
# Increase reliability of your transformers through forthcoming CompactCool Technology, Prognostics & Predictive Analytics

**POWERING GOOD FOR SUSTAINABLE ENERGY**

**HITACHI ABB POWER GRIDS**

# Background

## Liquid Immersed and Dry-type Transformers Values

Uses **LIQUID** for main dielectric and cooling media

| Liquid-immersed | Feature | Dry-type |
|---|---|---|
| ✓ | Size & Weight | |
| ✓ | Initial Cost | |
| ✓ | Losses/Efficiency | |
| ✓ | Noise | |
| ✓ | Overload capability | |
| | Fire Safety | ✓ |
| | Environmental Safety | ✓ |
| | Total Installation Cost* | ✓ |
| | Maintenance Cost | ✓ |
| | Short Circuit Strength | ✓ |

Uses **SOLID INSULATION** materials for main dielectrics and natural **AIR** for cooling

# The challenge – Wind, Solar, Data Centers

## Meeting Footprint Requirements

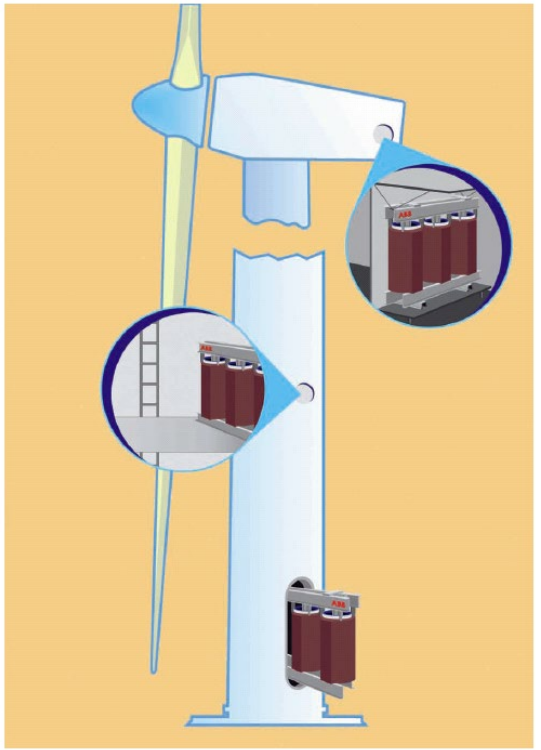
Due to the cooling and insulation methods of Dry-type transformers, meeting dimensional requirements has been one of the challenges.

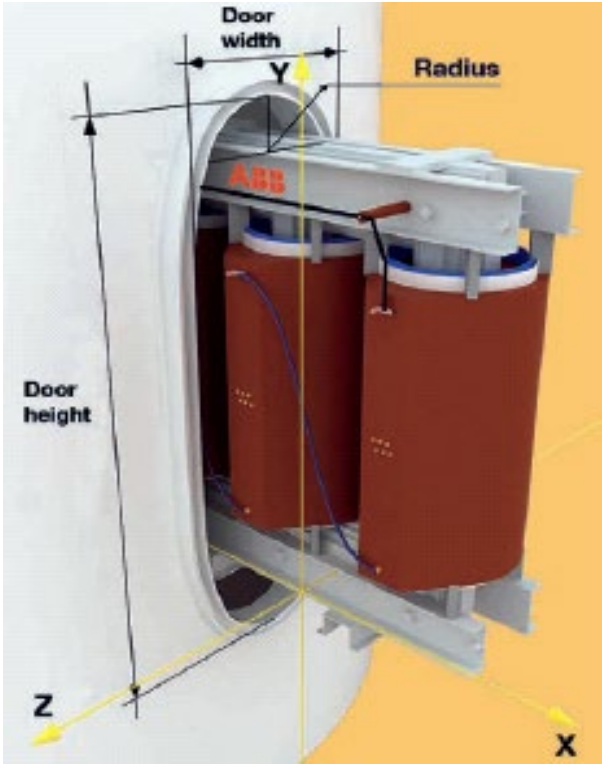
**Compactness** and **small footprint** requirements are two of the main challenges of the segments where the demand of **higher power density** is increasing.

## Control of Internal Substation Losses

Data centers' efficiency metrics is based on **power usage effectiveness** (PUE) and electrical losses have negative impact on PUE.

Similarly, transformer losses extracted into wind towers and solar containers are causing customers to invest on additional HVAC equipment to cool down the ambient.



