POWER DAY

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E-Mobility
BATTERY
Unified Cell
80%

SPECIAL CASES
Battery costs

-50%
in entry segment
High Power Charging

GLOBAL NETWORK
ENERGY MANAGEMENT
Power as Core Competence
NEW TECHNOLOGY DIVISION:

WE ARE THE POWERHOUSE OF VOLKSWAGEN
TWO MAIN PILLARS

BATTERY CELL & SYSTEM

CHARGING & ENERGY
FIRST CHALLENGE: SCALE VOLUME TO HUGE SPREAD OF PRODUCT PORTFOLIO
IF YOU HAVE THE VOLUME...
THE NEXT CHALLENGE WILL BE
TECHNOLOGY, TIMING
AND PRICE!
THERE IS NEED FOR SPEED!
MINDSET CHANGE IN Functional Responsibilities
Closed Loop Approach

- Recycling
- Battery Cell
- Second Use
- Battery Systems
- First Use
AND A FUNDAMENTAL MINDSET CHANGE IN TECHNOLOGY SETUP

CURRENT APPROACH

UNIFIED CELL

Concept cars
THE INTELLIGENCE OF THE BATTERY CELL

IS INSIDE
ACTUAL PRODUCT PORTFOLIO SHOWS POSSIBLE UNIFIED CELL UTILIZATION OF 80%
ROLLOUT UNIFIED CELL CONCEPT

STARTS 2023

START

2023

2030
REACHING COST TARGETS
WITH UNIFIED CELL CONCEPT

ENTRY
COST: -50%
Inexpensive Chemistry

VOLUME
COST: -30%
Mainstream Chemistry

SPECIFIC SOLUTIONS
COST: +XX%
High end chemistry for high performance

VARIETY IN CELL CHEMISTRY
VARIETY IN CHEMISTRY AND DESIGN
THE INTELLIGENCE OF THE BATTERY CELL IS INSIDE

ENTRY
IRON PHOSPHATE

VOLUME
HIGH MANGANESE

SPECIFIC SOLUTIONS
NICKEL MANGANESE COBALT

SOLID STATE
MOST IMPORTANT CONTROL LEVERS
FOR BATTERY FUTURE COMPETITIVENESS

ANODE
CHARGING TIME

CATHOIDE
COSTS AND RANGE

SEPARATOR

ELECTROLYTE
CATHODE

CONTROL LEVER FOR SUSTAINABLE SUPPLY CHAIN, COSTS AND RANGE
CATHODE
CONTROL LEVER FOR SUSTAINABLE
SUPPLY CHAIN, COSTS AND VEHICLE RANGE

STATE OF THE ART - NMC-CELL

CATHODE

- Nickel
- Manganese
- Cobalt

CATHODE CELL COST SHARE
40%

CATHODE RANGE IMPACT
90%
CATHODE
ROBUST AND INEXPENSIVE CHEMISTRY FOR ENTRY VEHICLES

LFP-CELL

CATHODE

• Iron-Phosphate
• Nickel
• Manganese
• Cobalt

COSTS
0% 100%

RANGE
0% 100%
CATHODE
FUTURE BEST COST TO VALUE FOR MAINSTREAM CHEMISTRY

HI-MN-CELL

CATHODE

• Nickel
• Manganese
• Cobalt
ANODE

CONTROL LEVER FOR CHARGING PERFORMANCE
ANODE
CONTROL LEVER FOR CHARGING PERFORMANCE

STATE OF THE ART - GRAPHITE

ANODE

• Synthetic graphite

ANODE CHARGE TIME IMPACT
100%

ANODE RANGE IMPACT
10%
ANODE

SILICON ANODE SIGNIFICANTLY REDUCES CHARGING TIME AND IMPROVES RANGE

HI-SI-CELL

ANODE

• Synthetic graphite
• Silicon

CHARGING TIME

0% 100%

RANGE

0% 110%
SOLID STATE

SIMPLER DESIGN LEADS TO HIGHER
PERFORMANCE AND LOWER COSTS
STATE OF THE ART BATTERY CELL IN DETAIL
SOLID STATE BATTERY CELL
SIMPLER DESIGN LEADS TO HIGHER PERFORMANCE

STATE OF THE ART

SOLID STATE
SOLID STATE BATTERY CELL
BEST IN CLASS CHARGING TIME AND INCREASED RANGE

SOLID STATE BATTERY

CHARGING TIME
0% 100%

RANGE
0% 100% 130%
ULTRA FAST CHARGING WILL IMPROVE 
EV LONG DISTANCE CAPABILITY

VOLKSWAGEN ID.4 PRO
[77 kWh]

DISTANCE
450 km / 280 mi

CHARGING TIME

- today ~ 25 min
- until 2025 ~ 17 min
- after 2025 ~ 12 min

LOS ANGELES
435 km
270 mi

LEIPZIG
430 km
267 mi

BEIJING
433 km
269 mi

LAS VEGAS
MUNICH
DONGYING
CLOSED LOOP APPROACH

BATTERY CELL

SUPPLY CHAIN

Chemistry

Production

Second Use

First Use

Recycling
MAIN OBJECTIVE FOR BEV RAMP UP

Volume

Time to market

Costs
VOLKSWAGEN EXPANDS SCOPE ALONG VALUE CHAIN

Expand scope ↔ Supply Chain Partnership

Mining, Chemistry, Cell factory, Car factory, Recycling

Cell value: 80% 20%
THE RIGHT BALANCE
THE RIGHT BALANCE

Buy

Partnership

Make

Vertical Integration
NEW STRONG PARTNERSHIPS – KEY TO FUTURE SUCCESS!
STATE OF THE ART BATTERY CELL PRODUCTION
INVESTMENT AND ENERGY INTENSE PROCESSES

