



**Hoe worden HS-stations en
componenten ontwikkeld voor
toekomstige ...?**

Wide range CT's

To help us

Towards a stronger energy transition

Co-creation of a new purpose: wide range current transformers

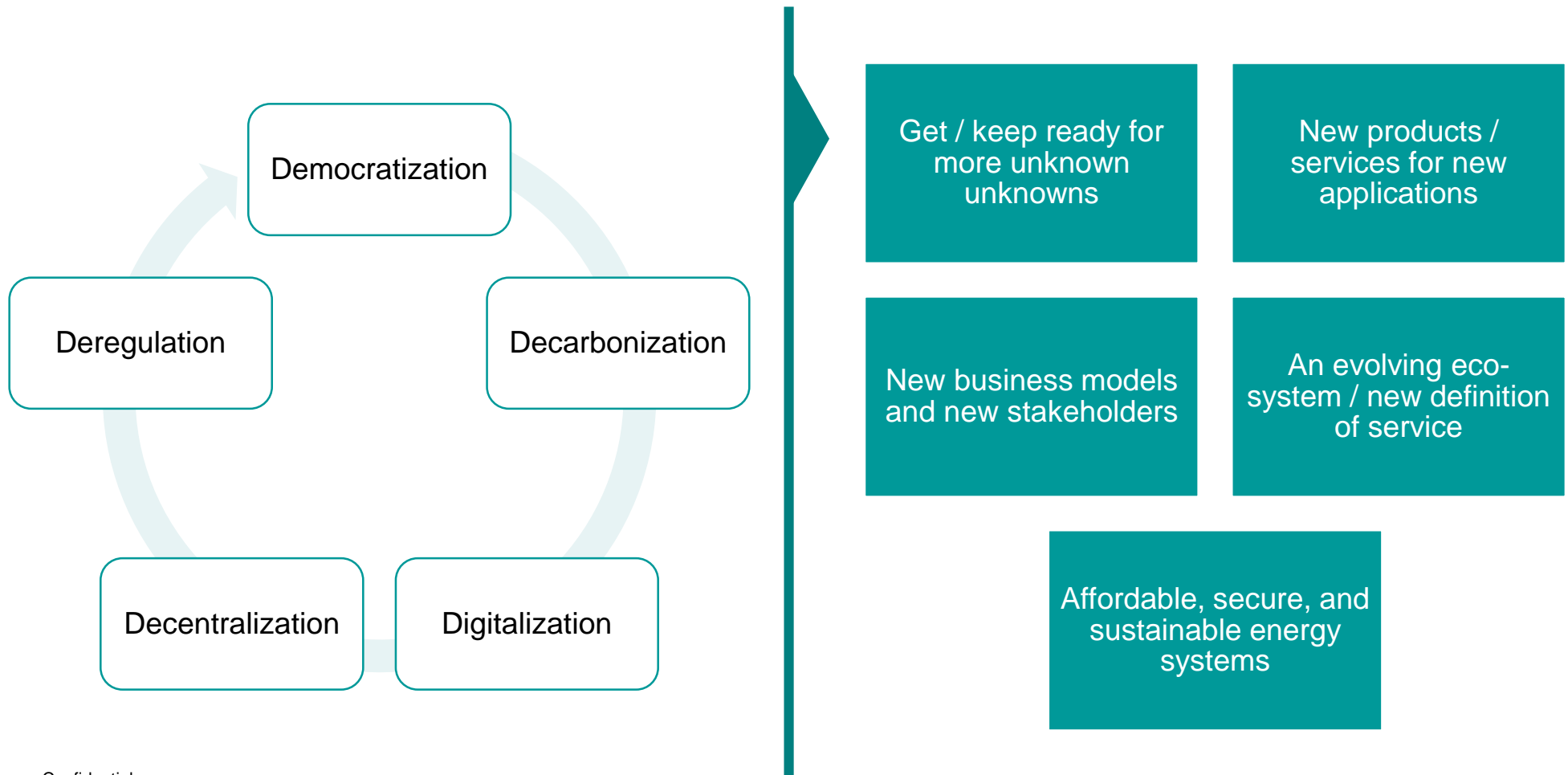
- Why this is an important topic?
- How to formulate the issue we are talking about?
- What might be a concept solution?
- Is this just a hope?
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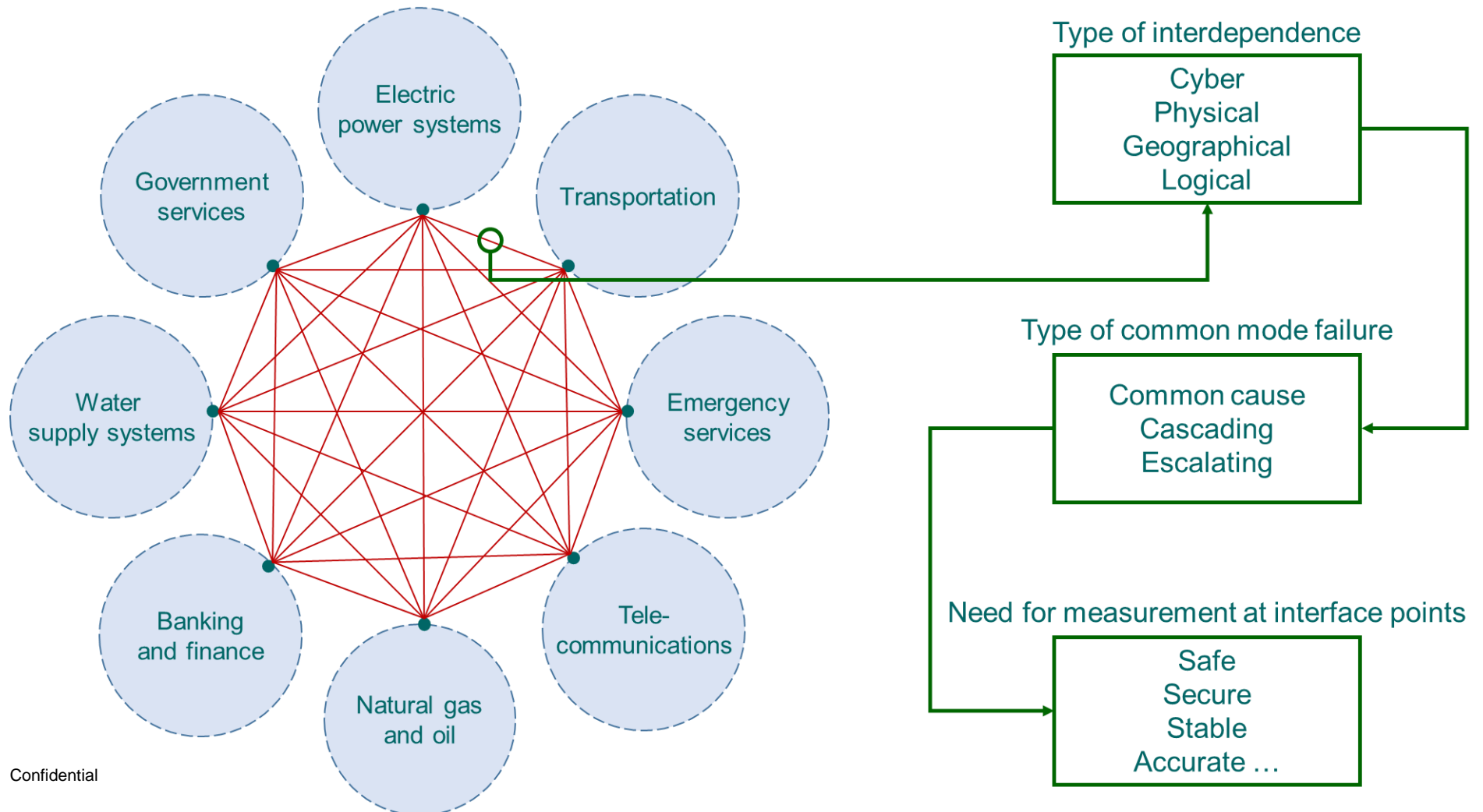
We are facing more unknown unknowns ...