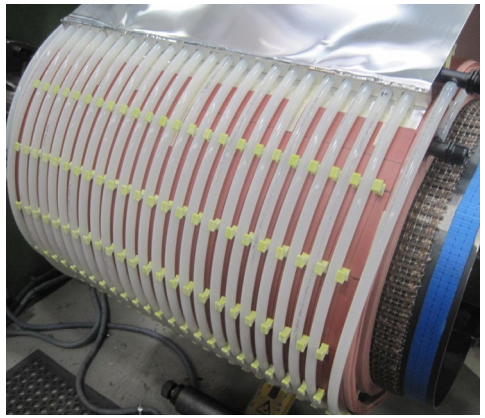


# The solution: CompactCool

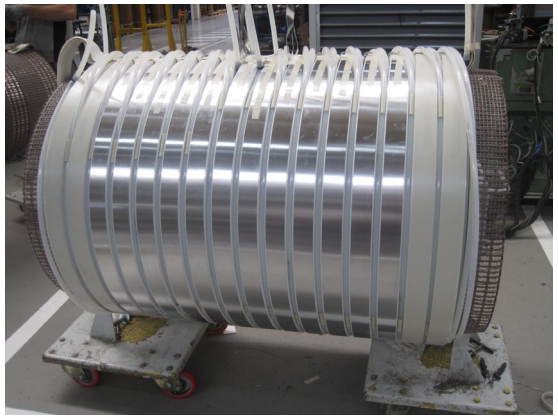
## Introducing new cooling technology

**CompactCool** is the technology combining dry-type solid/air insulations with direct liquid cooling.

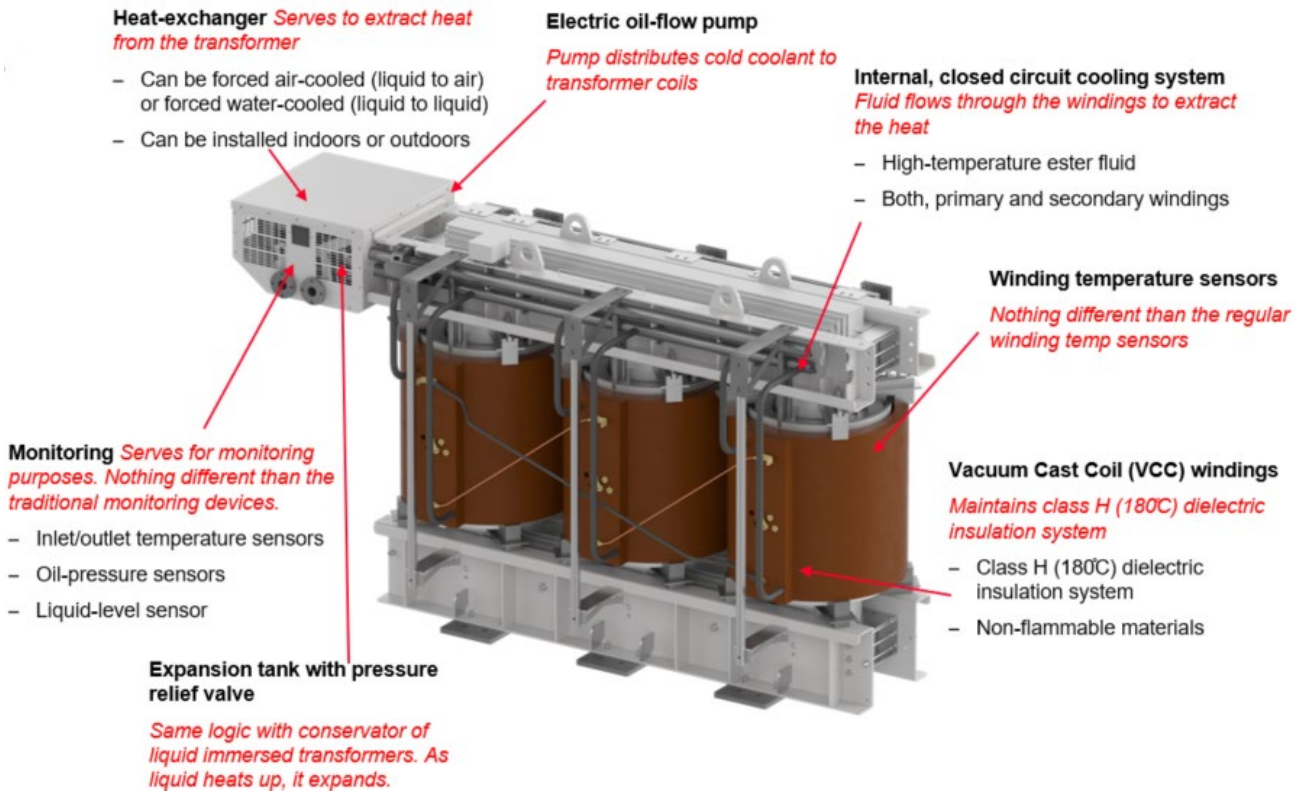
It forces a **fluid** to flow through the **windings** of the dry type transformer in order to **extract the heat** and transfer it to an **external heat-exchanger** that dissipates the losses; either to the ambient with a liquid-air heat-exchanger or to a fresh-water source through a liquid-liquid exchanger.



LV winding



HV winding



# The solution: CompactCool

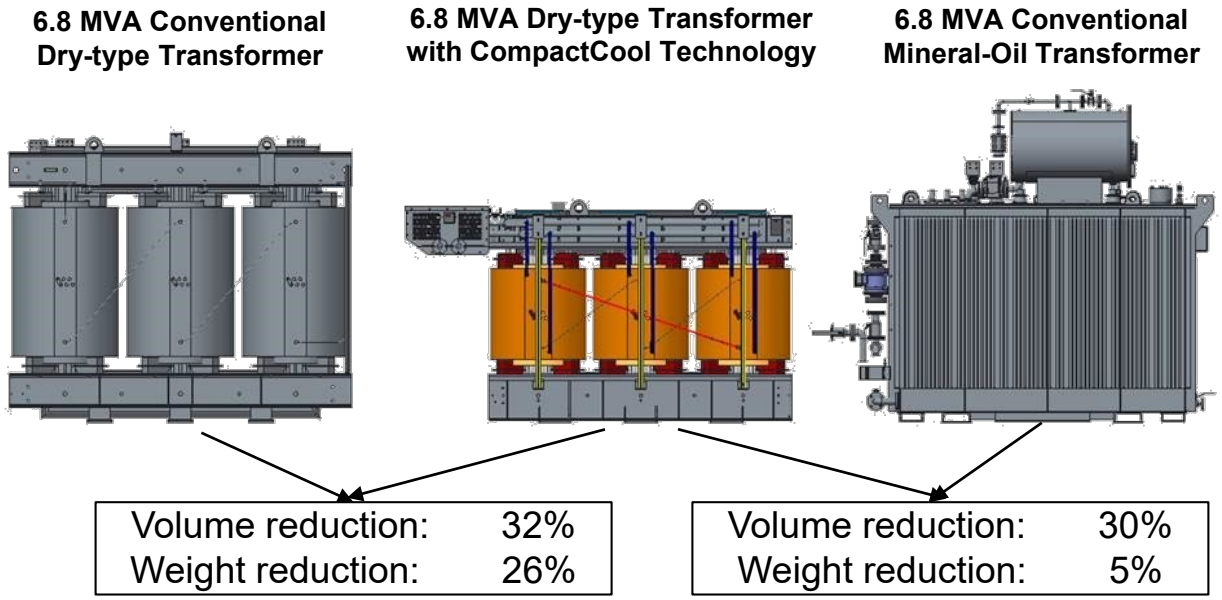
## Footprint, Controlled Losses, Environmentally Friendly

– **Weight and size benefits**
  - Conventional dry type technologies: Starting at 5 MVA and up (the larger the better) (~15-50%)
  - More watts per box (ideal for containerized solutions)

– **Environmentally friendly**
  - 98% reduction of cooling liquid volume (compared to liquid immersed transformers)
  - Ester fluid (non-hazardous waste), less losses and less material

– **Less HVAC requirement on site**
  - External heat exchanger connected to customer's central cooling system: no need to install fans/air extractors on enclosures.
  - Up to 90% of the losses can be captured at 100 % loading

