



Data Supported Plant Management and Digital Plant Lifecycle Record

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Berlin, May 11th, 2017

Agenda

1. Introduction
2. CEE's approach to digital Asset Management
3. Digital Plant Lifecycle Record for Renewable Energy Power Plants
4. Summary

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 - CEE Group - Overview
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CEE Group - Overview

CEE has been part of the Oetker Group since 2006 as an independent investment company



| Food | Beverages | Banking | Wine, sparkling wine & spirits | Other interests |
|--|---|--------------------|---|---|
| Sales: EUR 2,6 bn Employees: 12,272 | Sales: EUR 1,8 bn Employees: 5,689 | Bankhaus Lampe | Sales: EUR 0,7 bn Employees: 2,028 | OETKER COLLECTION MASTERPIECE HOTELS |



- Founded in 1852, Bankhaus Lampe is one of Germany's few independent, owner-managed private banks, with business volume of EUR 2,8 bn, Assets under Management of EUR 19,3 bn and an annual surplus in the amount of EUR 23 m.
- With over 670 employees at its twelve office locations and subsidiaries in New York, London and Vienna, Bankhaus Lampe offers the full range of high-net-worth private clients, mid-market corporate clients and institutional investors.



Investment Company focussed on Real Assets

- Clear focus on investment and asset management in the fields of infrastructure (renewable energy) and private equity
- Institutional Investors have access to regulated German and Luxembourg fund structures
- Interdisciplinary team of about 40 persons at the Hamburg office