Energy transition is accelerating ...

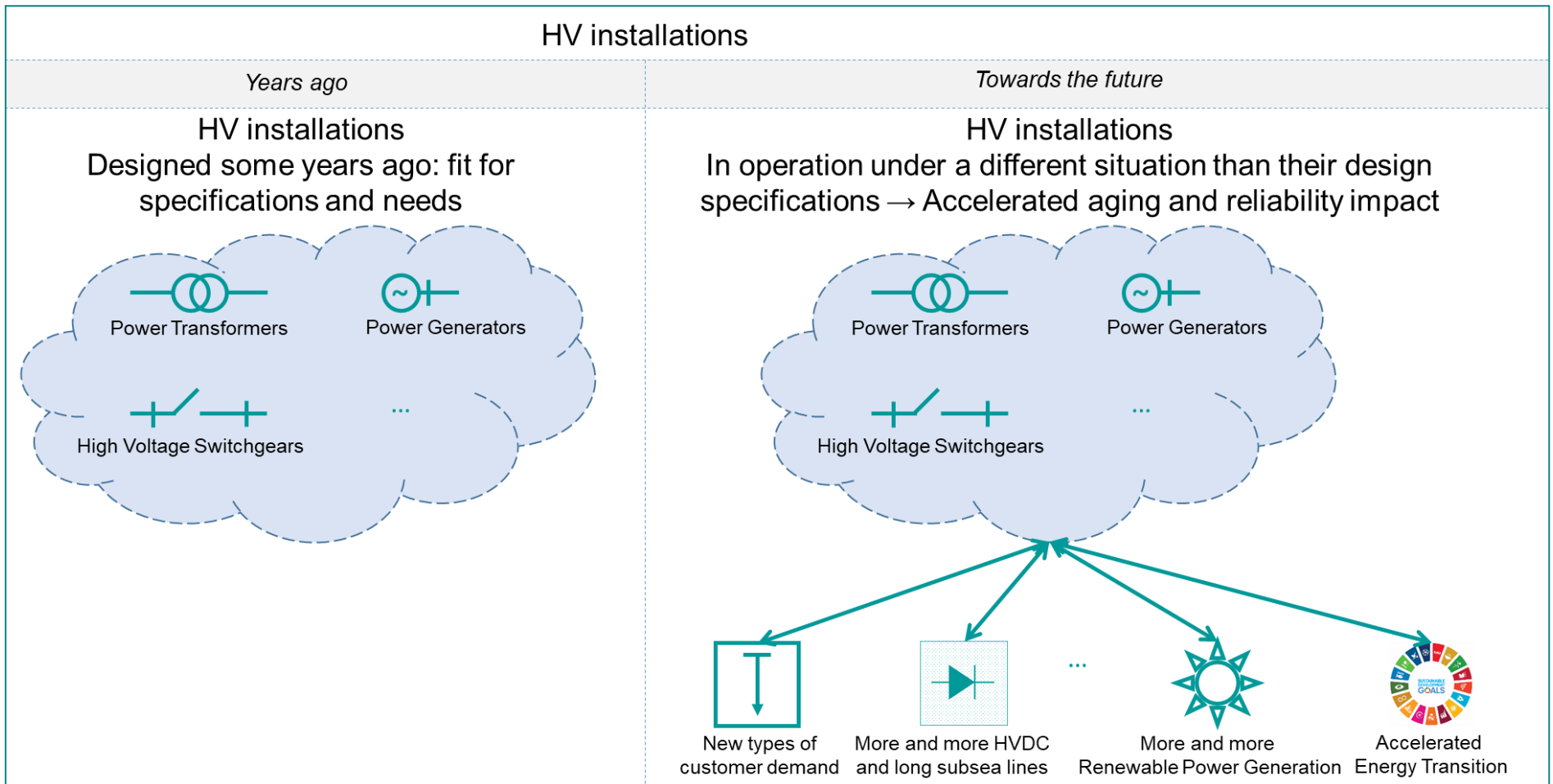


To make it even worse ...

