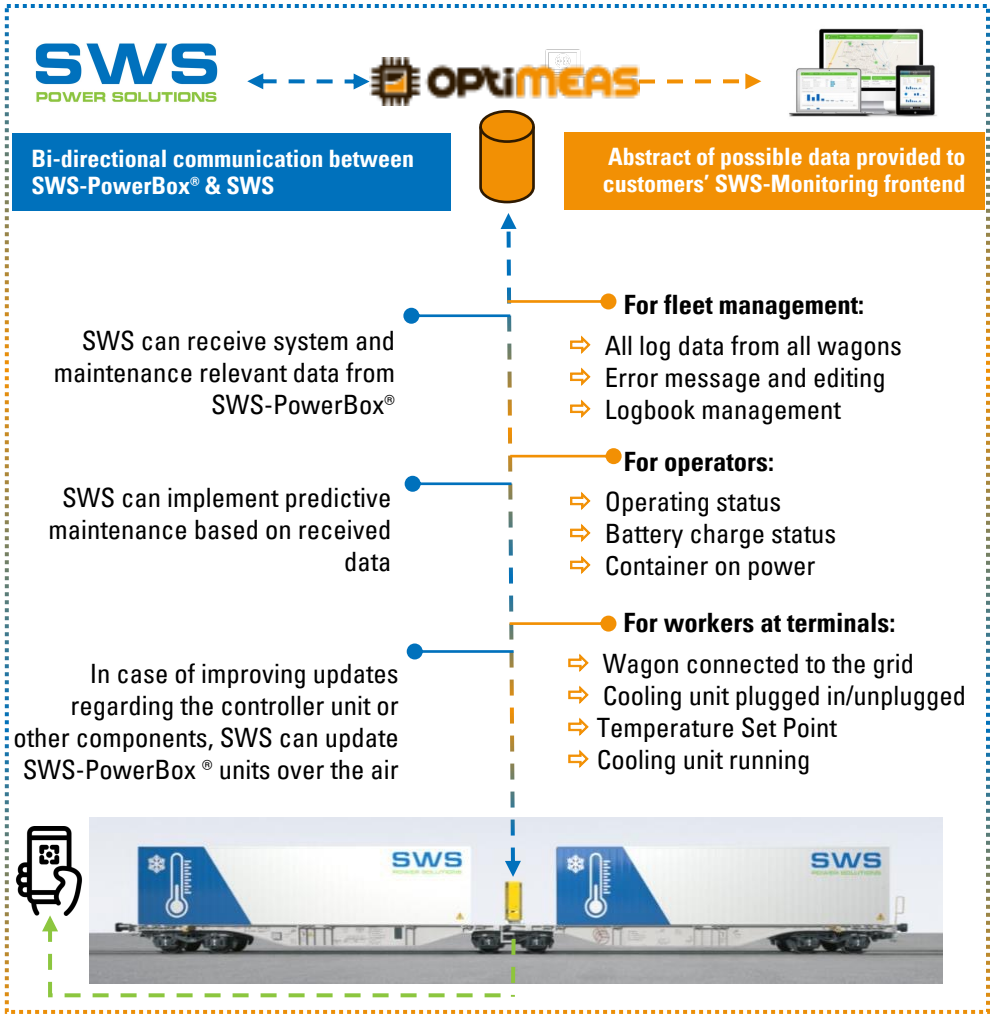
Every SWS-PowerBox® is equipped with a **secure state-of-the-art data transmission** technology, to send and receive a large amount of data

Data transmission is pushed every minute, therefore as long as there is a mobile connection, **data is available in real-time**

Depending on the customers' needs and respective role and level of the monitoring staff or report recipient, a vast number of **different datasets** can be relevant

Among ensuring the supervision of important factors for the cold chain logistics, **an increase in utilization** of freight wagons can be achieved

The focus of the monitoring solution lies on the **availability of data for our customers' monitoring**, although another data stream enables SWS to communicate with the SWS-PowerBox® on customers' request and in case of necessary updates



SWS-Information Centre

- Quality control system
- Cost management
- Management reports

SWS Information Centre

SWS Training Centre

- Training system using AR & VR
- Qualification requirements
- Online quality checklists

Document management
- Certifications
- Acceptance & inspection reports

Knowledge database
- Installation instructions
- Construction documents
- Repairment instructions

Spare part database
- Spare part overview & ordering

Ticket system
- Repair requests & defect descriptions
- Repair and replacement documentation
- Suggestions for improvement