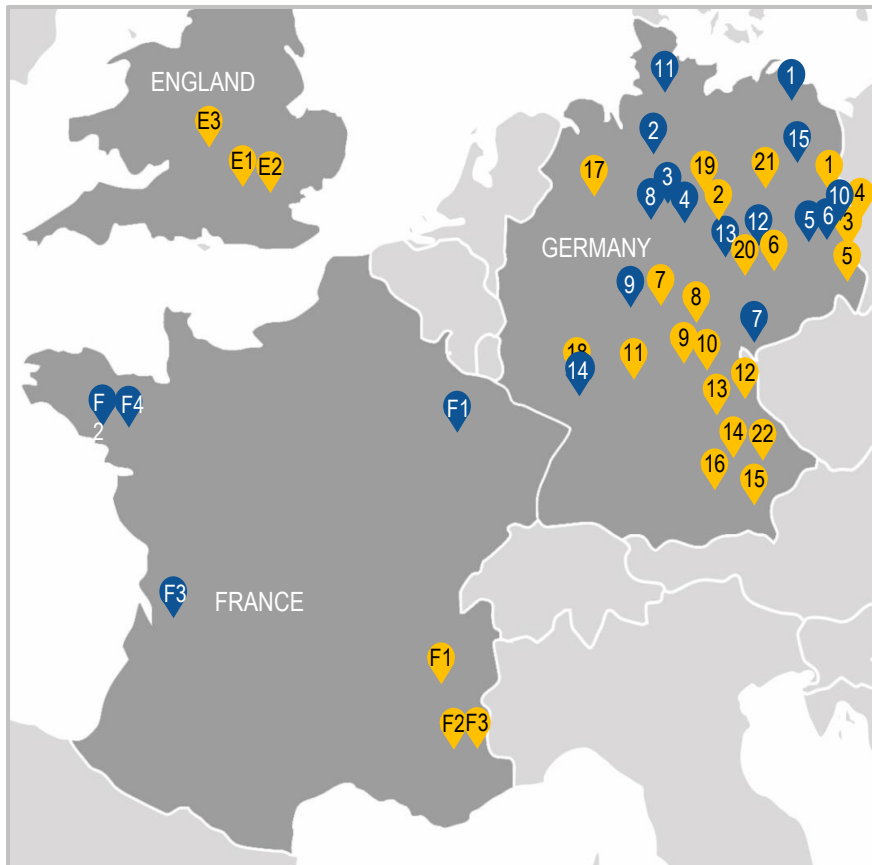


Agenda

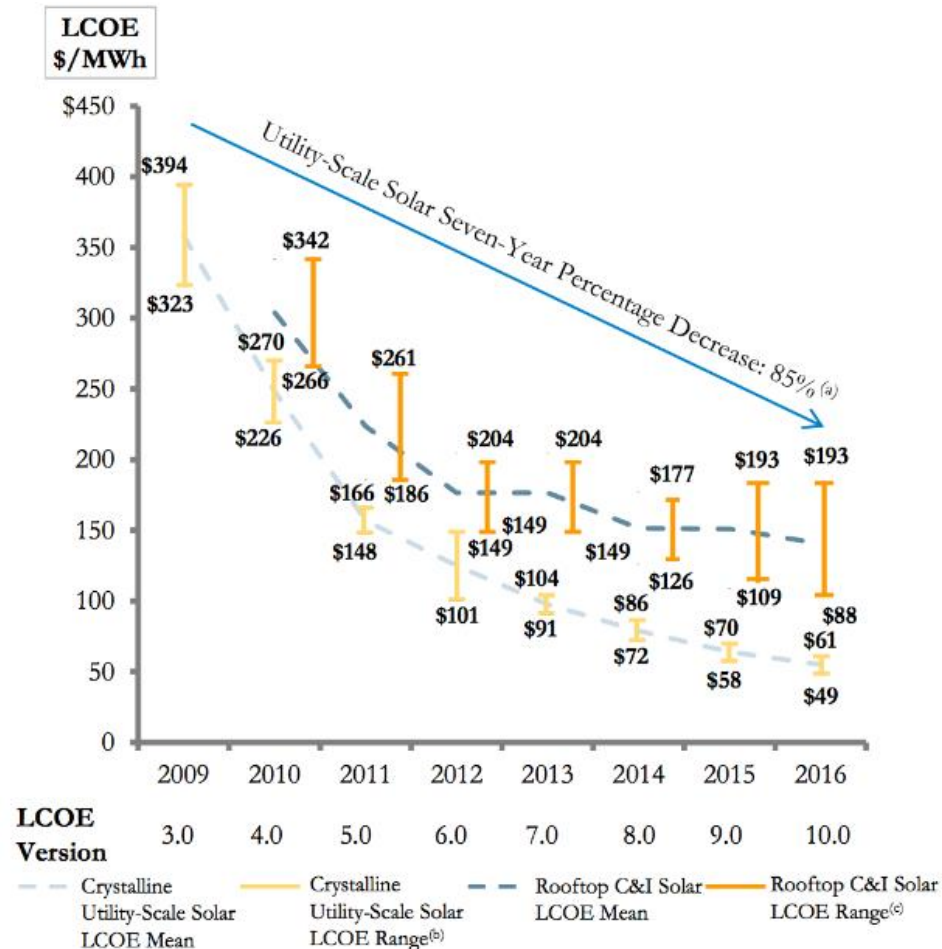
1. Introduction
2. CEE's approach to digital Asset Management
 - Motivation
 - Goals & Realization
3. Digital Plant Lifecycle Record for Renewable Energy Power Plants
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CEE Group – A diverse portfolio

Decentralization and diverse project participants require efficient tools



Motivation: Operating Costs in the LCOE* view



- CAPEX rapidly decreasing
- OPEX in LCOE-view getting more and more relevant
- O&M and Asset Management largest OPEX positions
- Improvement of the efficiency of O&M and Asset Management services thereby essential for further LCOE optimization
- Digitization of O&M processes are the key to increasing efficiency and minimizing risk

Source: Lazard

* LCOE = levelized cost of energy

Goal 1: Digital First

„We optimize all processes towards digital asset management to increase efficiency and minimize risks.“

| Betreff | Fällig bis | Priorität | Projekt | Ticket |
|--|------------|-----------|----------------------------|-----------|
| CEE PVF FRE: Versicherungsnachweis | 01.01.2017 | Norma | 10077 - CEE PVF Freimer | CONTRACT: |
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| CEE PVF FRE: Pachtzahlung leisten an | 31.12.2016 | Norma | 10077 - CEE PVF Freimer | CONTRACT: |
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| CEE PVF FRE: Pachtzahlung an Ortsge | 31.12.2016 | Norma | 10077 - CEE PVF Freimer | CONTRACT: |
| CEE PVF FRE: Grundsteuerdifferenz zw | 31.12.2016 | Norma | 10077 - CEE PVF Freimer | CONTRACT: |