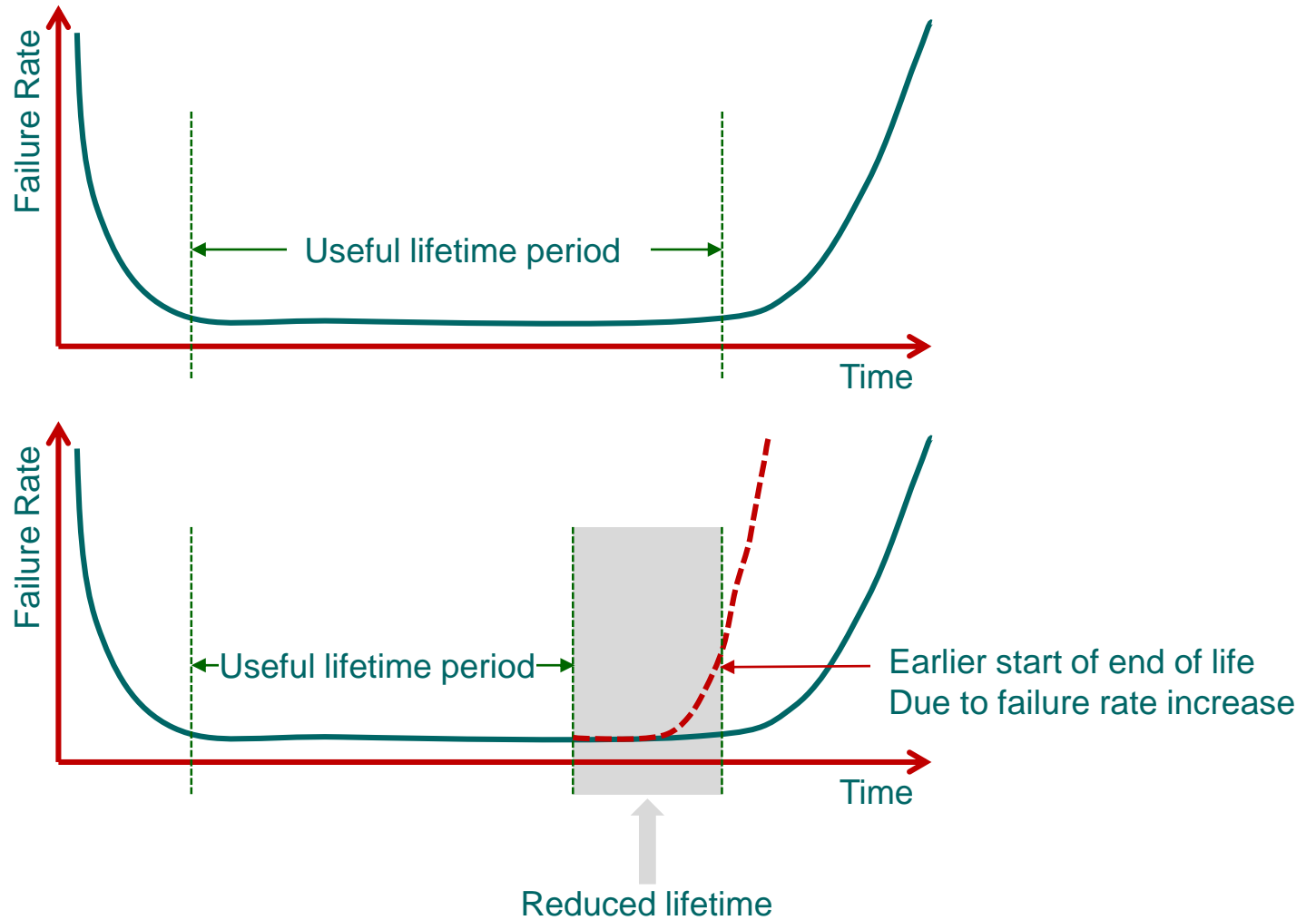
Increasing interdependency of critical infrastructures



A potential increasing risk to power system reliability?

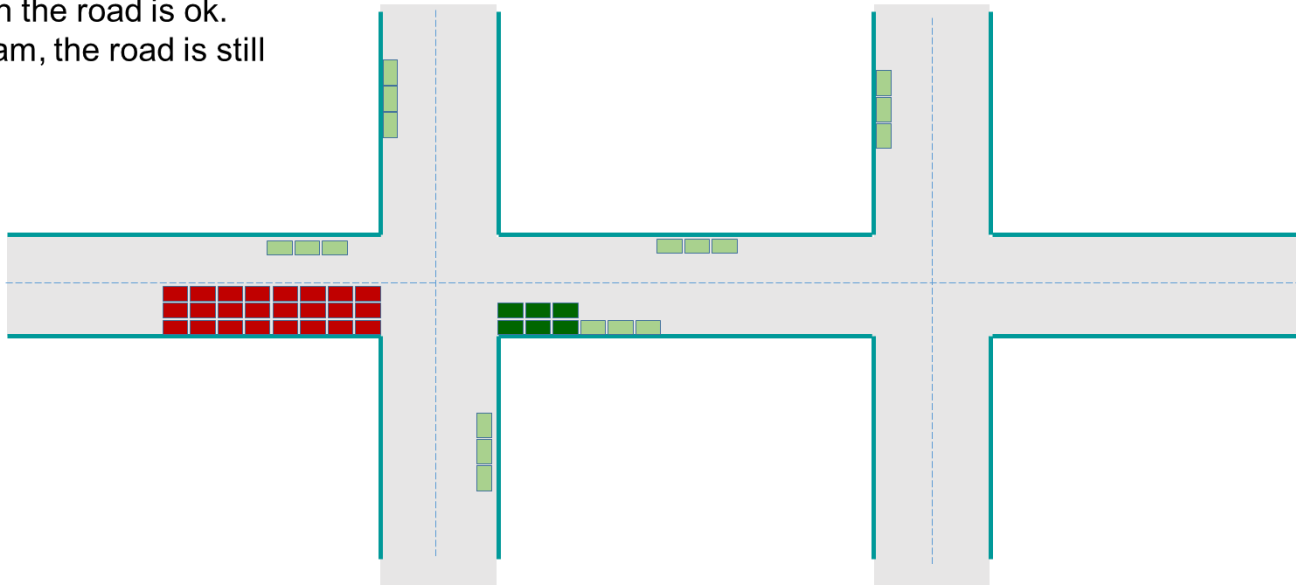


Earlier start of end of life

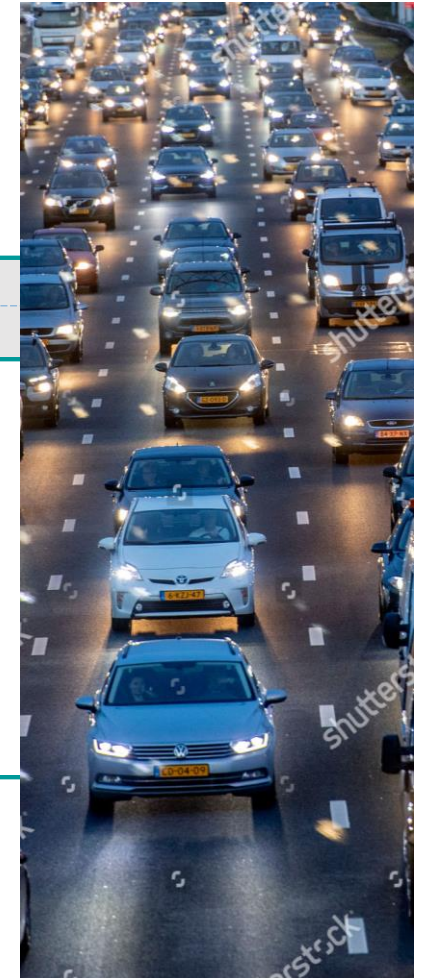
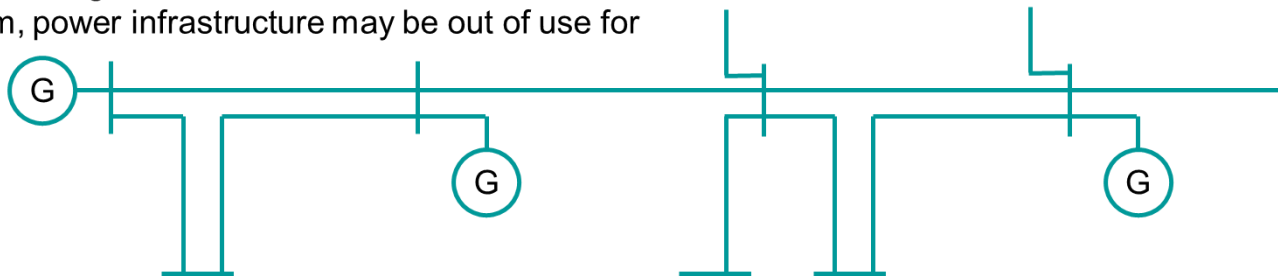


What we are facing at the moment ...