– **Conventional Dry-type transformer values are maintained.**




## Scope

- Up to 30 MVA, 72kV
- VCC
- Cooling fluid: only Ester
- ≤ (2) LV windings

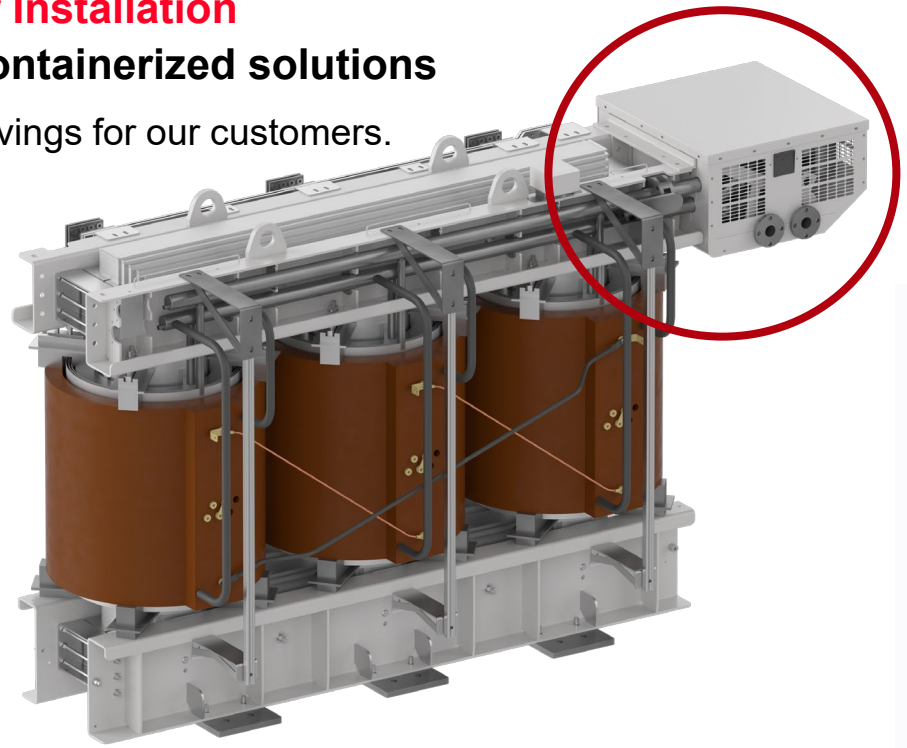
# Case example

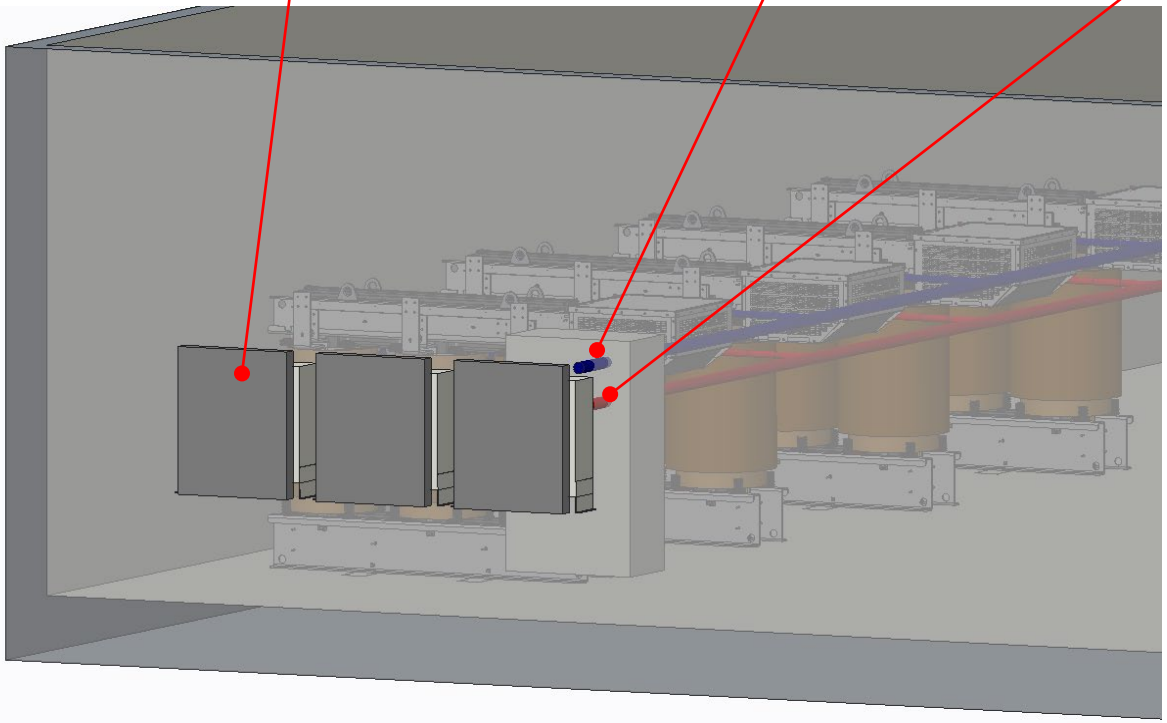
Extraction of losses in a controlled way.
Up to 90% of the losses can be extracted when transformer is 100% loaded.

## Data Center Installation

**Ideal for: Containerized solutions**

Brings cost savings for our customers.






## Reduced Costs

Possibility to use central cooling systems
Possibility to extract the losses to an outside ambient
Less HVAC system installation for our customers

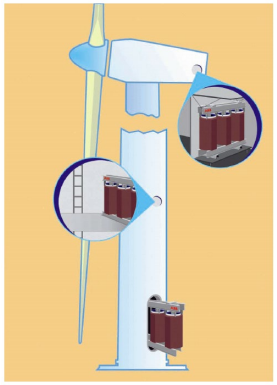
# Case example

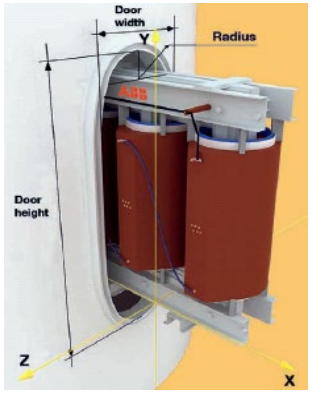
Extraction of losses in a controlled way.
Up to 90% of the losses can be extracted when transformer is 100% loaded.