SWS-PowerBox® interface Data archive
- Secure SWS communication interface
- Actual and historical data archive

access to

- From the construction on, until the whole time on duty, every part of the SWS-PowerBox®, key information, changes, additions, etc. will be **documented** in the Information Centre
- Via access to our **ticket system**, customers can directly place their repair requests, claims or suggestions for improvement. Device and repair status will be provided interactively
- On SWS' side, the document management part of the Information Centre is the intersection to SWS' internal **quality management system**

- Furthermore, customers will have access to a **knowledge database** with repair instructions and a **spare parts database**, in turn being connected to a **web shop** for ordering
- Before gaining access to the databases, customers have to train staff with the **SWS Training** to become a certified SWS-PowerBox® officer
- The SWS Information Centre will be the fundamental tool for all **after sales efforts**, continuous **customer support** and communication

Powered by Zugkraft-kN Digitalisierung nach Maß

Transport data Norway - SWS-PowerBox®

ONE RIDE

***2.2 tons CO_2**
have been saved **compared to truck** transport

Loading unit:
1. Cooling swap body
2. Refrigerated semi-trailer

Freight:
Fresh salmon

Container energy consumption:
(Average per hour)
1. ~ 4,0 kW per cooling unit
2. ~ 5,2 kW per cooling unit

Outside temperature:
~ 15° - 20°C
Setpoint: 0°C

Recuperation performance
8.0 kW (60 km/h)
15.0 kW (100 km/h)

Battery behaviour:
Batteries charged to 100% while driving

**Consumption per cooling unit -> Ø 3 liter/h – 2 trucks – 2 containers*
2,65 kg CO_2 emissions per liter of diesel Source: Deutscher Bundestag

Transport data Germany - SWS-PowerBox®

***440 kg CO_2** have been saved **compared to truck** transport

ONE RIDE

Loading unit:
1 Reefer container

Freight:
Nuremberg sausages

Container energy consumption:
(Average per hour)
1 ~ 4,5 kW ⇨ 2x cooling units

Outside temperature:
~ 0° - 15°C
Setpoint: 0°C

Recuperation performance
17.0 kW (100 km/h)

Battery behaviour:
After full charge & 5h waiting at the terminal
⇨ Battery capacity = 86%

**Consumption per cooling unit -> Ø 3 liter/h – 2 trucks – 2 containers*
2,65 kg CO_2 emissions per liter of diesel Source: Deutscher Bundestag

Transport data Italy - SWS-PowerBox®

ONE RIDE

***100 kg CO_2**
have been saved **compared to truck** transport

Loading unit:
1 Reefer-Container

Freight:
Frozen meat

Container energy consumption:
(Average per hour)
1 ~ 1,26 kW per cooling unit

Outside temperature:
~ 13°C
Setpoint: -18°C

Recuperation performance
13,3 kW (96km/h)
(Battery fully loaded)

Battery behaviour:
Power consumption <1 kW
⇨ 5% battery discharge
⇨ reserve battery capacity >48h

**Consumption per cooling unit -> Ø 3 liter/h – 2 trucks – 2 containers*
2,65 kg CO_2 emissions per liter of diesel Source: Deutscher Bundestag

Disclaimer

This presentation has been prepared by SWS PS Power Solutions GmbH ("the Company") and is provided to you for informational purposes only. This presentation is dated April 24 and the facts and information contained herein may be revised in the future. Neither the delivery of this presentation nor any further discussions by the Company with the Recipients shall under any circumstances create any implication that the affairs of the Company have not changed since that date. Neither the Company nor any of its associates or subsidiaries or any of their directors, officers, employees, or advisers nor any other person makes any representation or warranty, express or implied, as to, and no reliance should be placed on, the accuracy or completeness of the information contained in this presentation. Neither the Company nor any of its shareholders or affiliates or their directors, officers, employees, and advisors nor any other person shall have any liability whatsoever for any loss howsoever arising, directly or indirectly, from any use of this presentation. The same applies to information contained in other materials provided in this specific project. This document is selective in nature and is intended to provide an introduction and overview of the Company's and system's operations. Wherever external sources are cited in this presentation, such external information or statistics should not be interpreted as having been adopted or confirmed as accurate by any company. Certain information in this presentation is based on statements made by third parties. No representation or warranty, express or implied, is made as to, and no reliance should be placed on, the fairness, accuracy, completeness or correctness of this information or any other information or opinion contained herein for any purpose whatsoever. This presentation is an advertisement and not a prospectus. This presentation is directed only at relevant persons. Persons who are not relevant persons should not act or rely on this document or its contents.

SWS
POWER SOLUTIONS

SWS PS Power Solutions GmbH
Theodor-Körner-Straße 120A
8010 Graz, Austria