Traffic jam on the road is ok.
After traffic jam, the road is still useable.



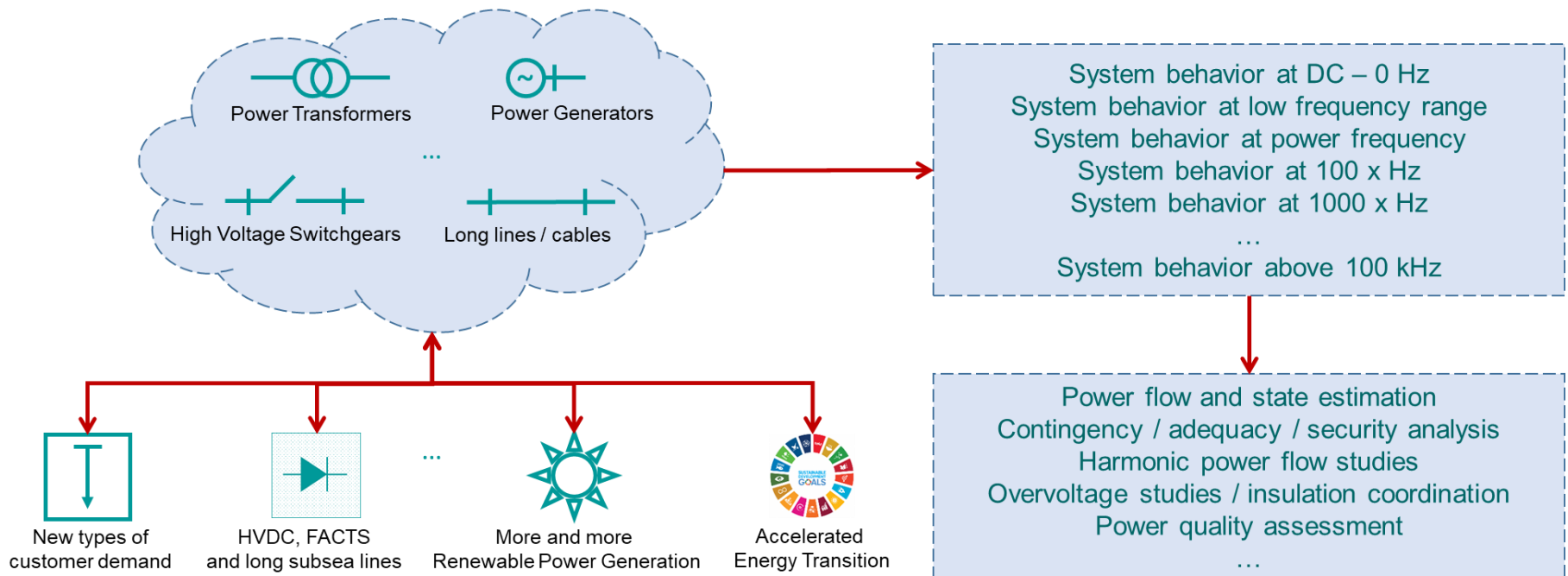
Traffic jam in power grids is not ok.
After traffic jam, power infrastructure may be out of use for months.



Co-creation of a new purpose: wide range current transformers

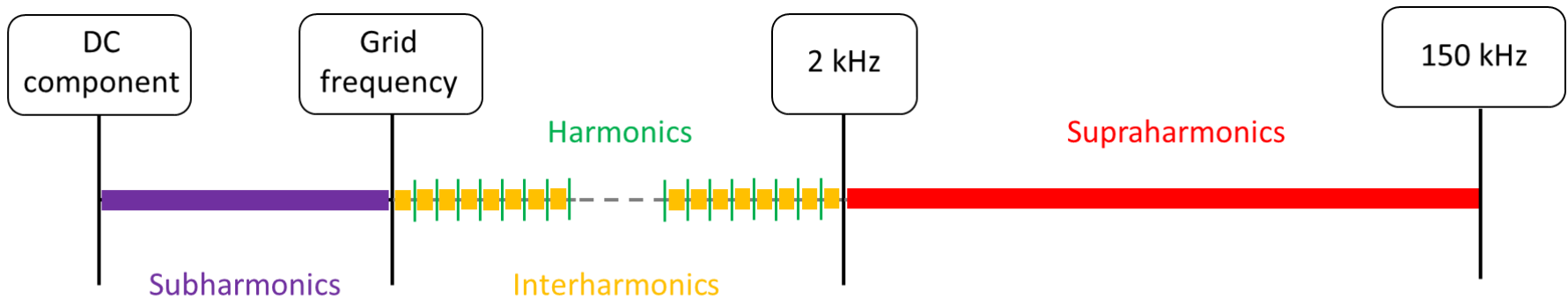
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We need more dimensions on accuracy of measurement



A wide range CT (DC, AC, ...)
 For metering, protection as well as digitalization and power quality

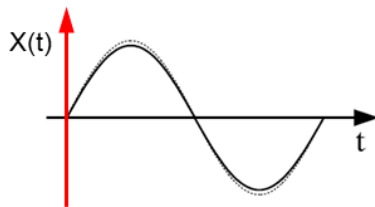
Measuring every current in the AC grid!



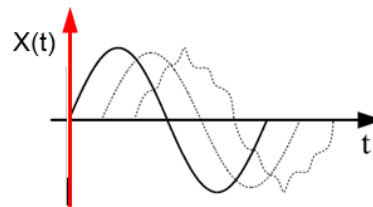
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Measuring every current in the AC grid!

