



# **Continuous Mining is the future – How to gain related operational know-how?**

**Dr. Martin Schmid, Senior Mining Consultant and Training Specialist**

# Agenda

1. RWE TI - Who we are
2. Utilization of Continuous Mining Equipment
3. RWE “OTAS”-training and success stories
4. Summary & Conclusion



# RWE Technology International (RWE TI)

## 1. Who we are



# Business model fully aligned with our strategic focus on the energy transition.

## Core

## Coal/Nuclear

|                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Offshore wind</b><br> <ul style="list-style-type: none"><li>• Global offshore activities</li></ul> | <b>Onshore wind/Solar</b><br> <ul style="list-style-type: none"><li>• Onshore and solar operations in<ul style="list-style-type: none"><li>• Europe &amp; APAC</li><li>• Americas</li></ul></li></ul> | <b>Hydro/Biomass/Gas</b><br> <ul style="list-style-type: none"><li>• Hydro, biomass and gas plants in Germany, UK, Netherlands</li><li>• Hydrogen projects</li><li>• Kelag stake</li></ul> | <b>Supply &amp; Trading</b><br> <ul style="list-style-type: none"><li>• Trading/origination</li><li>• Gas &amp; LNG</li><li>• Commodity solutions</li><li>• Gas storage business</li></ul> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- German lignite operations; mines and plants
- Hard coal plants
- German nuclear power plants
- Holding in Dutch EPZ (nuclear)

**1.5 GW** average **net growth** ambition p.a.

**5 bn Euro net capex plan** for growth in Wind/Solar for 2020 – 2022

**>80 %** of **capex** comply with proposed criteria of **EU taxonomy**

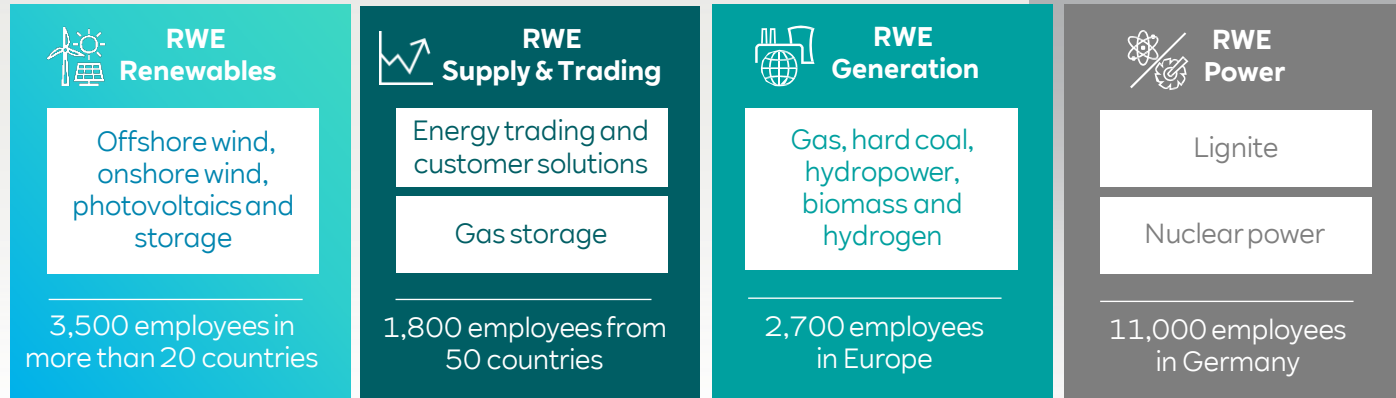
**250 g/kWh** Carbon **factor**<sup>1</sup>

<sup>1</sup> Calculated for generation portfolio of core business. | Note: Figures for FY 2020.

# RWE TI is your gateway to the know-how of the RWE Group.

## RWE

Operative business



● ————— Core business ————— ● ————— Coal/Nuclear ————— ●

**RWE TI bundles RWE's engineering know-how and makes it available to the global market.**

Last updated on 31/12/2020, 2020 Annual Report

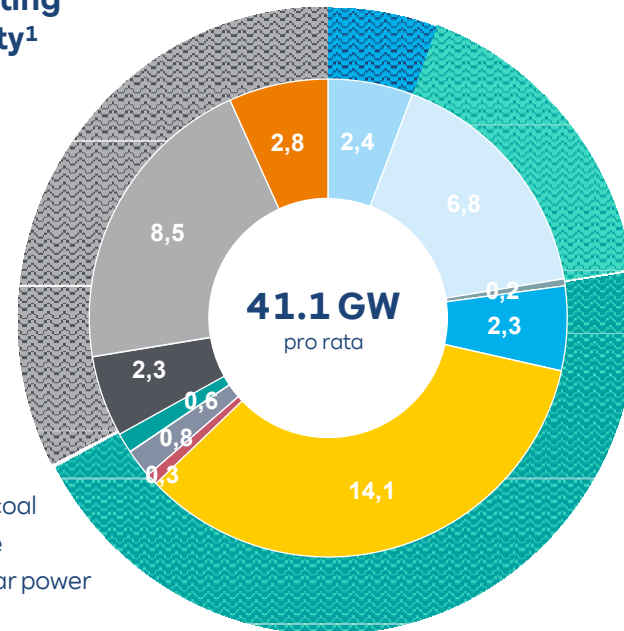
# We are ideally positioned for the new energy World.

- **Flexible capacities** comprise around 18 GW of gas, hydro and biomass.
- Flexible power park as the secure backbone of the energy supply on our European core markets.
- With our fleet of gas turbine power stations and LNG (liquid natural gas) trades, RWE ranks as the **No. 2 in Europe** in terms of capacity.