COMPLEX PRODUCTION PROCESS
HIGH INVESTMENT
HIGH ENERGY CONSUMPTION

ASSEMBLY
INTENSE CYCLE TIME

FINISH
INTENSE CYCLE TIME
CLOSED LOOP APPROACH

BATTERY SYSTEMS

- Recycling
- Second Use
- First Use
- Battery cell
REUSING 95% OF THE RAW MATERIALS THROUGH HYDROMETALLURGY PROCESS
THE FIRST PLANT FOR RECYCLING USED ELECTRIC CAR BATTERIES!

PRODUCTION IN SALZGITTER STARTED IN JANUARY 2021
1. Produce cathodes from recycled material: saving more than one ton of CO2 per vehicle

2. Ecologically and economically sustainable effect

3. The costs fall; the customer benefit is increase
LOCALIZATION AND VOLUME STRATEGY
THROUGH GREEN DEAL SHARE OF BEVs INSIDE VOLKSWAGEN GROUP WILL INCREASE...

BEV SHARE GROUP 2030

from 30%
THROUGH GREEN DEAL SHARE OF BEVs INSIDE VOLKSWAGEN GROUP WILL INCREASE...

BEV SHARE GROUP 2030

inkl. Green Deal

to 60%
This will create a demand of 240 GWh for Volkswagen in Europe. That means: 6 x 40 GWh!
Actual setup:
- 14 GWh in Skellefteå
- 16 GWh in Salzgitter

New setup:
- Unified cell premium in Skellefteå by Northvolt, up to 40 GWh
- Unified cell volume in Salzgitter by Volkswagen, up to 40 GWh
Cleaner Project Setup
Bundling Resources
Less Complexity
Faster Ramp Up
Higher Volume Output
SECOND PLANT: SALZGITTER

2nd

Start of production 2025
up to 40 GWh

Salzgitter
SECOND WAVE OF BATTERY TECHNOLOGY

GWH WORLDWIDE

INHOUSE
+ KEY SUPPLIERS

1

2

2021

2030
A FUTURE SUCCESS
DEPENDS ON A STRONG COLLABORATION

EXTERNAL PARTNERS

VOLKSWAGEN

Volkswagen Group

GOVERNMENT
HOW TO REACH COST TARGETS

- Cell design: -15%
- Production process: -10%
- Cathode / anode material: -20%
- Battery system concept: -5%

Costs up to -50%
KEY TAKE-AWAYS

- Technology roadmap with possible unified cell utilization of 80%
- Action fields to achieve cost targets defined
- Closed Loop process installed
- SOLID LOCALIZATION STRATEGY to secure volume and timing
TWO MAIN PILLARS

BATTERY CELL & SYSTEM

CHARGING & ENERGY
Among TOP 3 reasons to NOT buy an electric car:

CHARGING INFRASTRUCTURE
DIFFERENT CITIES, DIFFERENT CHALLENGES
Volkswagen covering most important e-mobility markets
Our HPC-Boost-Program for Europe

IONITY
Our HPC-Boost-Program for Europe
Our HPC-Boost-Program for Europe

Spain

IBERDROLA
Starting 2021
United Kingdom

Starting 2021
Germany

Our HPC-Boost-Program for Europe
bp

8,000 HPC Points by 2025
Our HPC-Boost-Program for Europe

IONITY

enel

IBERDROLA

bp
Our contribution: We will expand today’s HPC network in Europe by factor 5 until 2025

Boost 18,000

Total HPC network 2020 x5
Our HPC-Boost-Program for Europe

about 18,000 HPC points by 2025

1/3 of essential HPC Infrastructure in Europe
FLEXPole

2x DC UP TO 150 kW

BATTERY BUFFER

2nd LIFE OPPORTUNITY

GRID INDEPENDENT

2 PRODUCTION SITES
SUZHOU (China), HANOVER (Germany)
INNOVATIONS MADE BY VOLKSWAGEN GROUP COMPONENTS
BEVs to become smart charging devices for solar and grid integration
The car as a mobile power bank
BiDirectional charging enables car-owners to become their own utility.
Mobility and renewable energy are complementary

200 km / 125 miles driving

5 Days

House to be powered by the car
Business model scalable to fleet level
Business model scalable to fleet level – first running project

- 1,250 apartments
- 2 MWh storage capacity
- 270 wallboxes
- 720 kWp photovoltaics

Pilot @ Wolfsburg, Germany
Activating unused renewable energy with the new storage capabilities

6,500 GWh/year

in Germany are **not used** due to lack of storage capacity

2.7 million BEVs

could be driving **one year** with the energy
Volkswagen will use battery production capacities for large scale storage including 2nd life options.
Large scale storage as part of the closed loop.
Energy integration: Fully digital and data driven
Key Take-aways

- **Global Boost-Plan**
  for charging infrastructure

- **Expand fast charging**
  in strong partnership with **local partners**

- **The car will be a part of the energy system**

- **Storage systems**
  to facilitate fluctuating **renewable energy supply**

- **Cloud based energy management**
OUR VISION & MISSION

With the right energy management and intelligent storage systems

ONE DAY, CHARGING WILL BE FOR FREE