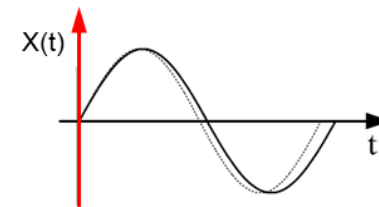
Amplitude



Phase shift

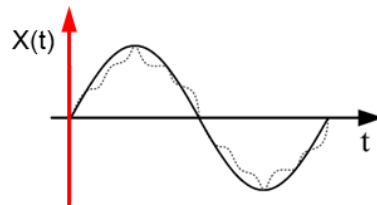


Frequency

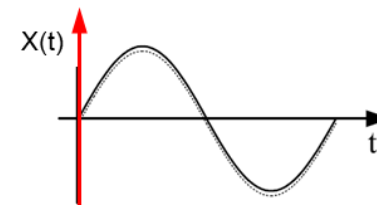


High Accuracy

Harmonics/Supraharmonics

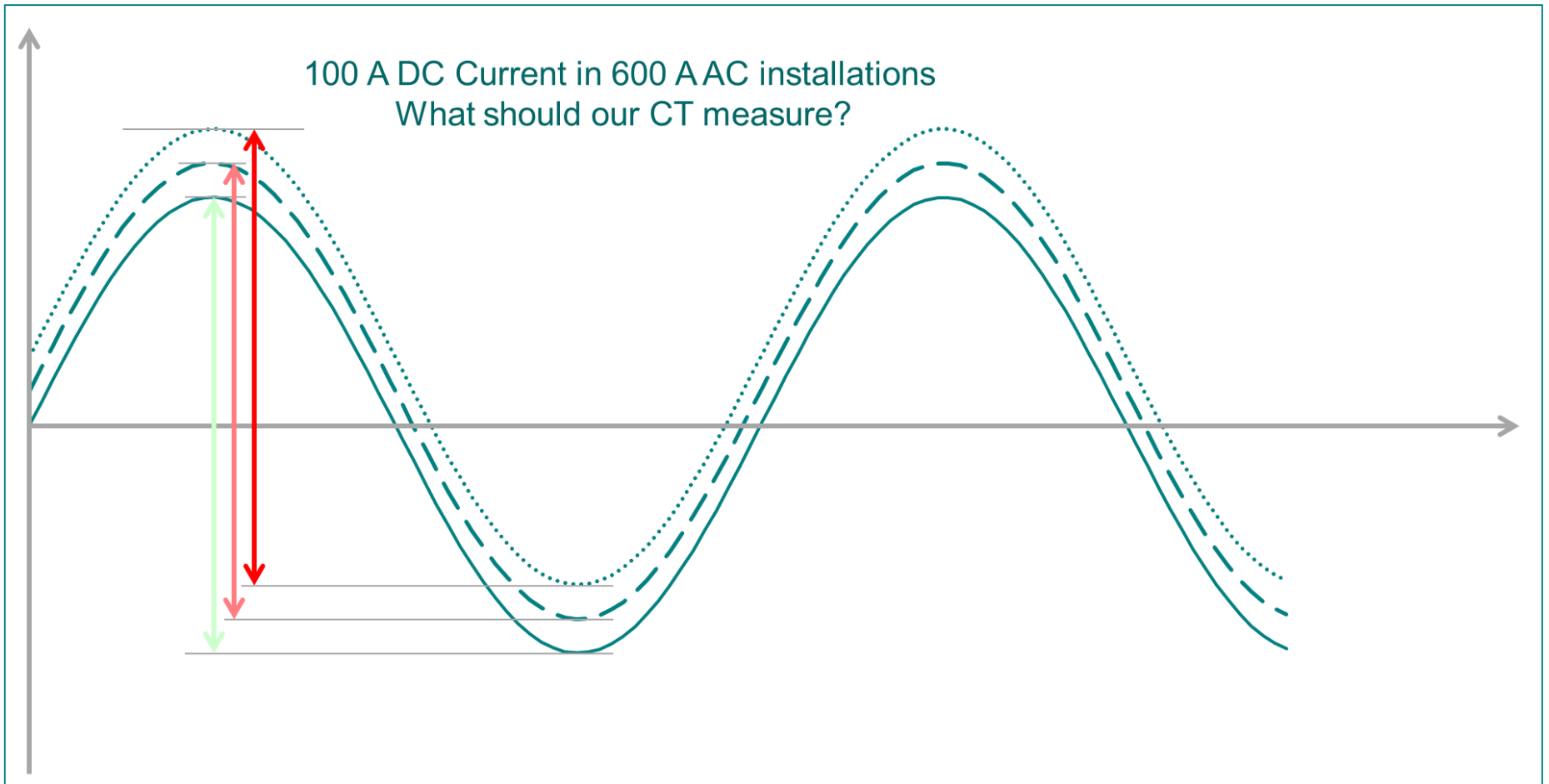


DC component



A wide range CT (DC, AC, ...)
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A practical question



A future proof current transformer is needed

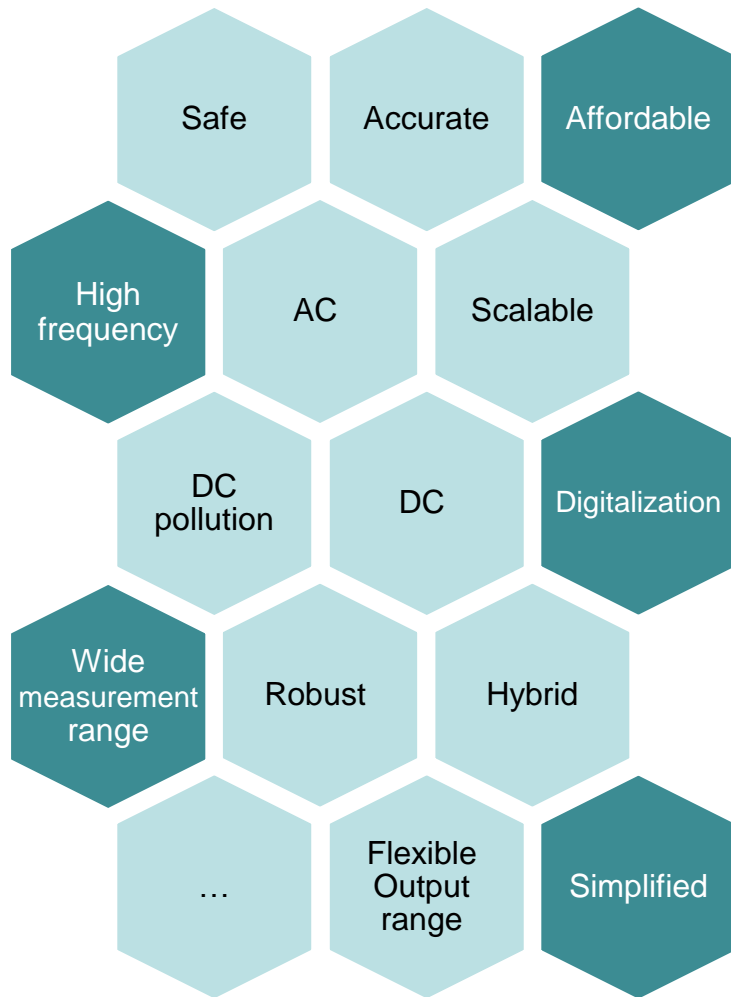


Co-creation of a new purpose: wide range current transformers

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A wide range CT (DC, AC, ...)
 For metering, protection as well as digitalization and power quality

What is expected from a future proof CT ...