Goal 2: Data Mining

„We capture as much data of our power plants as possible.“

Renewable Energy Power Plant



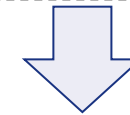
Monitoring measuring points



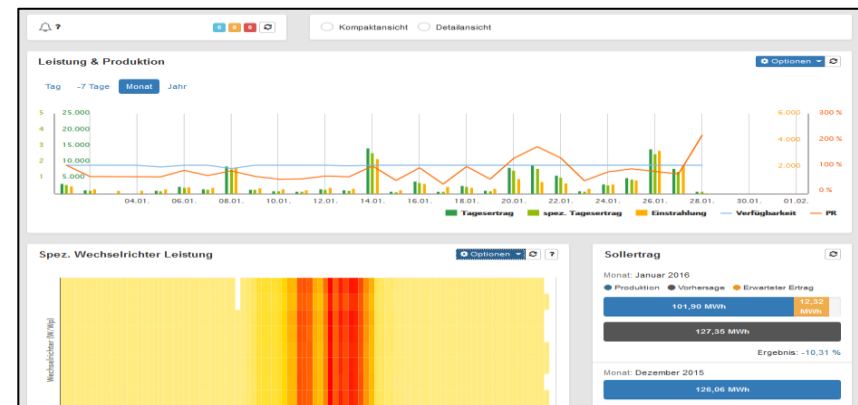
Independent sensor systems



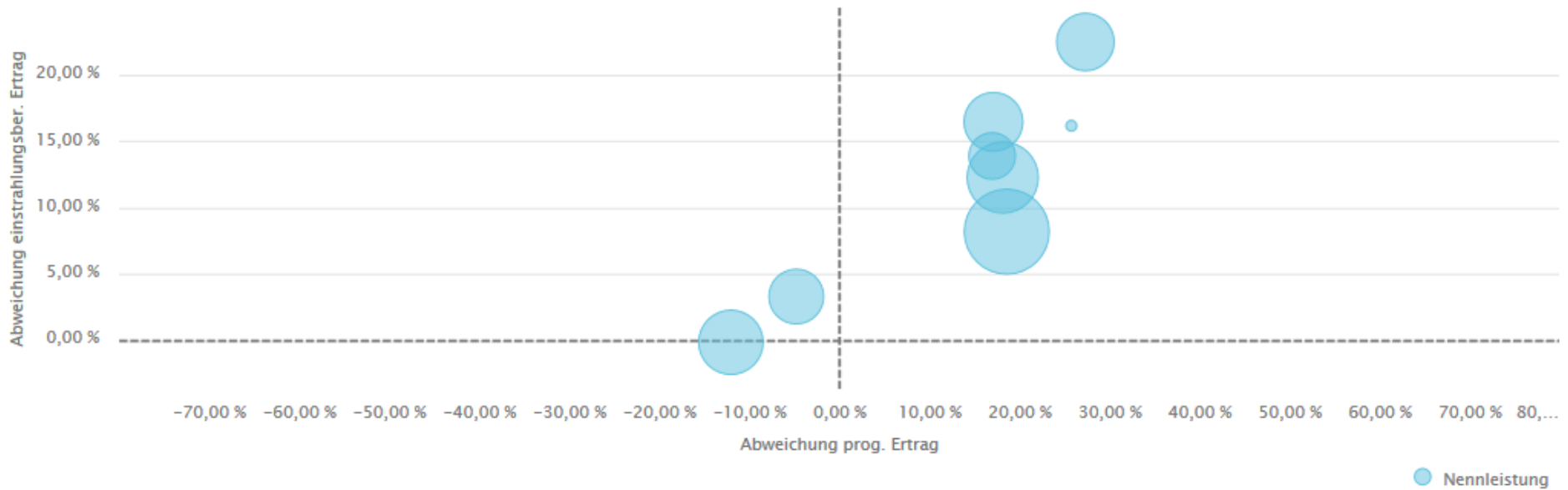
Independent metering



Central monitoring-platform



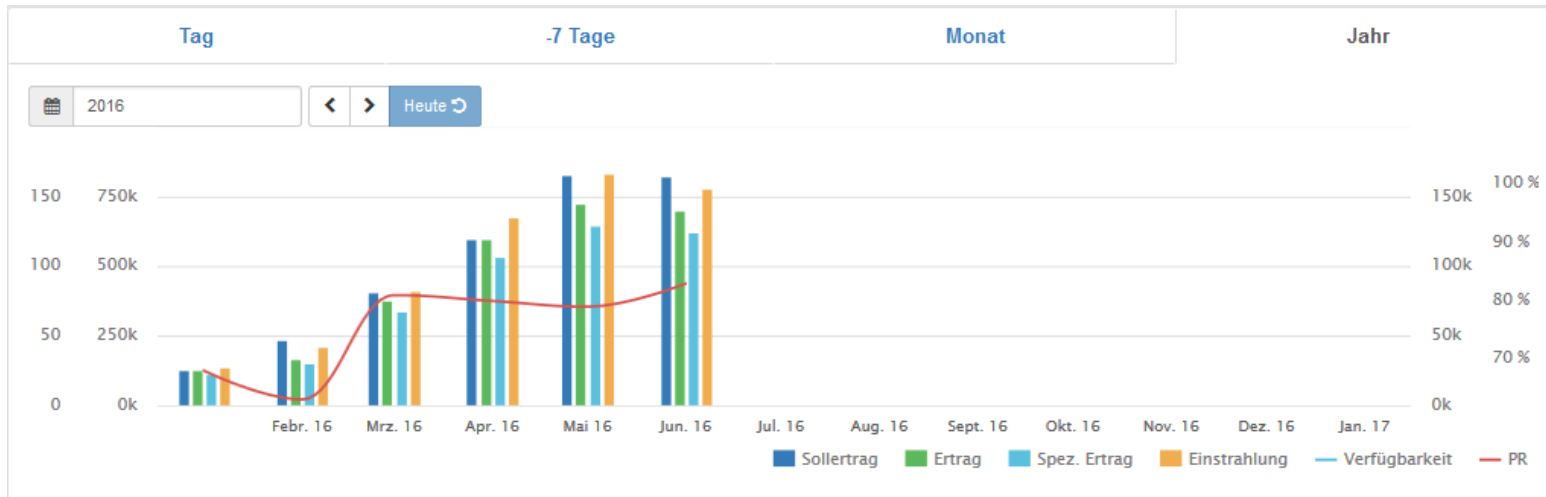
Portfolio Overview



Extremwert Filterung:

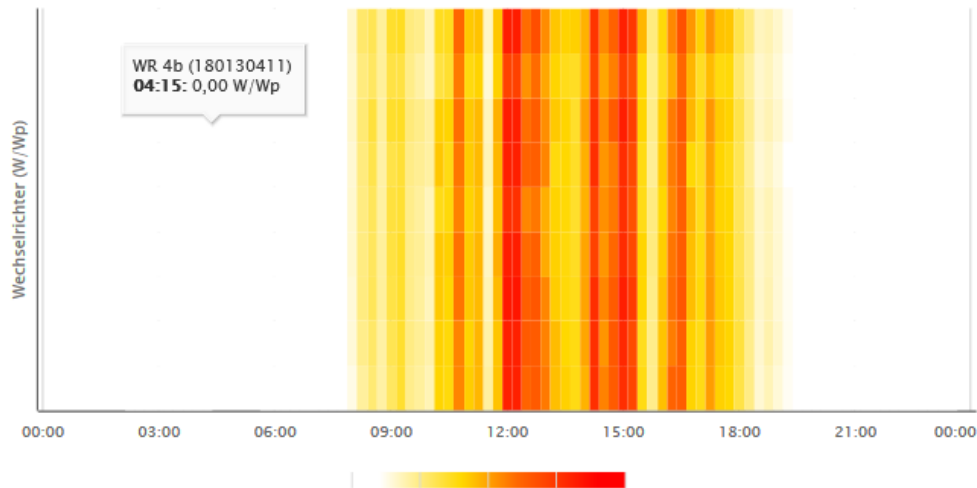
| Name | Ertrag | Sollertrag | Abweichung | EB-Sollertrag | Abweichung | Einstrahlung | Solleinstrahlung | Abweichung | Performance | Verlauf |
|---------------------------|------------|------------|------------|---------------|------------|---------------|------------------|------------|-------------|---------|
| CEE PVF Haag Gutenstetten | 727,93 MWh | 827,80 MWh | -12,06 % | 728,92 MWh | -0,14 % | 166,38 kWh/m² | 188,95 kWh/m² | -11,95 % | 78,94 % | |