## Total electricity generating capacity<sup>1</sup>

### Coal/ Nuclear energy

- Hard coal
- Lignite
- Nuclear power



### Offshore wind power

- Offshore wind

### Onshore wind/ solar power

- Onshore wind
- Solar

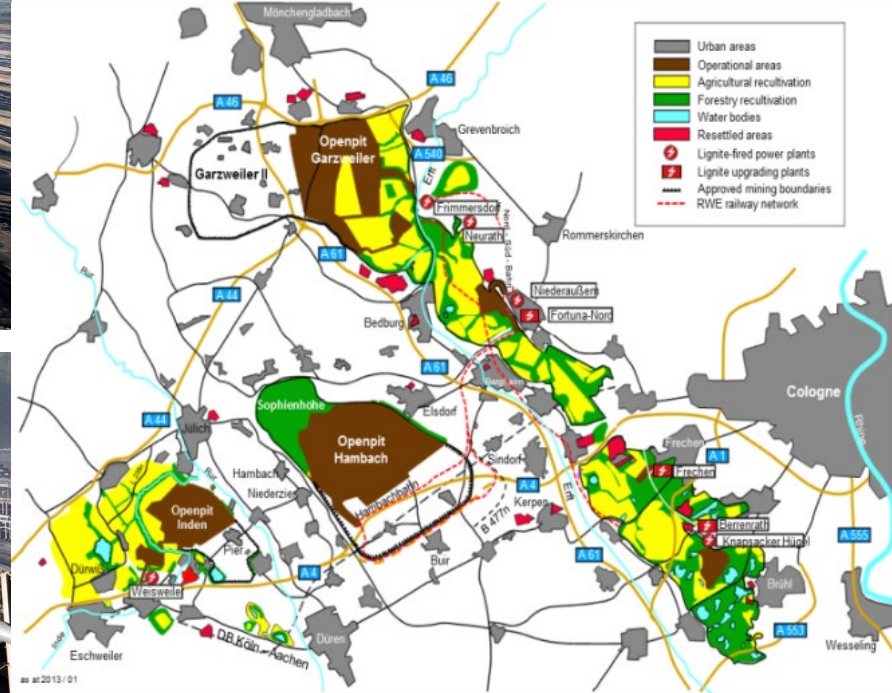
### Hydro/ Biomass/ Gas

- Pumped storage, batteries
- Gas
- Other
- Hydro
- Biomass

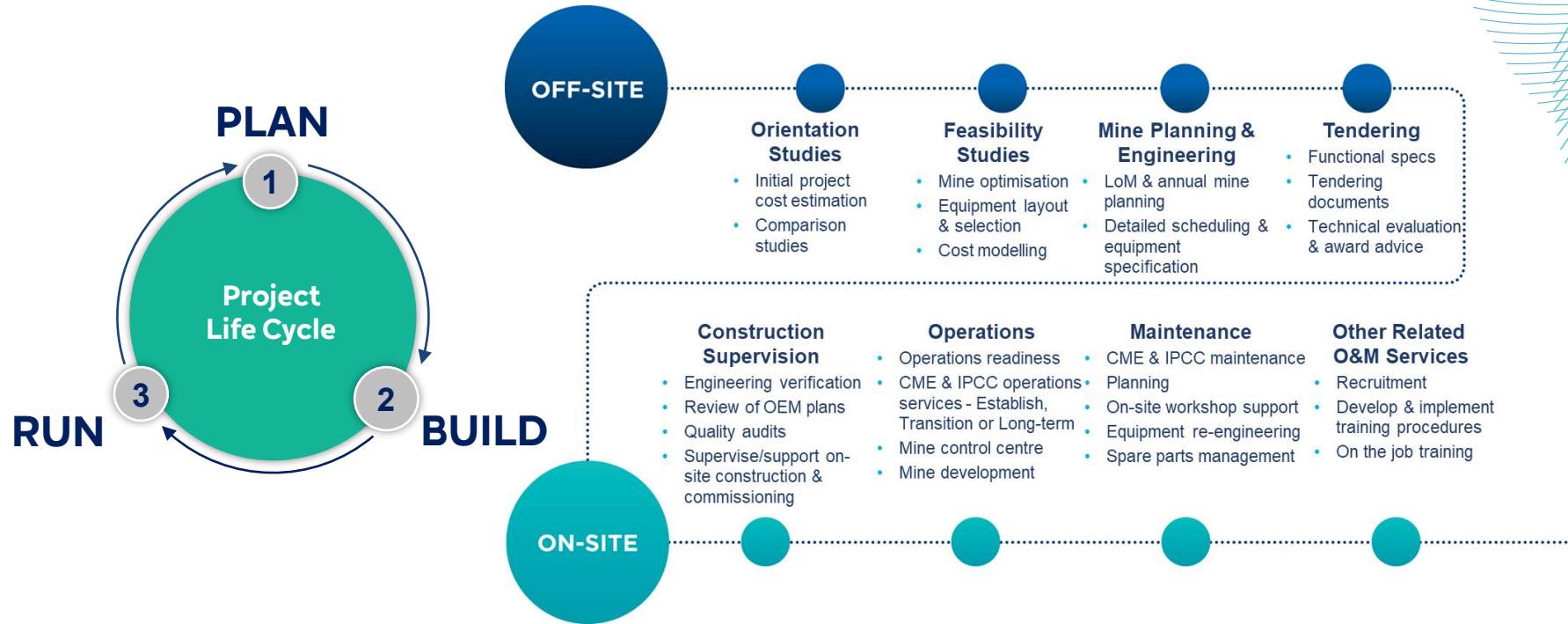
<sup>1</sup>Annual figures 2020



# RWE TI's proven operational experience: We operate Continuous Mining Equipment (CME)

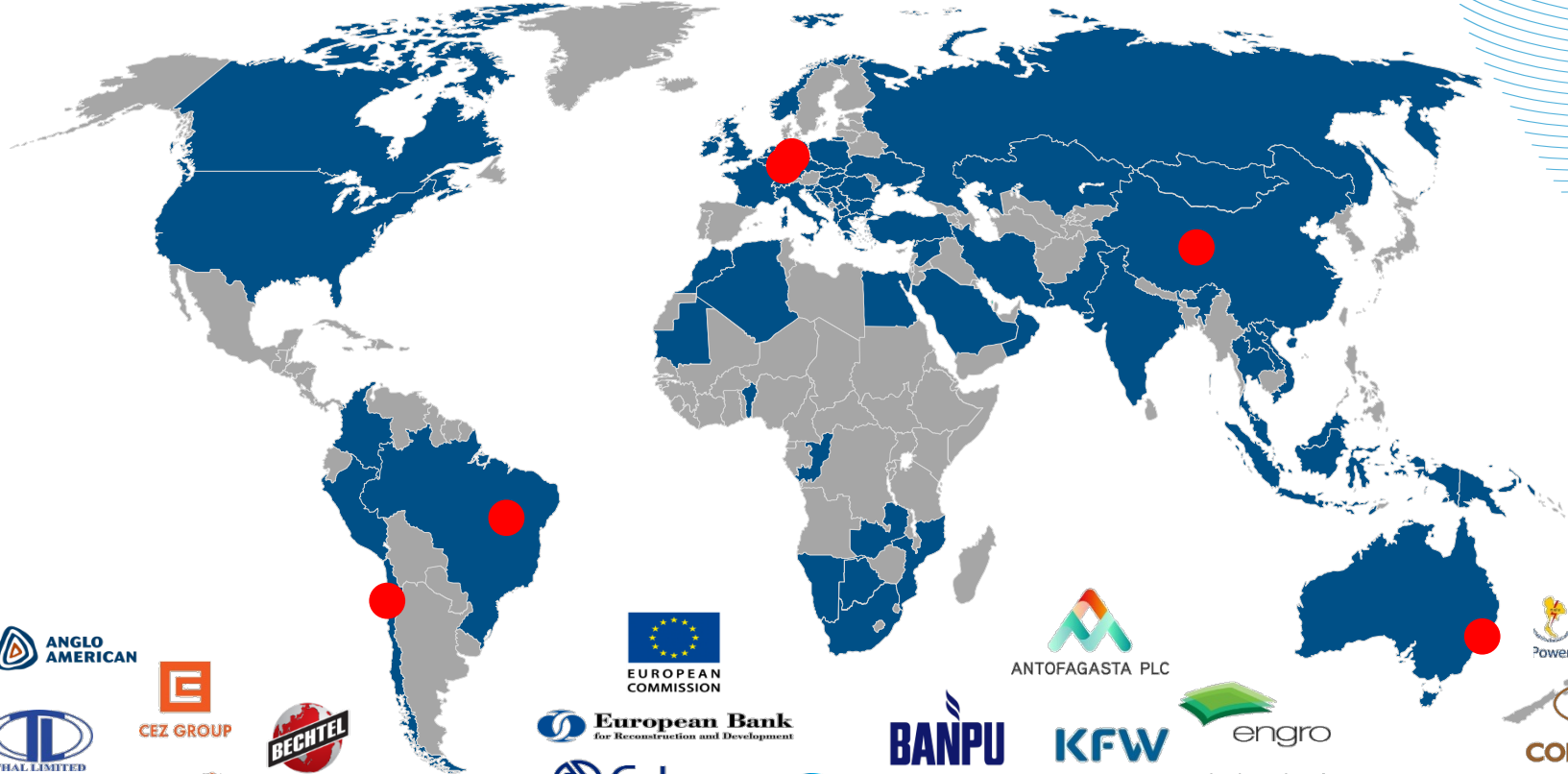


# RWE-TI's Services include:





● RWE Office



ANTOFAGASTA PLC



SIEMENS



CODELCO



Fosfatos del Pacifico