A wide range CT
 For metering and protection,
 as well as ...
 Digitalization and power quality

Co-creation of a new purpose: wide range current transformers

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- 75 years experience in T&D industry
- Stable family business
- High quality production process
- Two manufacturing sites (NL, DE)
- Long term relationship with customers

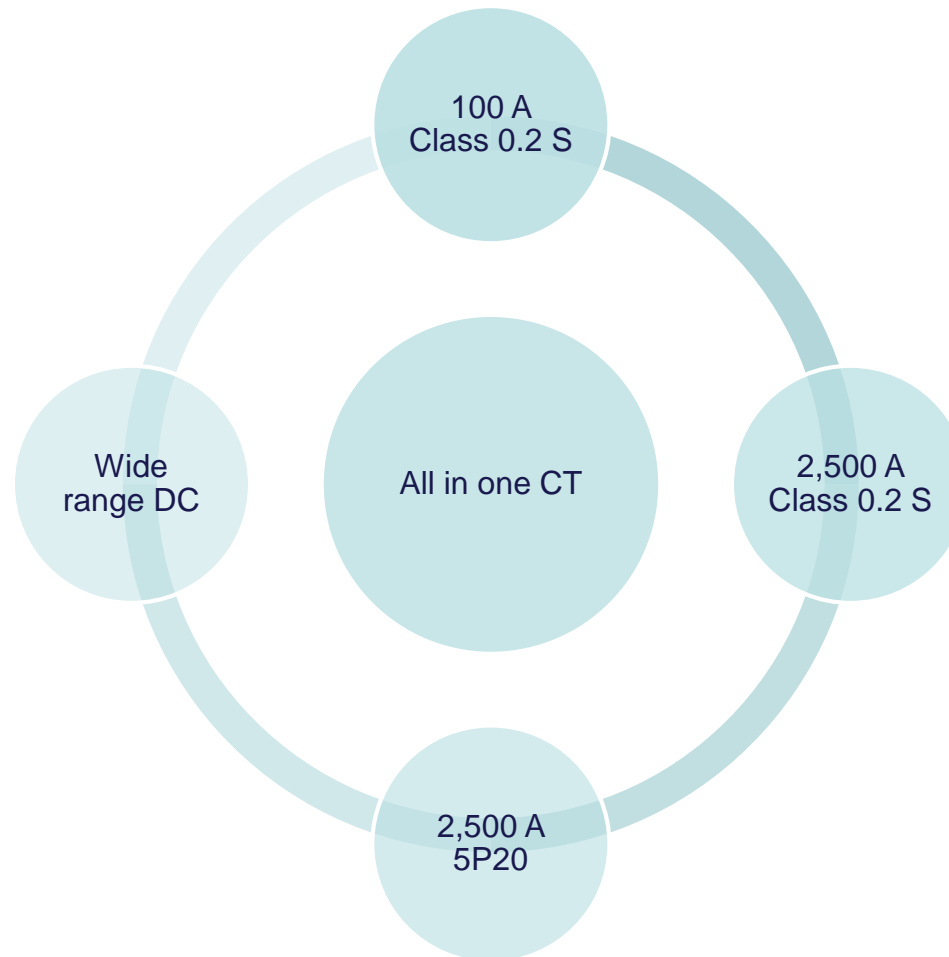
- Expert in high end current measurement
- Private own company
- >25 years experience in zero flux (DCCT)
- 25% of the team in R&D
- T&M, medical, research centers (e.g CERN)

Provide advanced measuring components for T&D eco-system to help identify operational challenges by combining field application expertise, universal accurate measuring technology and high-quality manufacturing.

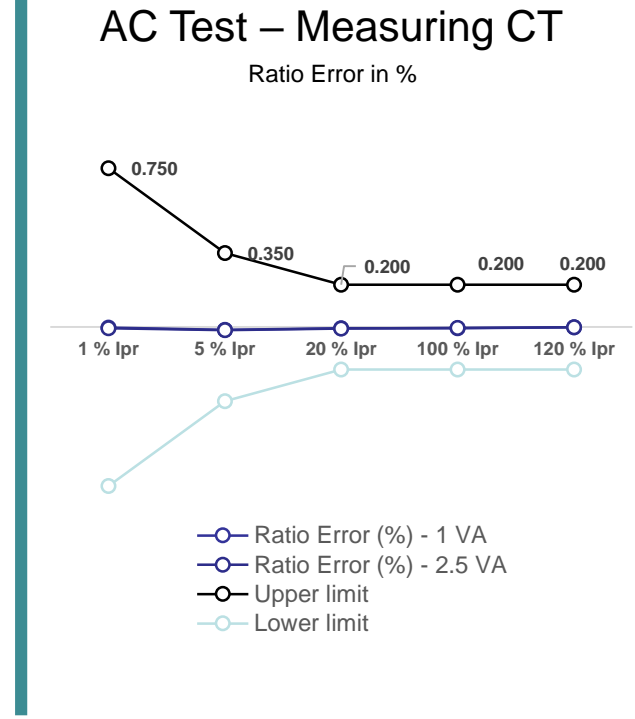
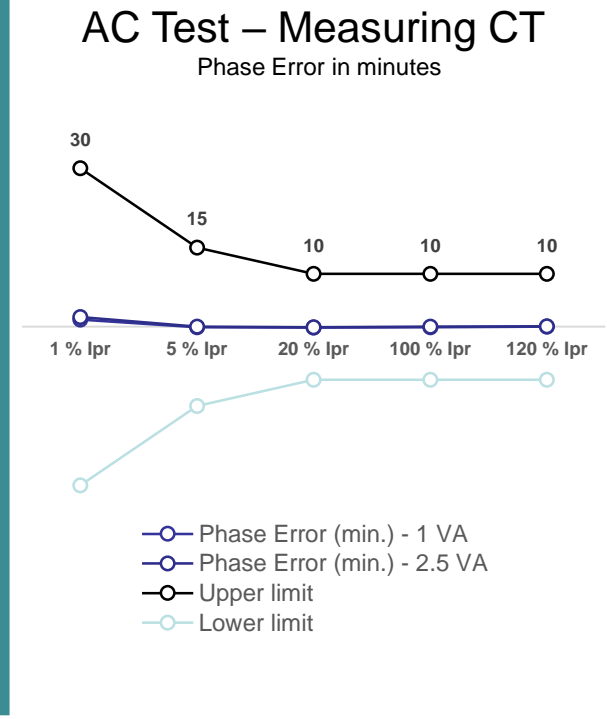
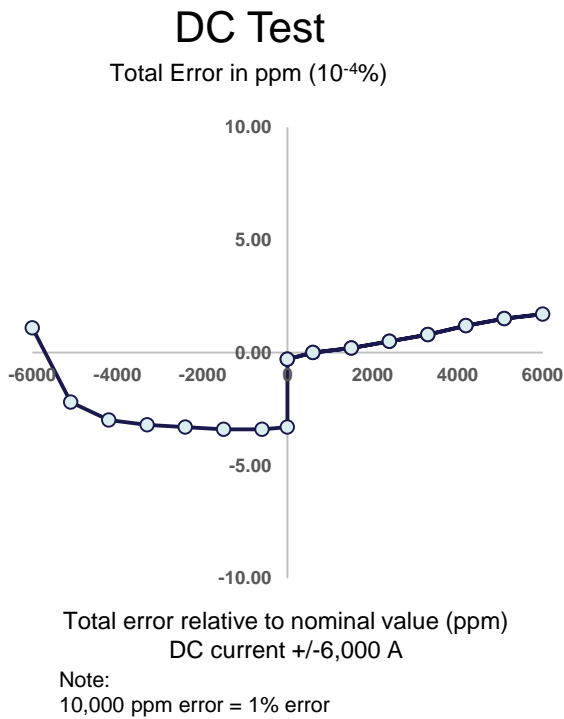