| CEE PVF Haidenaab | 446,73 MWh | 382,00 MWh | 16,95 % | 392,34 MWh | 13,86 % | 155,09 kWh/m² | 151,00 kWh/m² | 2,71 % | 90,52 % | |
| CEE PVF Birkig | 177,30 MWh | 141,00 MWh | 25,75 % | 152,68 MWh | 16,13 % | 167,84 kWh/m² | 155,00 kWh/m² | 8,28 % | 89,10 % | |
| CEE PVF Ebern Heubach | 682,65 MWh | 583,00 MWh | 17,09 % | 586,33 MWh | 16,43 % | 155,88 kWh/m² | 155,00 kWh/m² | 0,57 % | 91,06 % | |
| CEE PVF Ebern TUP | 1,00 GWh | 850,00 MWh | 18,12 % | 894,50 MWh | 12,25 % | 163,11 kWh/m² | 155,00 kWh/m² | 5,23 % | 86,77 % | |
| CEE PVF Froschham | 487,40 MWh | 512,00 MWh | -4,80 % | 471,73 MWh | 3,32 % | 150,18 kWh/m² | 163,00 kWh/m² | -7,87 % | 77,77 % | |
| CEE PVF Missen | 1,54 GWh | 1,30 GWh | 18,57 % | 1,42 GWh | 8,18 % | 173,18 kWh/m² | 158,00 kWh/m² | 9,61 % | 88,23 % | |
| CEE PVF Rohr | 672,17 MWh | 528,00 MWh | 27,30 % | 549,03 MWh | 22,43 % | 159,09 kWh/m² | 153,00 kWh/m² | 3,98 % | 91,29 % | |