thyssenkrupp



SEC MC  
Sindh Engro Coal Mining Company

THIASS RWE  
LOW COST, SUSTAINABLE MINING SOLUTIONS



WORLD BANK GROUP



SAHAKOL

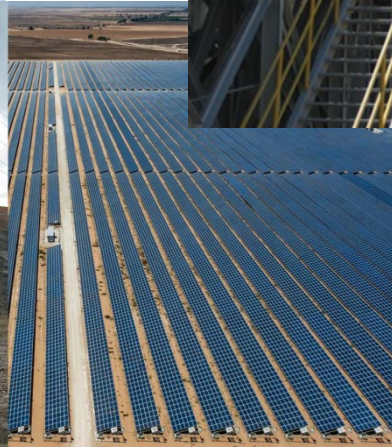
RWE TI: How to gain CME related operational know-how?

RWE

# Typical Examples of our Work



Operational Assistance  
(leverage existing technologies)



Innovative Technologies  
(think out of the box)



Engineering & Tech. Audits  
(optimization of plants)



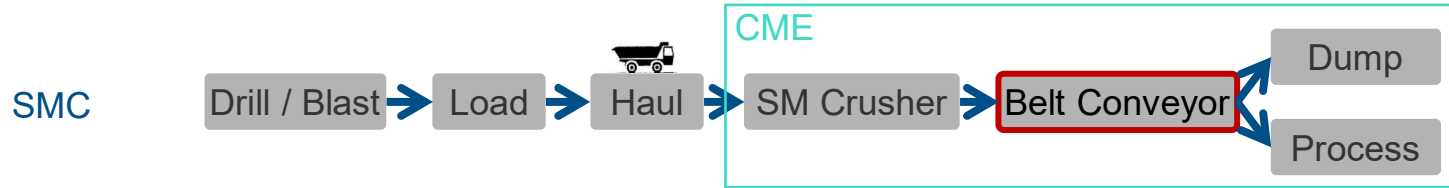
# RWE Technology International

## 2. Utilization of Continuous Mining Equipment (CME)

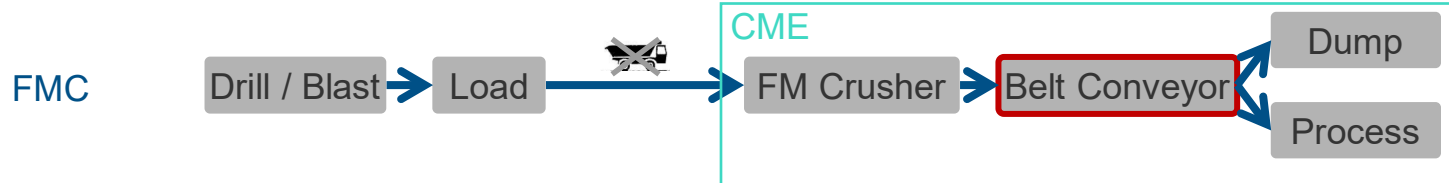
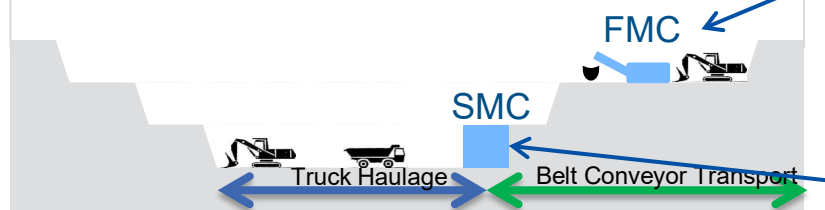