A wide range CT (DC, AC, ...)
For metering, protection as well as digitalization and power quality

Our first manufactured units show outstanding quality

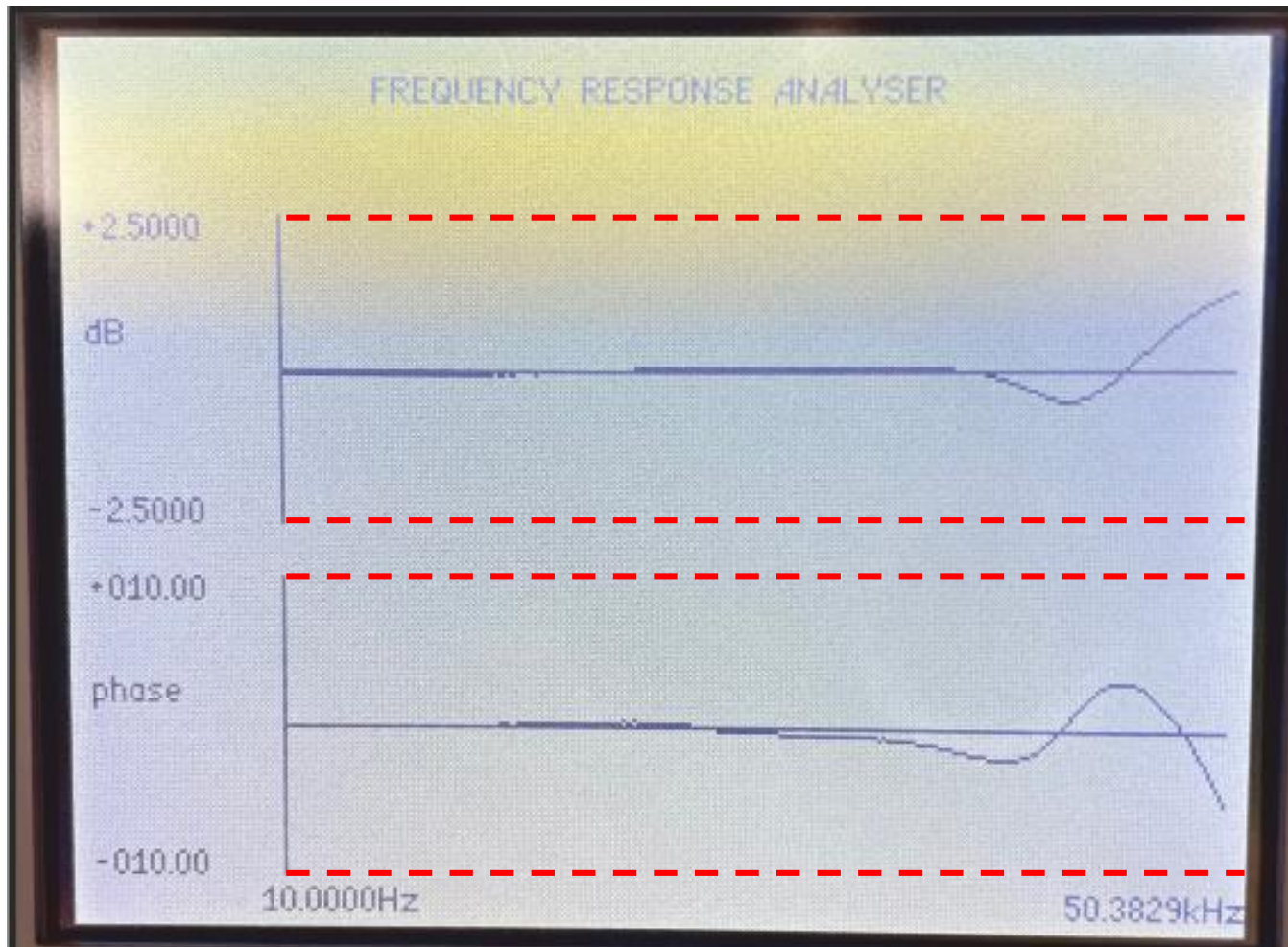


Our first manufactured units show outstanding quality



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Frequency Response - Small Signal 10 Hz to 50 kHz



A wide range CT (DC, AC, ...)

For metering, protection as well as digitalization and power quality

Our first manufactured units show outstanding quality

We would like to appreciate **GE Grid Solutions** and **OMICRON electronics** for the recent order for **ELEQ** and **Senseleq** current transformers to be installed together with **#GE #HYpact** switchgears in **#OMICRON** Customer-Care Center (OCC-Showroom) in **#Austria**.

OMICRON electronics will use **GE Grid Solutions #HYpact** module with the different sets of conventional and also **#zeroflux** wide range current transformers. Also tests of digital solution based on **#IEC61850-9-2 #Goose** and Samples value will be part of these setup.

These current transformers will help provide a secure, accurate, and reliable measurement of the current flow - DC, AC, high harmonics, low harmonics, power quality, advanced protection application, ...

This project is showcasing a collective effort towards **#energytransition** and **#cocreation** of new possibilities and purposes.

Konrad Priebe Carsten Kramer Dirk NOTROFF Jens Kallweit
Roy de Graaf Roland Bürger Loic Moreau



Press Release

April 2022

GE Renewable Energy integrates new generation CT from Senseleq in its HYpact (HV mixed technology) switchgear

Key points:

- One current transducer for all applications: power quality, metering and protection
- Current measurement from DC to hundred's kHz answering to new power quality challenges
- Output compatible with digitalization program

The European Commission's proposal to cut greenhouse gas emissions by at least 55% by 2030 sets Europe on a responsible path to becoming climate neutral by 2050. This has brought further strength towards a pan-EU energy system with net zero emissions of greenhouse gases in 2050 which calls for decarbonization, electrification, and digitalization are reshaping the entire energy system.

Within the context of the energy transition, TSOs and DSOs face new power quality challenges with higher harmonics and DC pollution. This is also because of the changes in power generation, transmission, and distribution technologies as well as design and operation philosophies.