Project detail view



Spez. Wechselrichter Leistung

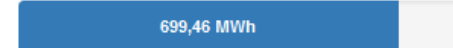
Optionen ↕ ?



Soll'ertrag

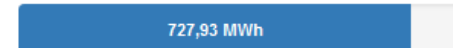
Monat: Juni 2016

● Produktion ● Vorhersage ● Erwarteter Ertrag





















Ergebnis: -14,96 %

Monat: Mai 2016



Ergebnis: -12,06 %

Inverter comparison

| | | | | | | |
|-------------------------|-----------------|--------------------|---------------------|---------------------|---------------|--|
| Station 2 | wb150028897 (2) | 4.370,86 kWh | 3,31 kWh/kW | | | |
| Wechselrichter ▲ | | Tagesertrag | Spez. Ertrag | Betriebszeit | Fehler | Verfügbarkeit |
| WR 2a | 180130428 | 2.168,29 kWh | 3,27 kWh/kW | 00:45 - 17:45 (69) | 2 | 100,00 %   |
| WR 2b | 180130430 | 2.202,57 kWh | 3,36 kWh/kW | 00:30 - 17:45 (66) | | 100,00 %   |
| Station 3 | wb150031899 (2) | 4.211,70 kWh | 3,25 kWh/kW | | | |
| Wechselrichter ▲ | | Tagesertrag | Spez. Ertrag | Betriebszeit | Fehler | Verfügbarkeit |
| WR 3a | 180130429 | 2.103,29 kWh | 3,27 kWh/kW | 00:45 - 17:45 (69) | | 100,00 %   |
| WR 3b | 180130431 | 2.108,41 kWh | 3,23 kWh/kW | 00:45 - 17:45 (68) | | 100,00 %   |
| Station 4 | wb150028807 (2) | 4.284,56 kWh | 3,31 kWh/kW | | | |
| Wechselrichter ▲ | | Tagesertrag | Spez. Ertrag | Betriebszeit | Fehler | Verfügbarkeit |
| WR 4a | 180130409 | 2.078,11 kWh | 3,21 kWh/kW | 00:30 - 17:45 (70) | 2 | 100,00 %   |
| WR 4b | 180130411 | 2.206,45 kWh | 3,41 kWh/kW | 00:30 - 17:45 (67) | 2 | 100,00 %   |
| Station 5 | wb150031790 (2) | 4.305,24 kWh | 3,31 kWh/kW | | | |
| Wechselrichter ▲ | | Tagesertrag | Spez. Ertrag | Betriebszeit | Fehler | Verfügbarkeit |
| WR 5a | 180130410 | 2.016,93 kWh | 3,13 kWh/kW | 00:30 - 17:45 (70) | 2 | 100,00 %   |
| WR 5b | 180130412 | 2.288,31 kWh | 3,48 kWh/kW | 00:30 - 17:45 (66) | 2 | 100,00 %   |
| Station 1 | wb150031878 (1) | 1.296,17 kWh | 3,21 kWh/kW | | | |
| Wechselrichter ▲ | | Tagesertrag | Spez. Ertrag | Betriebszeit | Fehler | Verfügbarkeit |
| WR 1 | 180150046 | 1.296,17 kWh | 3,21 kWh/kW | 02:15 - 17:45 (60) | 2 | 100,00 %   |