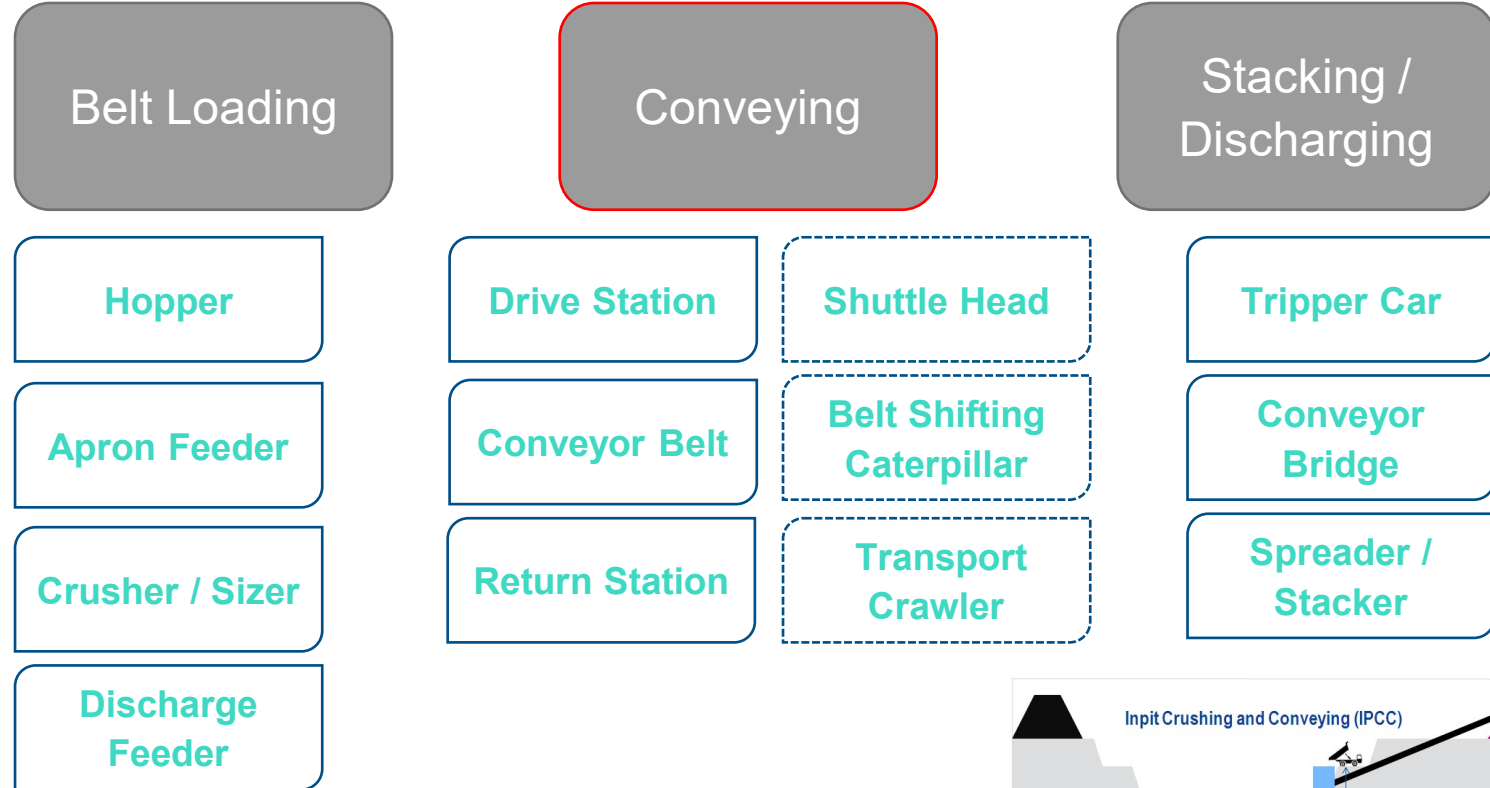
# Process of Inpit Crushing and Conveying



## Inpit Crushing and Conveying (IPCC)



# IPCC Components



Can conventional truck/excavator technology be replaced by **continuous mining equipment (CMS)** to sustainably reduce greenhouse gas (GHG) emissions?