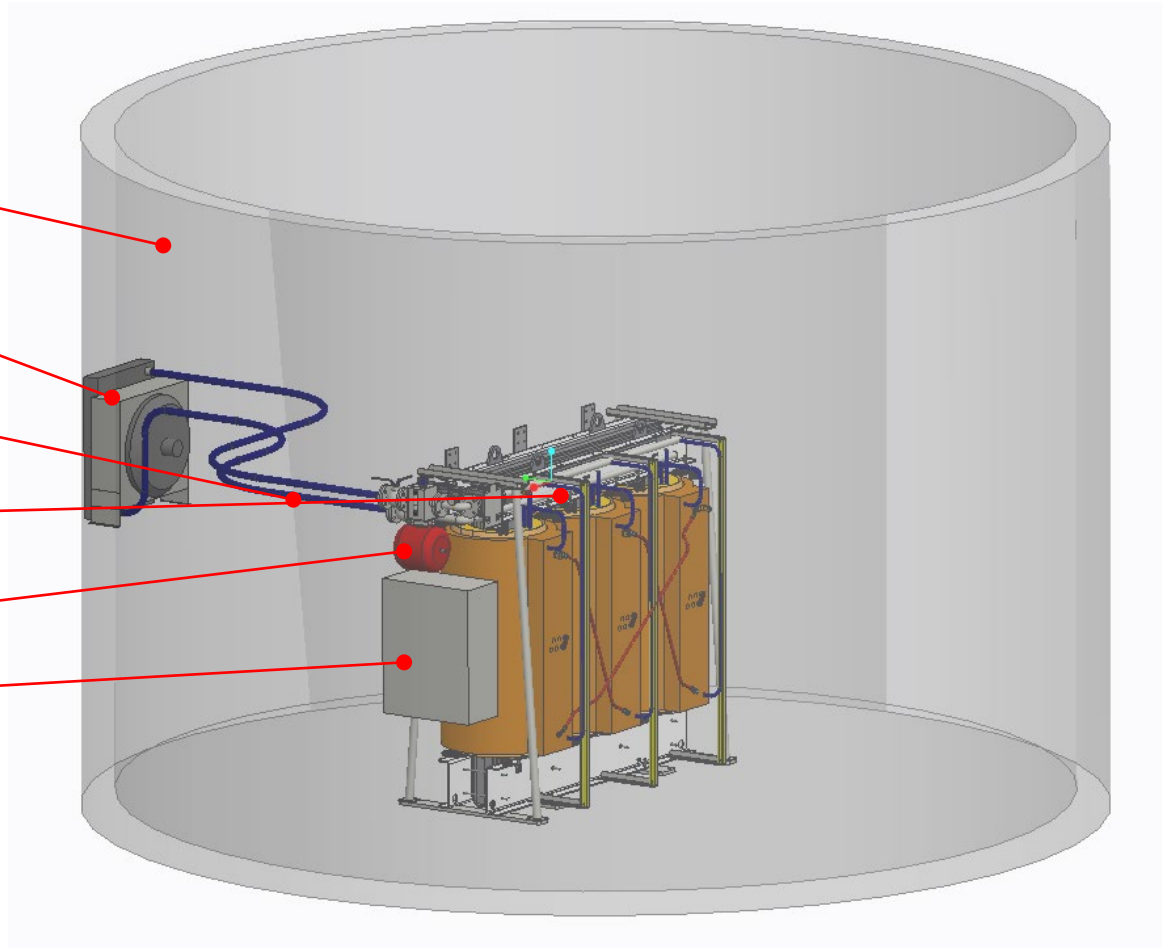
## Wind Installation

**Ideal for: Above 5 MVA**

Heat Exchanger is installed externally to extract the losses outside of the turbine.






## Reduced Costs

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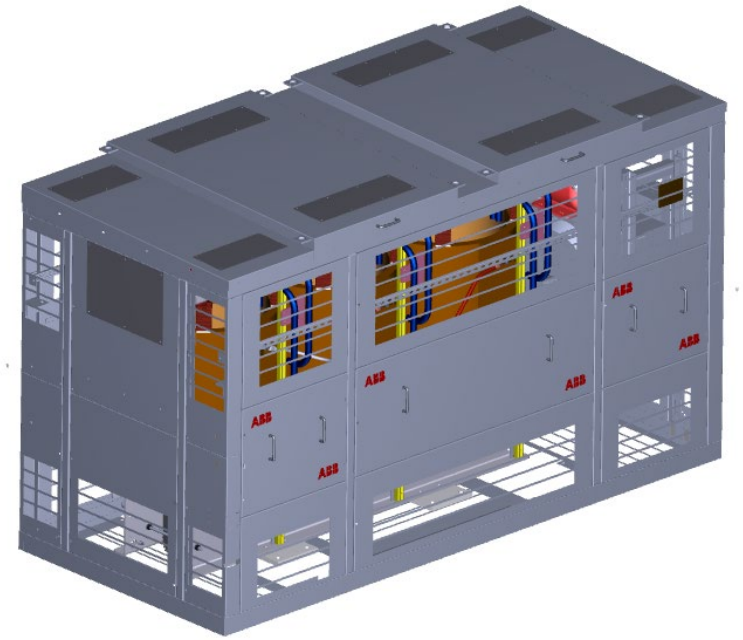
# Case example

## Solar Installation

**Ideal for: When there is height limitation**



**Alternative 1:**

– 3510 kVA Dry type transformer with CompactCool technology with reduced dimensions

**Alternative 2:**

– 5000 kVA Dry type transformer with CompactCool technology to fulfill same dimensional restrictions as base case

**Alternative 3:**

– 7000 kVA Dry type transformer with CompactCool technology to be installed in same enclosure (considering +200 mm height due to extractor elimination)

**More Watts per Box!**

## Reduced Size

Up to 50% reduction depending on power rating; the larger the better

# Final takeaways

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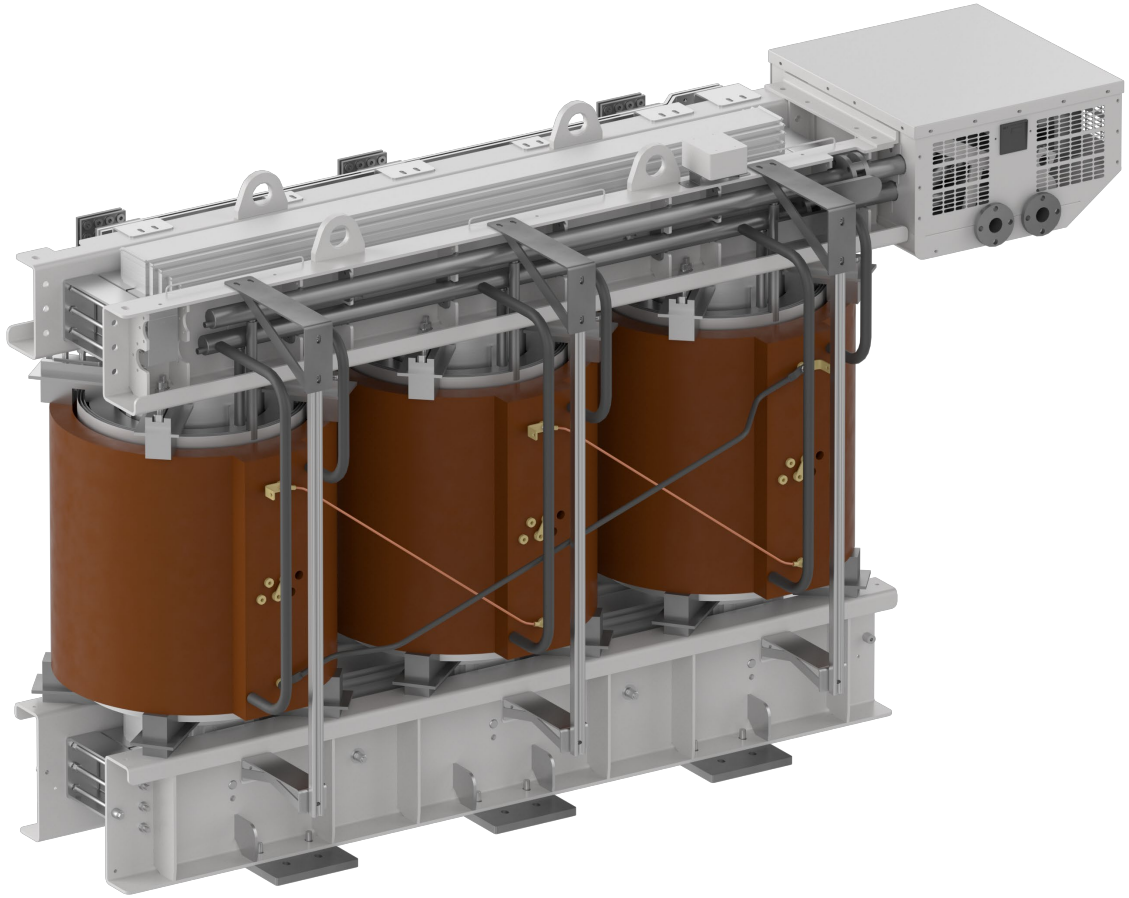
**Weight & Size Reduction**