Alarms & Error Reports

Diagramm

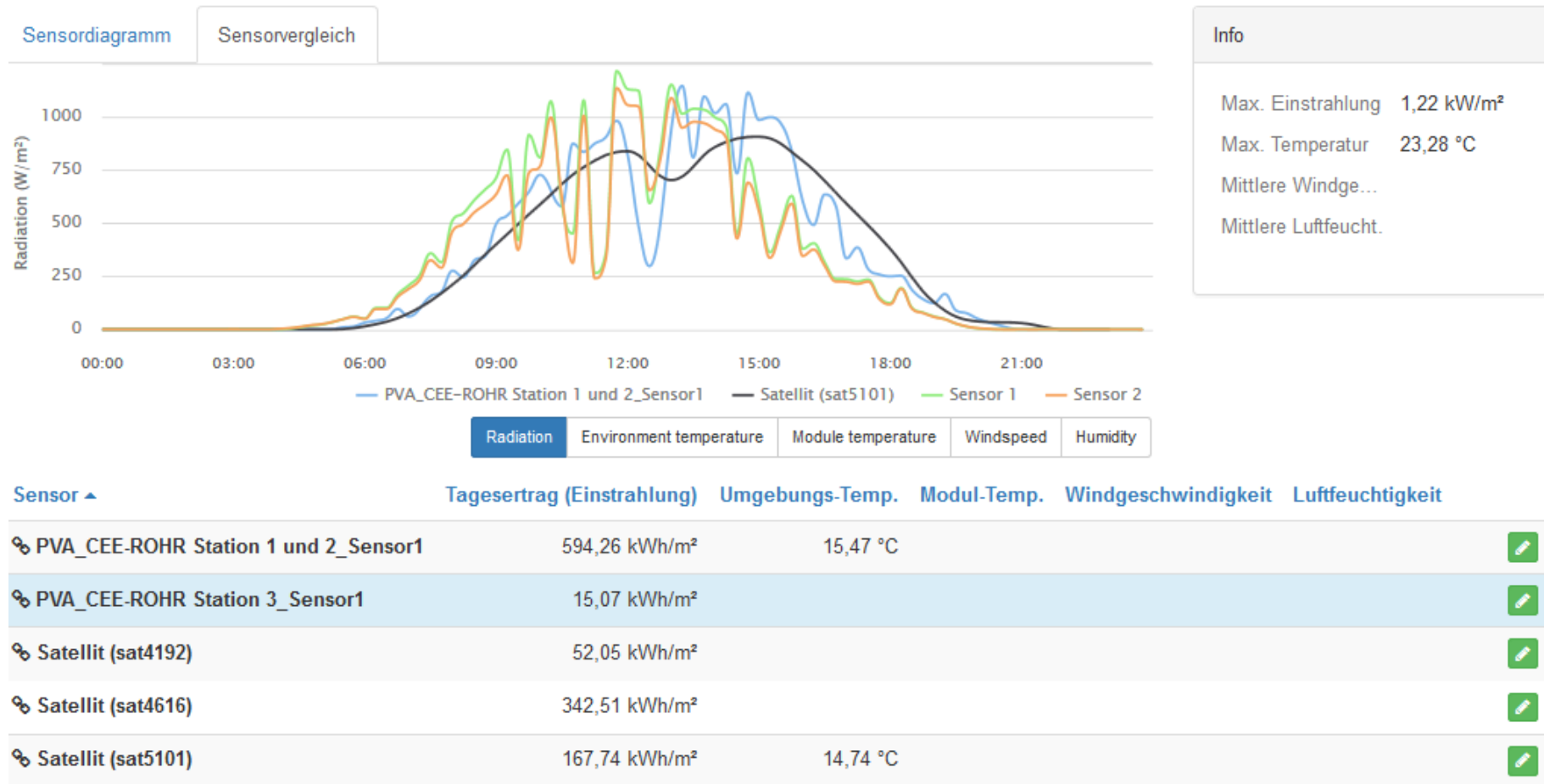
Status/Fehler



| Zeitspanne | Status |
|---------------|----------|
| 00:30 ↔ 05:30 | 1 |
| 05:45 ↔ 05:45 | 2,298246 |