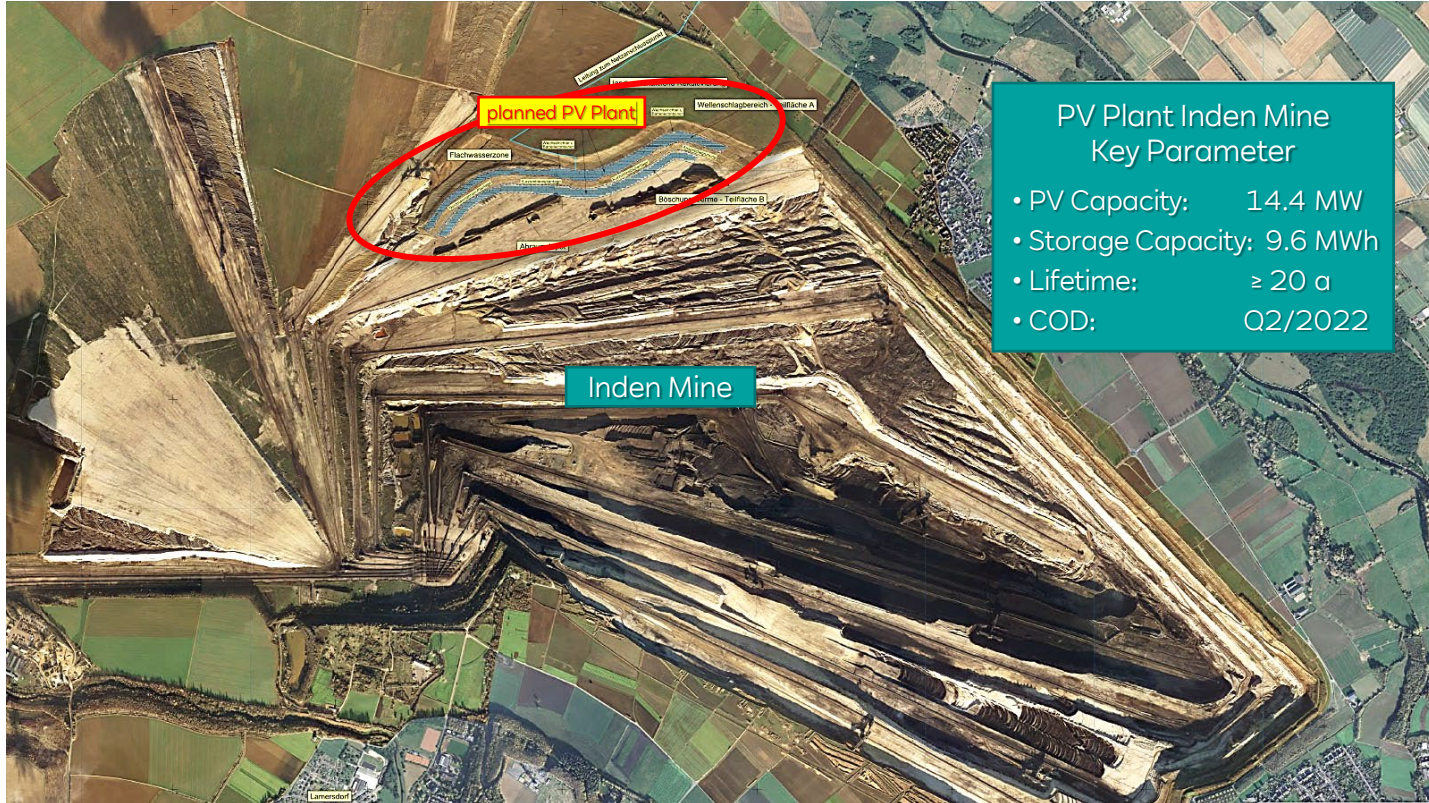
# Key Findings

Electric powered CME can substantially and sustainably reduce the GHG emission footprint of an diesel based operation, provided that:

- High mass movement capacities are required
- Vertical transport component (rise) is significant
- Lifetime of operation justifies the corresponding investment
- The source of electric power has a (growing) renewable component

**Availability of renewable Energy is the key!**

# At RWE we realize the integration of renewable power generation at our own operations



# Key Findings

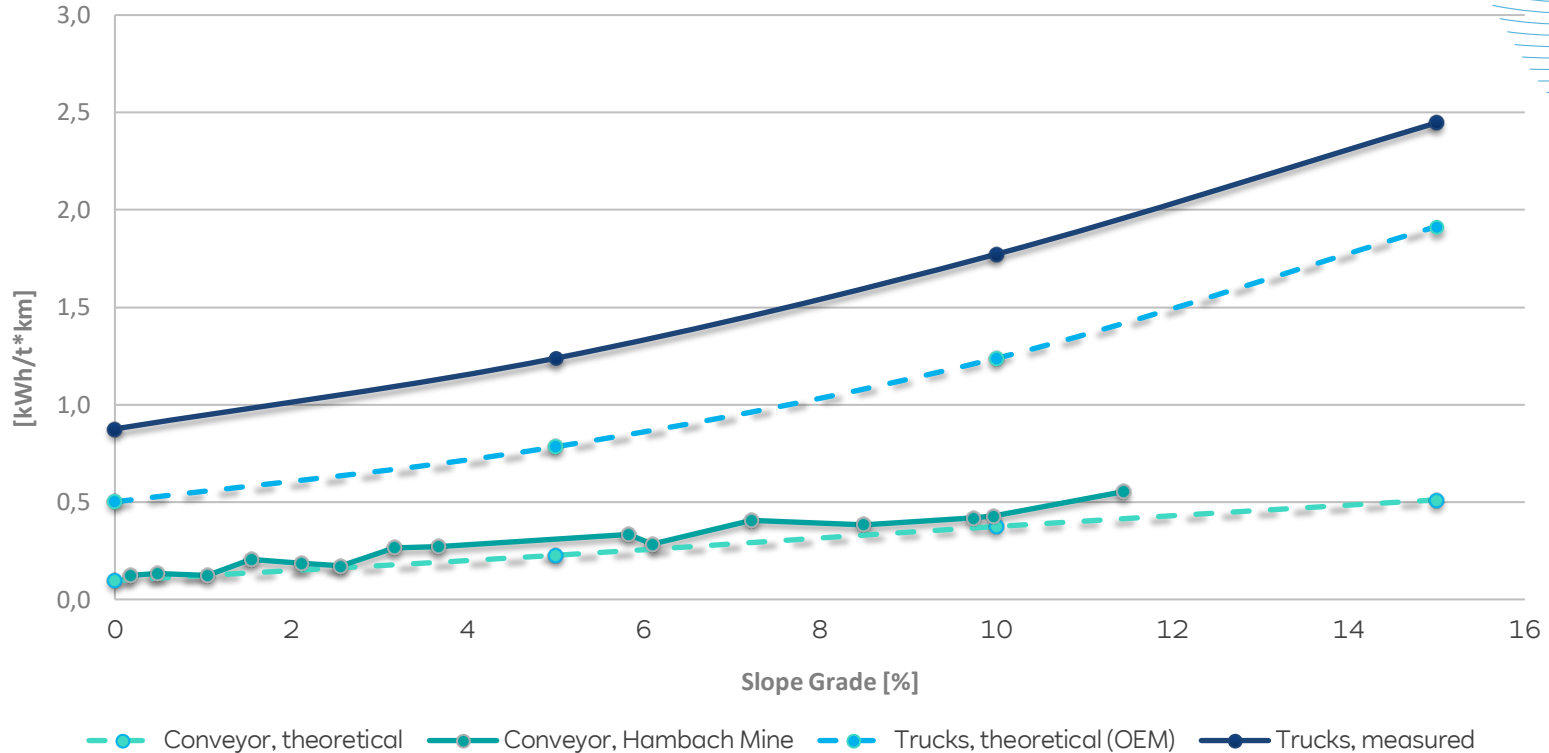
The substitution of diesel powered fleet by electric powered equipment can have further positive side effects such as a