**Less HVAC Investments for Customers**

**Environmentally Friendly**

**Conventional Dry-type transformer values are maintained**



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# CompactCool Technology for superior performance

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# Our shared DNA and joint solution areas

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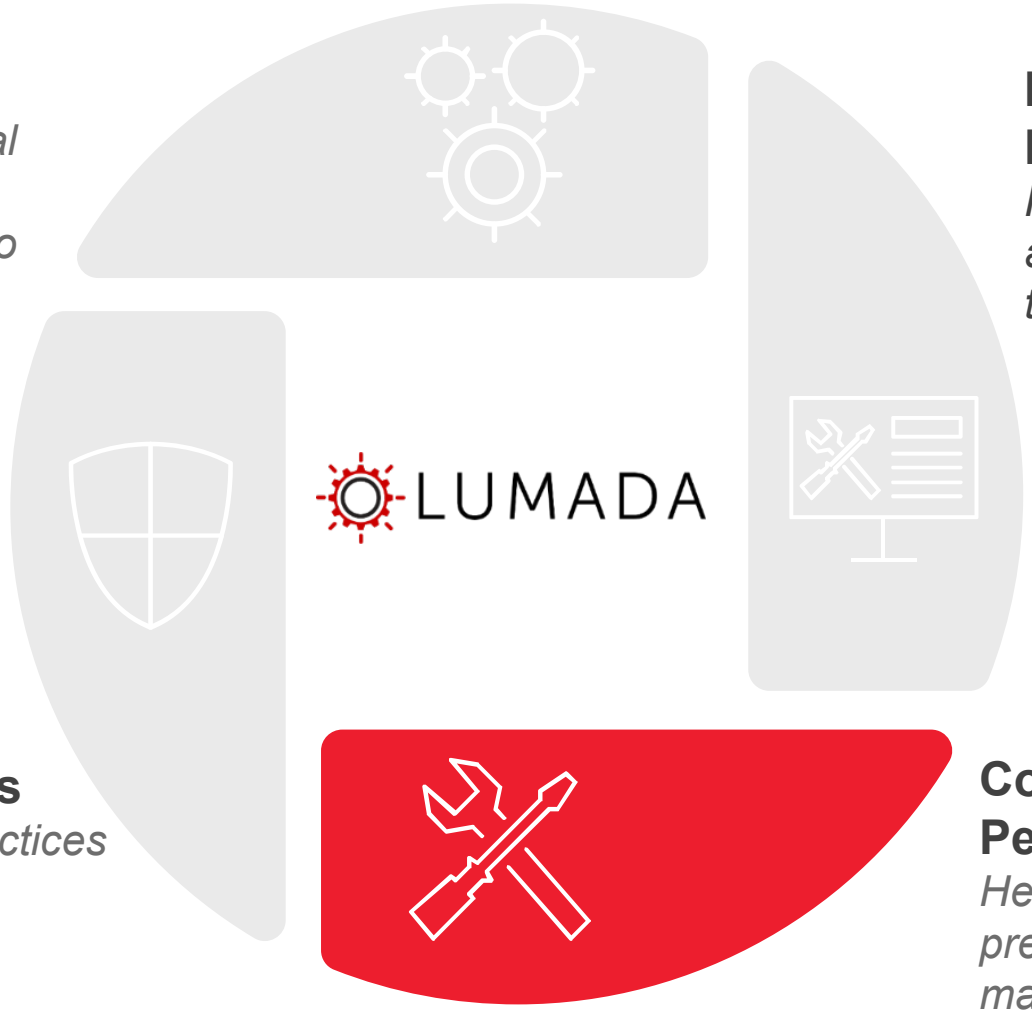
## Digital Transformation & Data Modernization

*Advising and supporting customers on their digital transformation journey, enabling better access to insights from data.*




## Intelligent Operations Management

*Helping customers more efficiently and effectively operate and maintain their assets.*

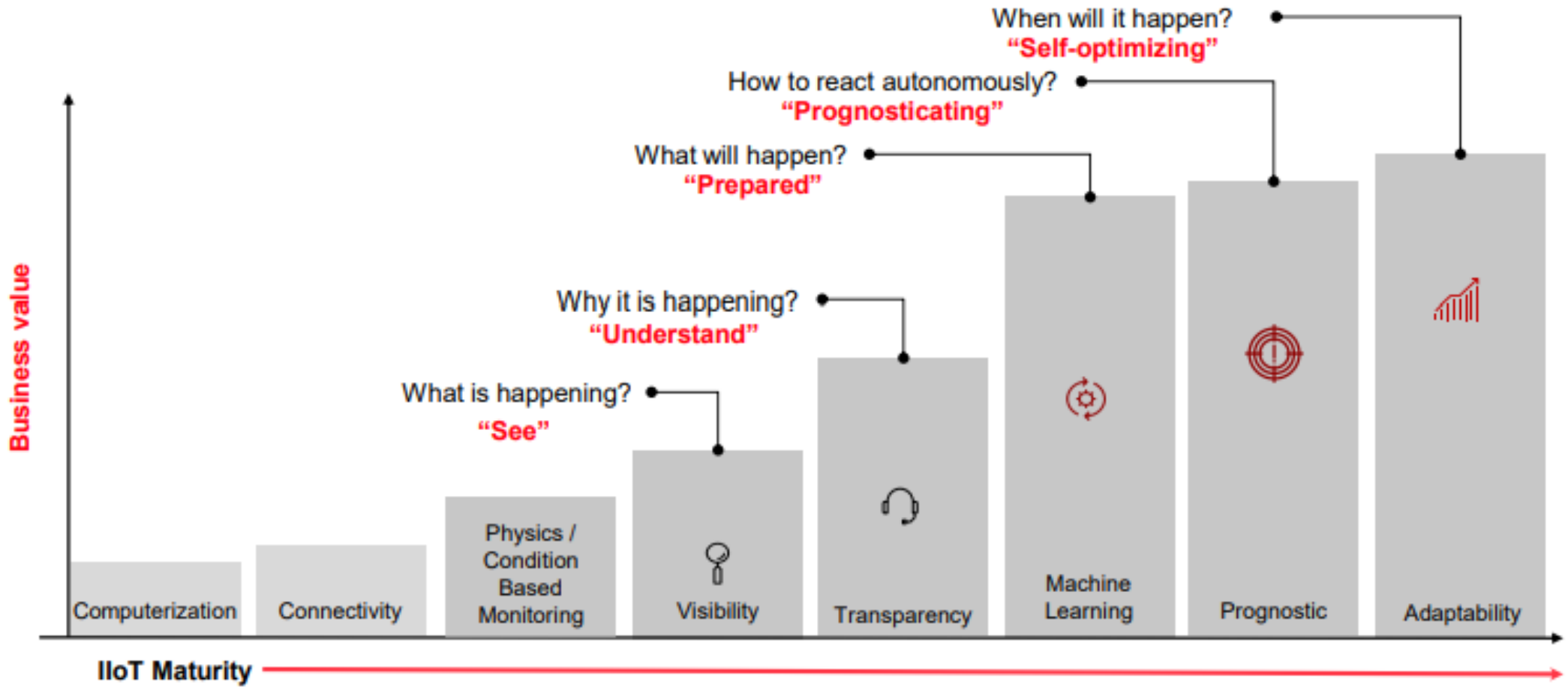
## Health, Safety & Environment Solutions