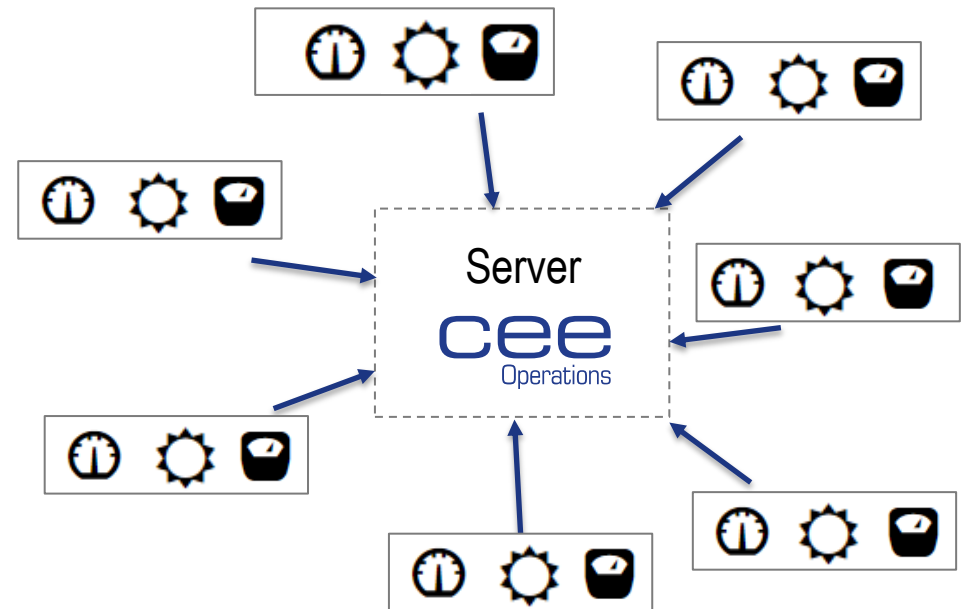
| Zeitspanne | Fehler |
|---------------|-----------|
| 17:00 ↔ 17:00 | 26,949153 |
| 17:15 ↔ 23:45 | 30 |

Comparison of Sensor Data



Goal 3: Data Ownership

„We are in the possession of our data in order to remain capable of acting in case we need to change a technical service provider.“



Goal 4: Security

„We protect our data against unwanted access or loss.“



Goal 5: Standardization

„In the heterogeneous actors landscape we consider the unification of interfaces and processes as a compelling requirement for an efficient management of the power plants.