- High degree of automation
- Reduction of dust emissions and water consumption
- Significant reduction in operating costs
- Reduced exposure to (future) carbon taxes

**Balancing possible technological solutions, hence  
Lifecycle of Asset (LCA) economics vs CO<sub>2</sub> footprint**

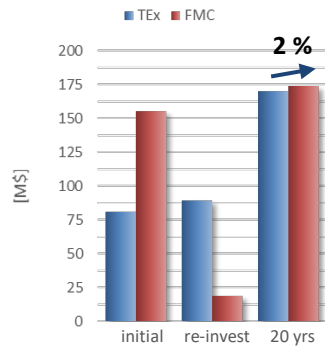


# Comparison of Specific Energy Consumptions of Trucks and Conveyors

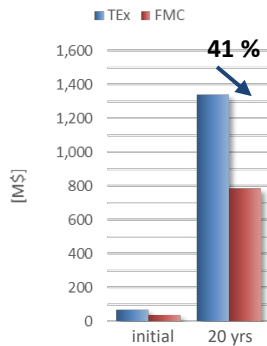


# TEx vs fully mobile Crushing Unit

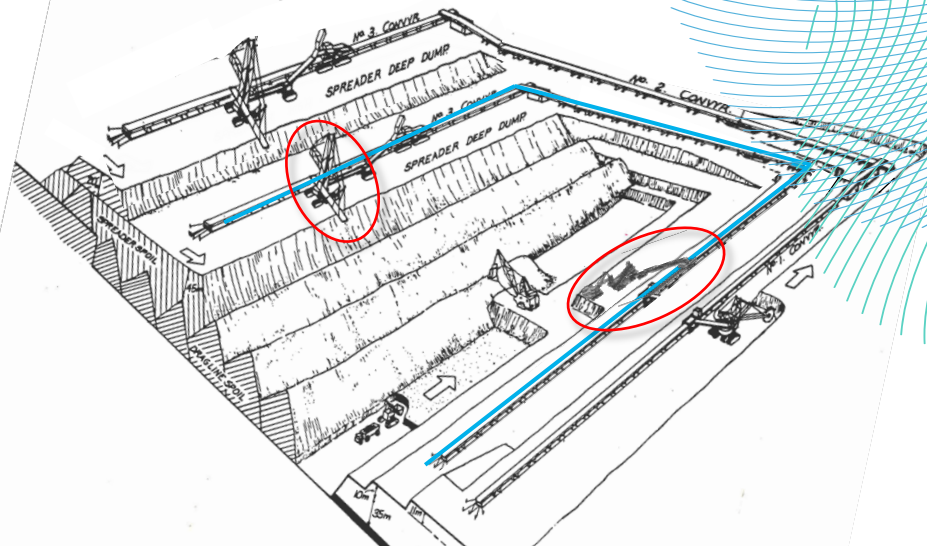
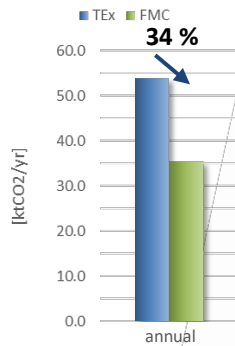
CAPEX



OPEX



GHG







RWE Technology International

### 3. RWE “OTAS”-training and success stories



# Main learning objectives of RWE customers



Cost savings

Engineering  
know-how transfer

Sustainable  
learning experience

Planning

Hands-on Operation  
& Maintenance

Long-term  
cooperation

Preventing  
Failures / Outages

# OTAS – Operational and Training Assistance Services



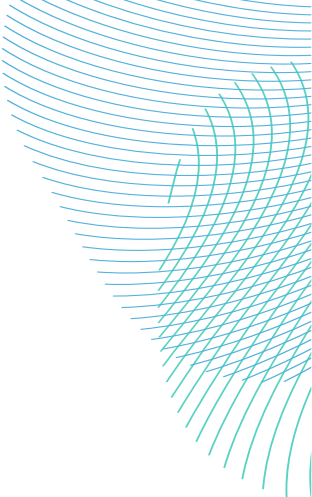
Since more than 40 years RWE provides OTAS to its international customers.  
The OTAS are:

- 1. Operational Assistance at clients site – long term experts**
- 2. Operational Assistance at clients site – short term experts**
- 3. Operational Training provided at RWE sites**
- 4. Operational Training provided at clients site**

All training assistant services are based

- on client's trainee's need analysis (target definition),
- on trainees capability and experience (class definition), and
- on RWE training experience based client specific curriculum (didactic transfer)

# OTAS – Operational and Training Assistance Services



How is operational know-how transferred?

Three steps:

- 1. Theoretical lecture on general and specific context**
- 2. Continuous exposure to processes in real world environment**
- 3. Trainee's reflection of the day's learnings and Q&A**

RWE's trainings comply with both the need of client's technical departments and the need of the client's HR/Training departments:

- Exact planned daily curriculum
- Hourly statements
- Certificate of attendance / Certificate of understanding



# Training Approach @ RWE

## Look. Listen. Do!

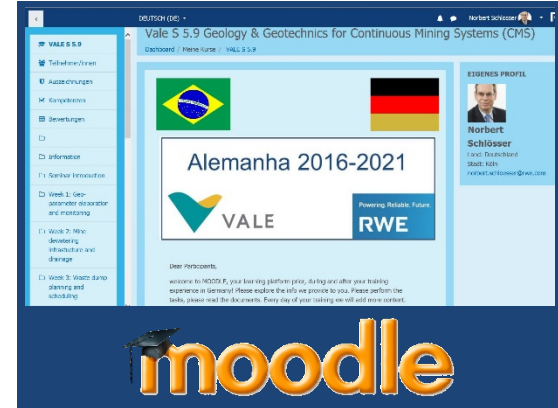
### Classroom Training “Know-how”-Effect