*Helping to ensure safe practices for workers and a safe environment for the public.*

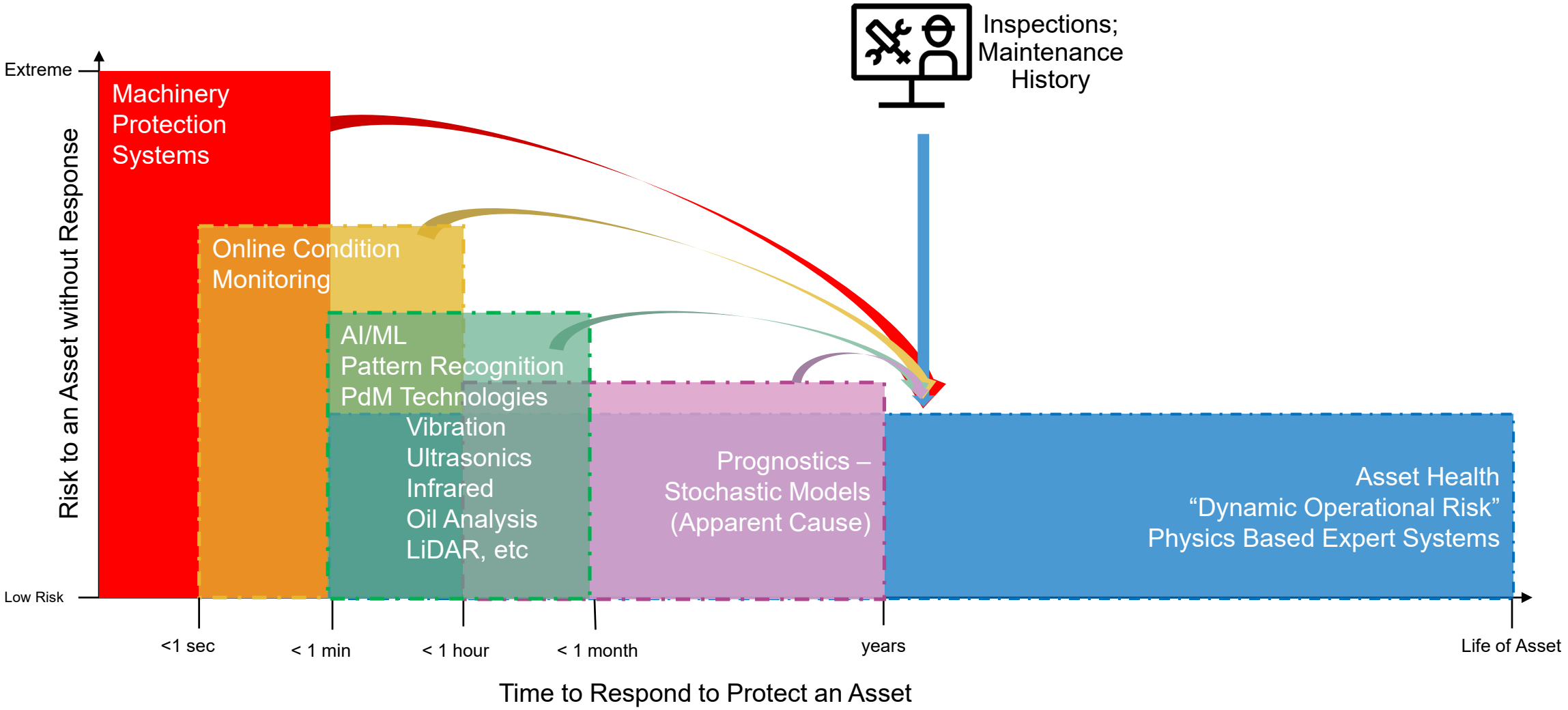
## Connected Asset Performance

*Helping customers predict and prevent failures, optimize maintenance strategy.*

# Market drivers for asset performance in Industry 4.0

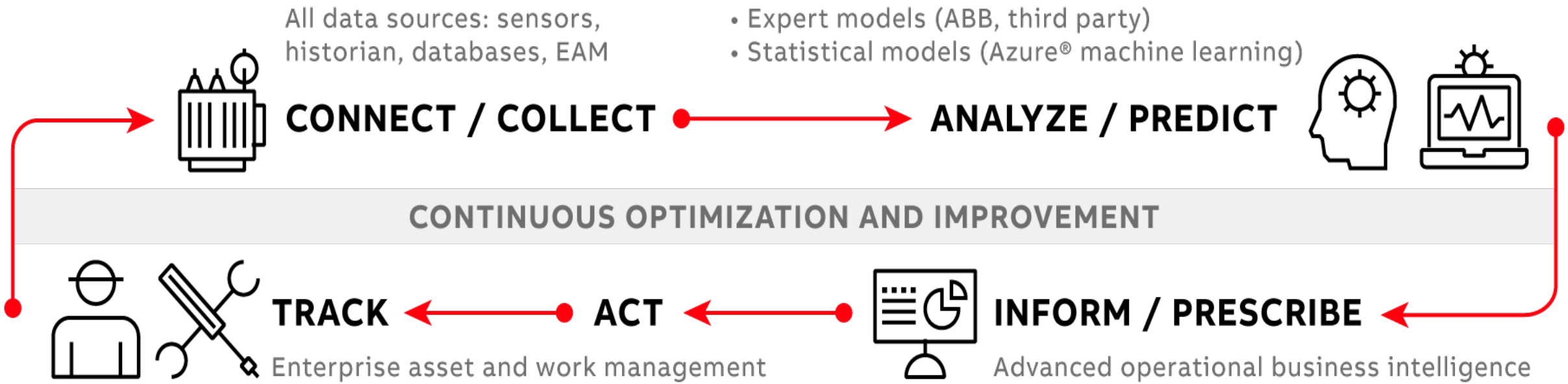


# Risk to Asset without Response

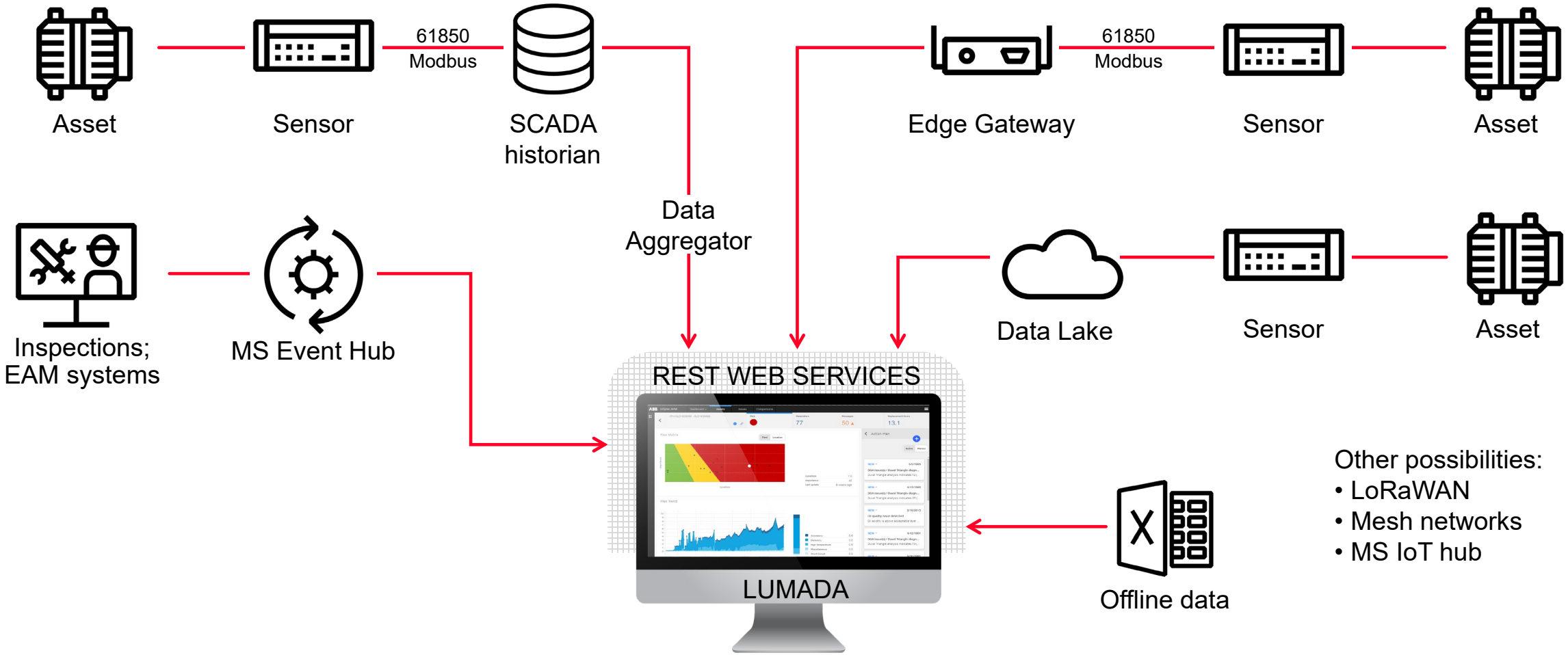


# Lumada Prognostics

## Enterprise asset health analytics to improve processes through risk-based optimization



# Connect and Collect




Other possibilities:
- LoRaWAN
- Mesh networks
- MS IoT hub

# Examples of Performance Models

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### Expert Models
Built based on the foundation of 70 plus years of experience in servicing equipment's

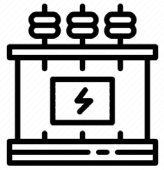
### Advanced Physics based Algorithms
Years of domain knowledge gone into building these algorithms

### Thousands of Expert Recommendations
Codified servicing expertise to recommendation

### Advanced Mathematical Models
Stochastic process model (Markov), Stochastic inference model (Bayes)

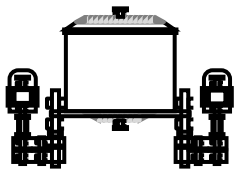
### Remaining Useful Life curve
For rotating equipment's like turbines, motors, pumps etc.