We therefore support the **creation of industry standards.**“

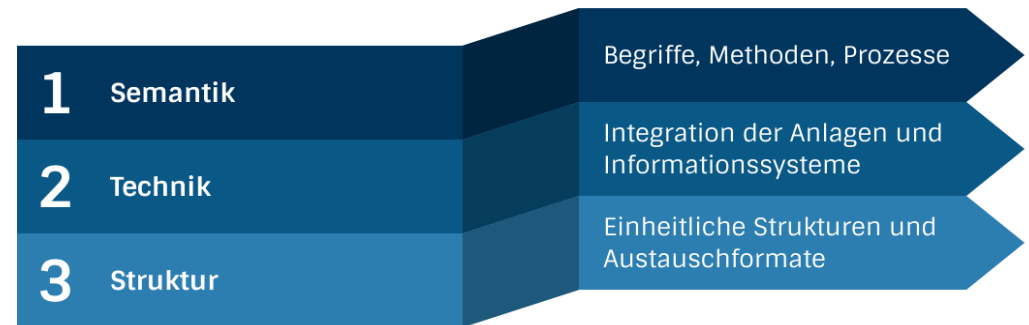


Agenda

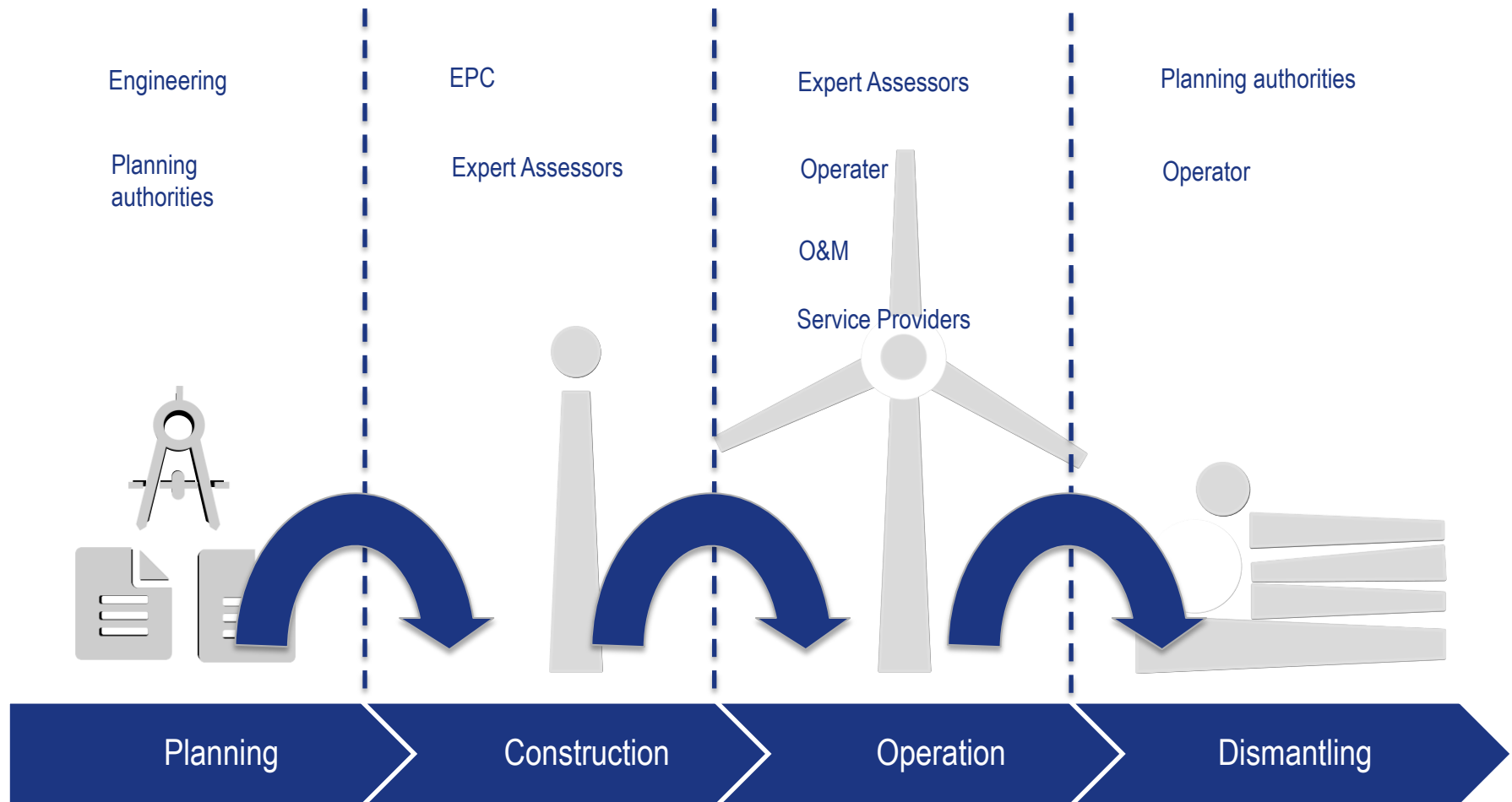
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Digital lifecycle record according to DIN* 77005

„The digital lifecycle record for renewable energy power plants is an integrated information system, which allows the uniform, structured and coherent management of all relevant informations.“



Consistent set of documentation through the lifecycle

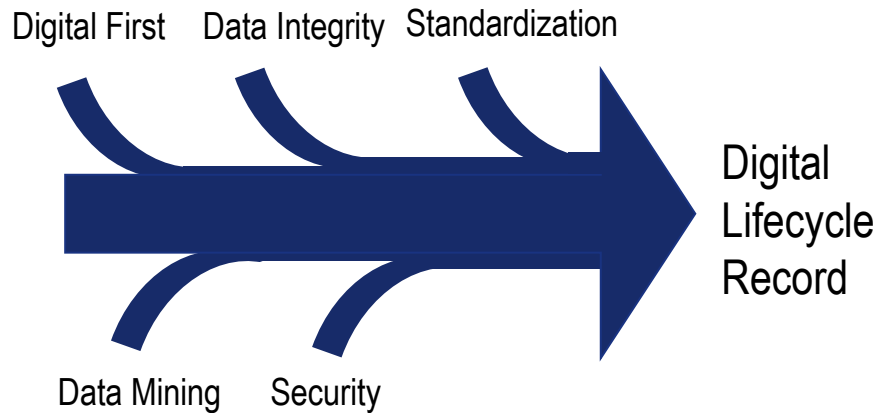


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Summary



- CEE Group pushes for **full digitalization in the asset management** of its renewable energy power plants.
- Quantitative data is already captured standardized for the most part of the portfolio. The uniform handling of **qualitative information** of the various actors remains a challenge.
- For a uniform handling of heterogeneous information, **industry-wide standards** are essential.
- The **digital plant lifecycle record** plays a central role as an integrated information system that integrates existing systems and creates cross-references between these information in the further digitalization.



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