### Practical Sessions “Show-how”-Effect

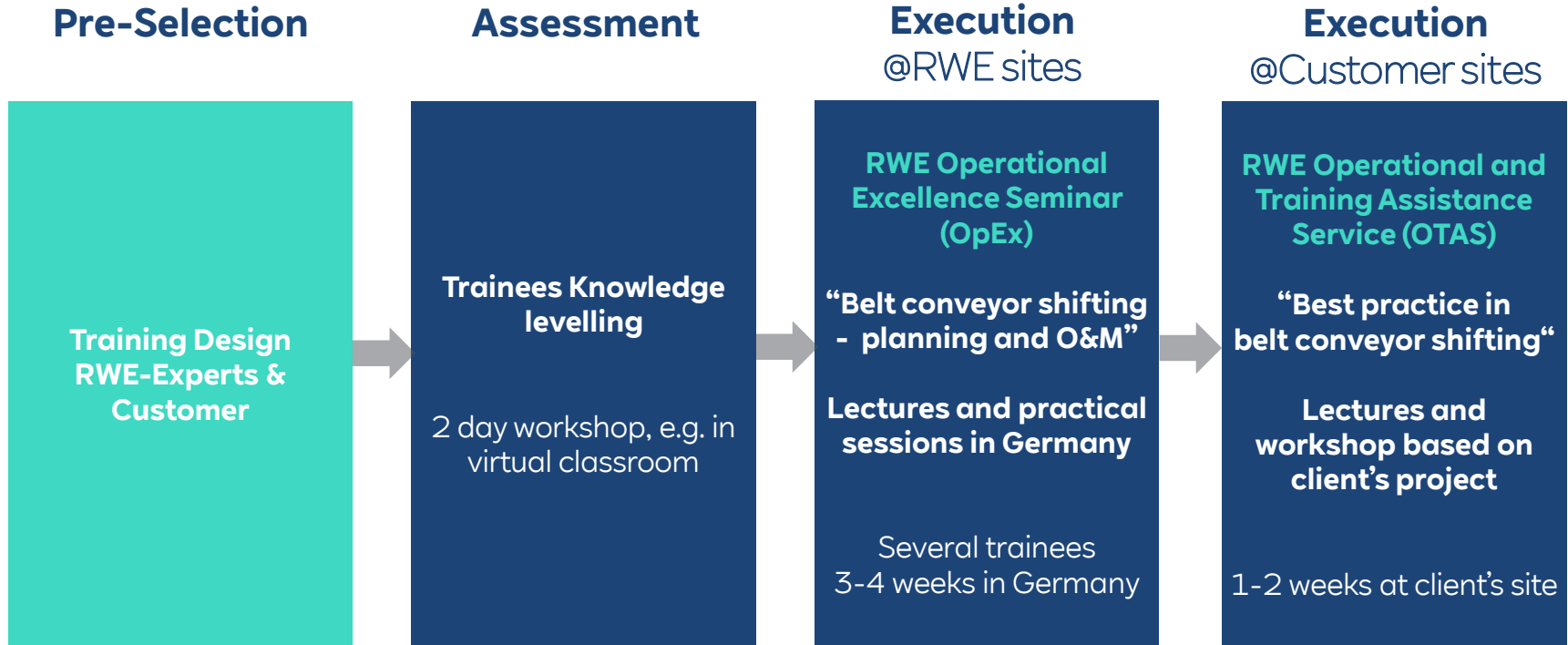


### Learning Diaries Individual Study



# Customised training for groups

## Exemplary Setup for a typical training



# How training is organized in Germany

## A thorough planning, managed by RWE Training Department

### 1. Training Needs Assessment

- Assess training needs
- Develop learning objectives
- Close alignment with customer
- Target group



### 2. Expert Selection

- Identify areas of responsibility
- Define training setup, e.g.
  - classroom training
  - on-the-job / observation
  - e-learning modules
- Close alignment with supervisors and “potential” experts



### 3. Training Preparation

- Define training content
- Designing training materials
- Develop detailed training schedule
- Pre-training preparation
- Close alignment with selected experts (RWE Trainers)



### 4. Training Implementation

- Final prep before training starts
- Look-Listen-Do: combining observation, classroom and hands-on training
- Evaluation of the training