## Critical Assets

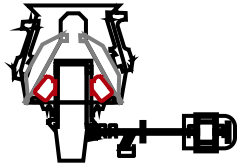


Transformers

Circuit Breakers



SAG Mill/Cracker



Pressure Valves

Pump/Compressors

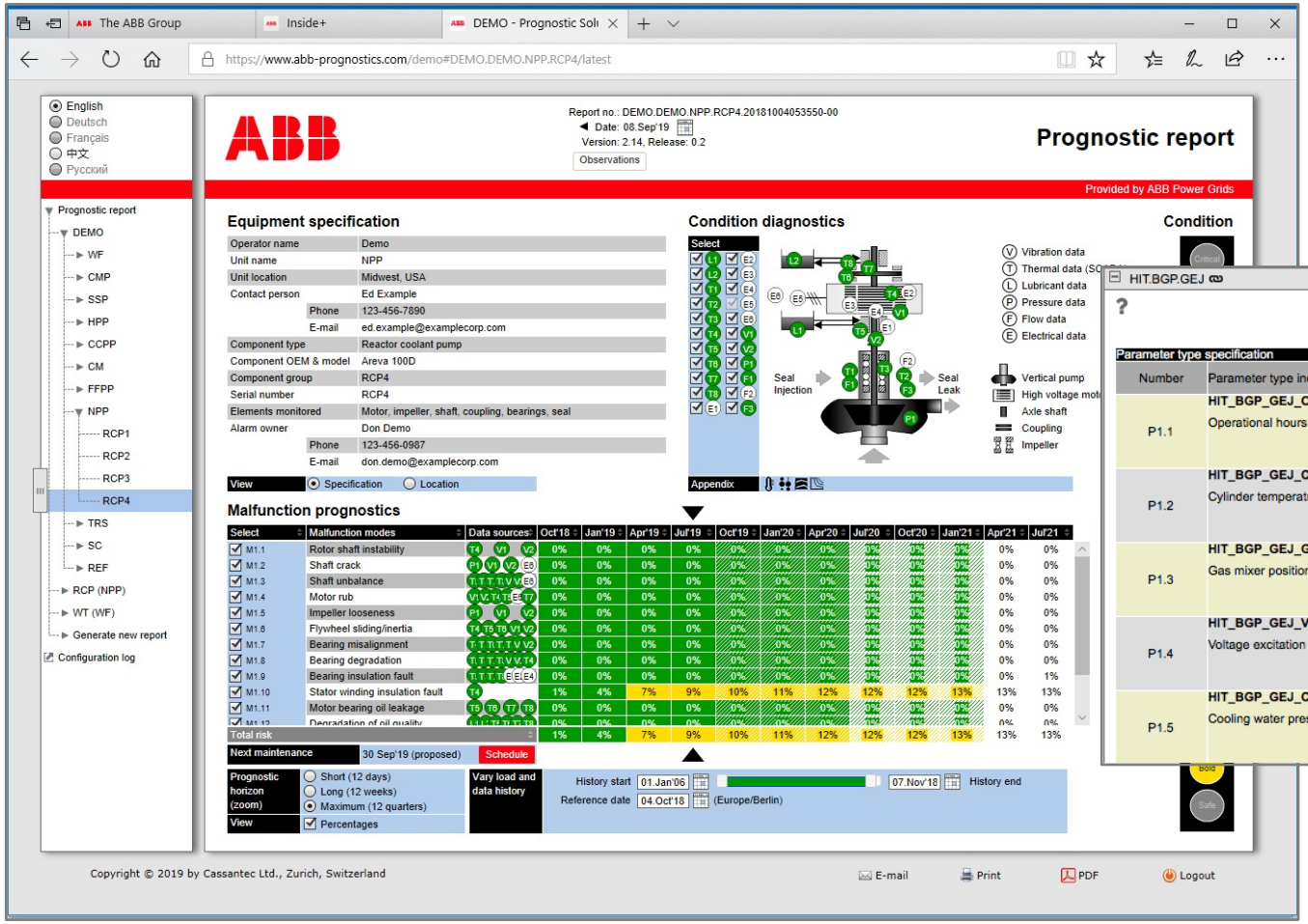
Motors

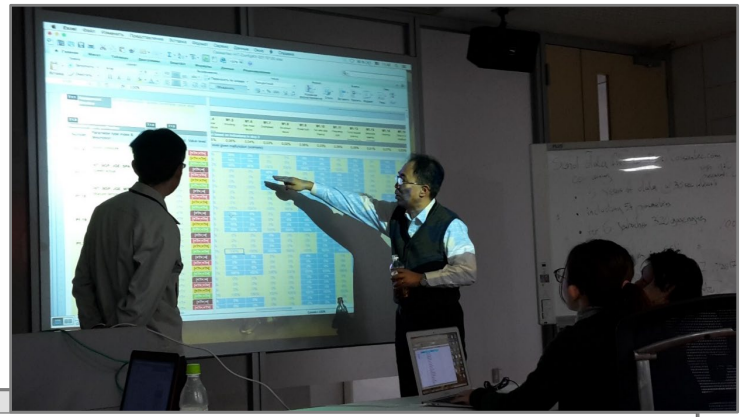
## Electrical and Rotating Equipment's (**200 plus**)

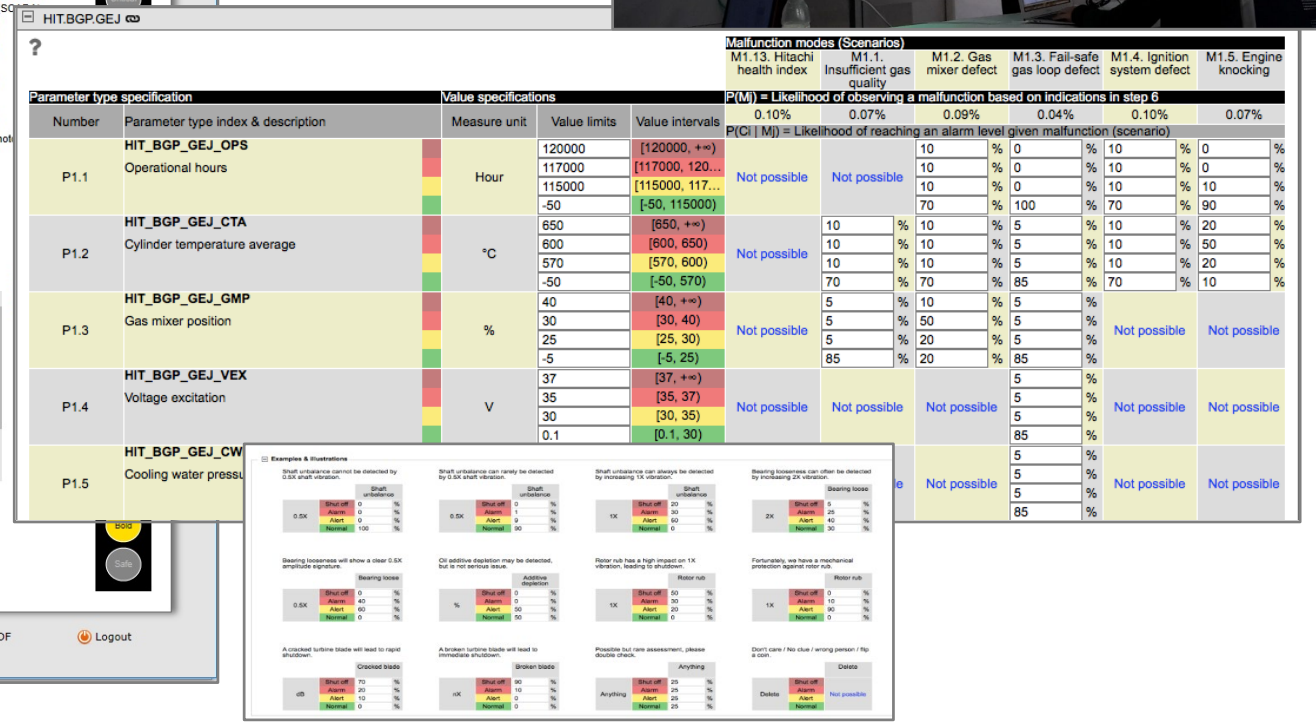
| | | | | | |
|---|---|---|---|---|---|
| Steam Turbines<br>Capacitor Banks<br>Reactors<br>Battery Banks | Cables<br>Motors<br>Pulverizer<br>Draft fan | CCVT<br>Surge Arrestors<br>Proppant mixer<br>Variable speed drive motor | Conveyors, feeders<br>Cyclone pump<br>Tertiary crusher | Ball Mill<br>Diesel engine<br>Sag Mill | Heat Exchangers<br>Suction rolls<br>Compressors<br>Ventilator |

# Online configuration & validation toolkit (CVT)

The CVT allow creation, validation and management of prognostic performance models



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From this October, we are evolving to become **Hitachi Energy!**
Together, with customers and partners, we are excited to be accelerating the transition towards a **carbon-neutral energy future.**

# Questions and answers


## Thank you!


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