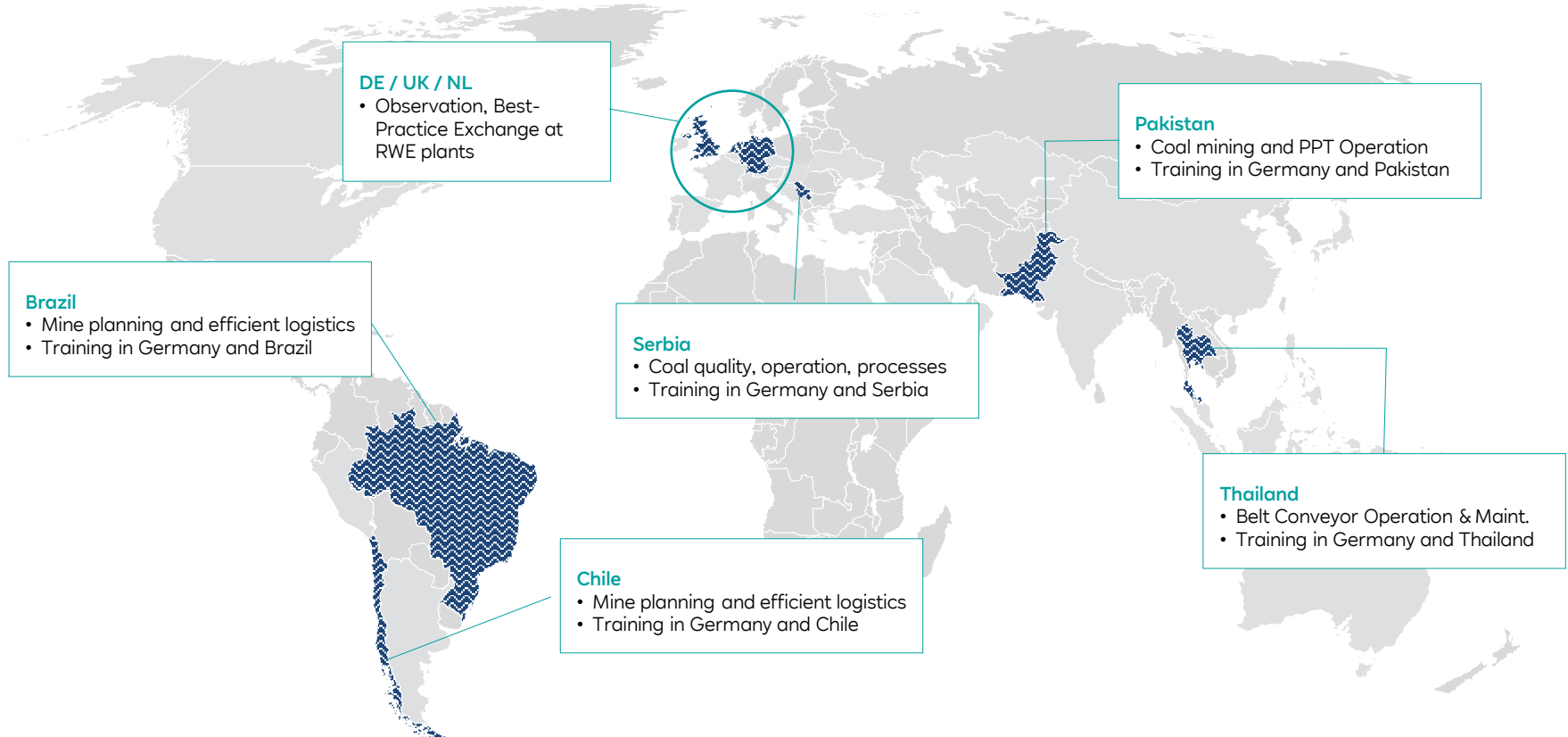
# Managers Training

## Exemplary training schedule

| Day / Date             | Time | Place / Room       | Topic                                                                       | Meeting with                                               | Responsible |
|------------------------|------|--------------------|-----------------------------------------------------------------------------|------------------------------------------------------------|-------------|
| Saturday, 02.Sep.2017  |      |                    | Travel day                                                                  |                                                            |             |
| Sunday, 03.Sep.2017    |      |                    | 1. Week's focus: Strategic mine planning and organisation                   |                                                            |             |
| Monday, 04.Sep.2017    |      | Multiple locations | RWE Lignite Mining Division & Lignite Planning Division                     | T Mr. Ralf-Jürgen Hempel / Head Mining Technology          |             |
| Tuesday, 05.Sep.2017   |      | Hambach&Inden Mine | Inden Mine - Introduction and mine visit                                    | T Dr. Andreas Wagner, VP* Inden Mine                       |             |
| Wednesday, 06.Sep.2017 |      | Hambach Mine       | Hambach Mine - Introduction and mine visit                                  | P Mr. Thomas Körber / VP Hambach Mine                      |             |
| Thursday, 07.Sep.2017  |      | Garzweiler Mine    | Garzweiler Mine - Introduction and mine visit                               | P Dr. Markus Kosma / VP Garzweiler Mine                    |             |
| Friday, 08.Sep.2017    |      | MEC Workshop       | RWE Maintenance and Engineering Center (MEC) / Belt Laboratory / Asset Care | P Mr. Wolfgang Kortmann / VP Maintenance and Engineering   |             |
| Saturday, 09.Sep.2017  |      |                    |                                                                             |                                                            |             |
| Sunday, 10.Sep.2017    |      |                    | 2. Week's focus: Production and operations planning of CMS                  |                                                            |             |
| Monday, 11.Sep.2017    |      | BOWA Bohlendorf    | Surface water and groundwater control measures                              | P Mr. Frank Schippers / Head of Water Resources Management |             |
| Tuesday, 12.Sep.2017   |      | Hambach Mine       | Operational planning and integrated production planning                     | T Mr. Tim Jaetzel / Head of Mine Planning                  |             |
| Wednesday, 13.Sep.2017 |      | Hambach Mine       | Visit of Belt Conveyor Shifting Operation I713RR & Automation               | P Mr. Herbert Stork / Belt Conveyor Shifting               |             |
| Thursday, 14.Sep.2017  |      | Hambach Mine       | Operation control systems                                                   | P Dr. Hermann Oppenberg / Head of Mine Production          |             |

|       |                          |                                               |                                                   |
|-------|--------------------------|-----------------------------------------------|---------------------------------------------------|
|       | Hambach Mine             | Operation control systems                     | P Dr. Hermann Oppenberg / Head of Mine Production |
| 7:45  | Hotel                    | Transfer to Hambach Mine                      |                                                   |
| 8:30  | Hambach                  | Live Presentation operation control systems   | Mr. Christian Schmitt / Mine Planning Department  |
| 11:00 | Hambach                  | Change PPE                                    |                                                   |
| 11:30 | Mine Canteen             | Lunch                                         |                                                   |
| 12:30 | Mine visit               | Mine Visit - Operator Assistant Systems       | Dr. Hermann Oppenberg                             |
| 15:30 | Hambach Haus C, Raum 203 | Final discussion, daily learning diary Moodle |                                                   |
| 16:30 |                          | Transfer to hotel                             |                                                   |

# RWE TI's training customers



# #Training #MineOperation #Brazil #HandsOn



# OTAS – Success Story

## Introduction of fully mobile iron ore mining

Mine planning of FMC mine with shiftable conveyor technology in the mine

Equipment technical specification

Equipment purchase

Mine commissioning

Training of Management, Engineers, Technicians and Operators (20% of workforce)

Short- and longterm experts at site

Regular training at site for sustainability

**Production Ramp up achieved in time**

**Further production increase planned**



# RWE Technology International

## 4. Summary - Conclusion



# Summary

RWE TI is a independent consulting and engineering firm for electric powered Continuous Mining Equipment (CME), including In-pit Crushing and Conveying (IPCC)

RWE TI fully understands the key factors to reduce your carbon emission in your mine form generation to consumption

# Conclusion

RWE TI is ideally positioned to help you to the CME implementation, hence the energy world of tomorrow

**How to gain CME related operational know-how?**  
Through RWE's Operational and training assistance services (OTAS)!



# Thank you for your attention!

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