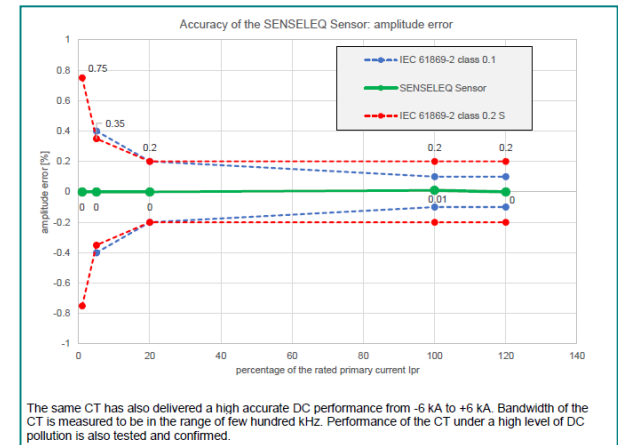
This means utility operators need new generation of transducers to ensure a wide range of properties of current flow is measured by future proof current transformers.

GE Renewable Energy has set a target to deliver in its HYpact switchgear a high accurate universal CT for a wide range of frequencies from DC to 50k Hz from mA's to kA's for digitalization purposes - independent from the nominal current, etc. **GE Renewable Energy** is constantly looking for smart solutions to reduce the interface engineering and use one CT for all customer requirements which can save interface engineering hours needed in their projects.

Senseleq has designed, tested, and delivered a ring core universal wide range CT equivalent to the following specifications to meet future requirements – based on zero-flux technology:

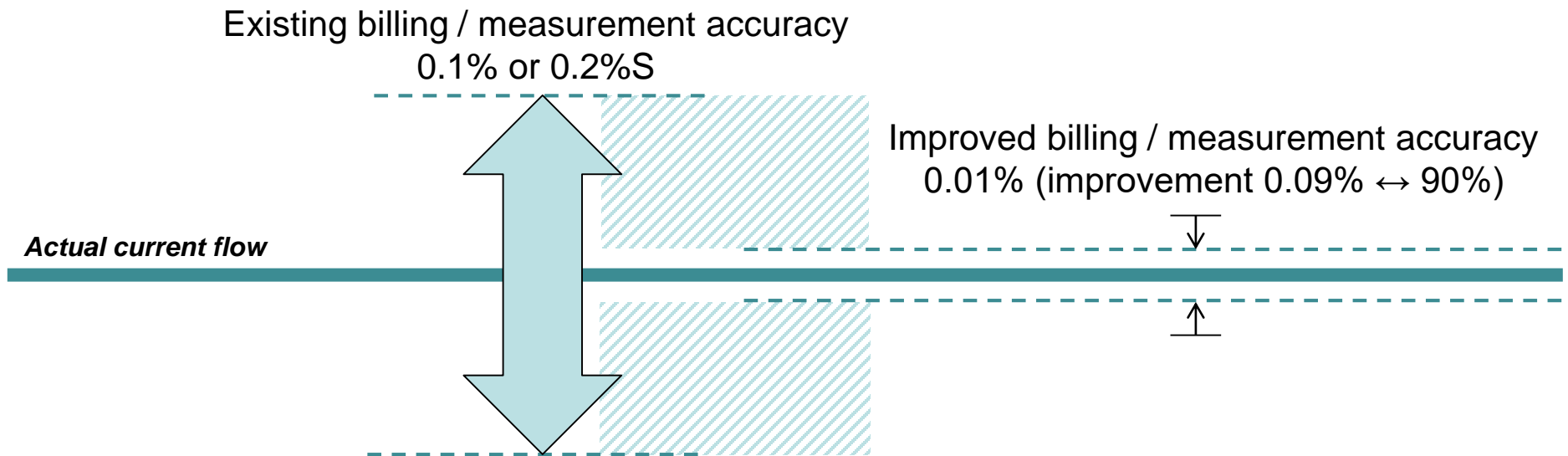
- Metering class 100 A 0.2S
- Metering class 2,500 A 0.2S
- Protection class 2,500 A 5P20
- Wide range DC

The result was a CT measuring from 1 A up to 50 kA with accuracy shown in the diagram below.



A wide range CT (DC, AC, ...)
For metering, protection as well as digitalization and power quality

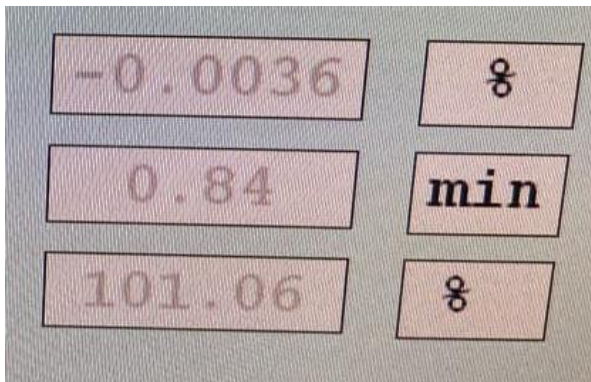
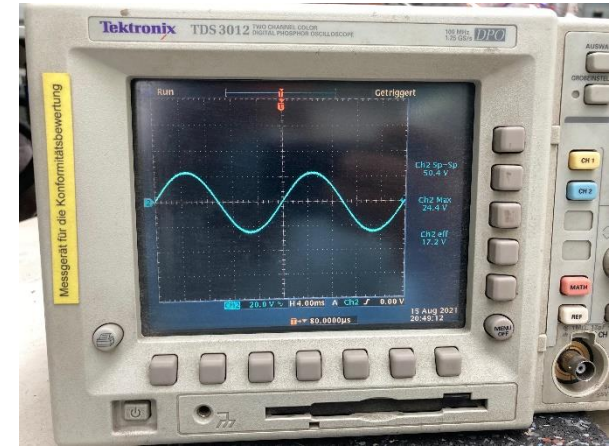
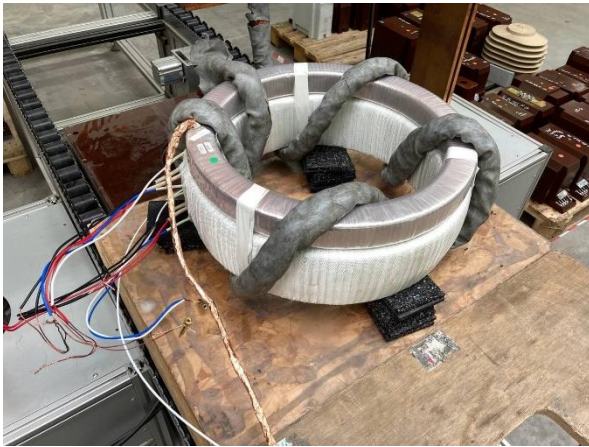
What more value add can be developed in specific applications?



What more added value this improvement can provide
in addition to confidence in billing results?

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Overload test in presence of inductive ring cores



- ❑ Test is done to measure overload ability of the sensor
- ❑ Precision is measured with and without presence of inductive ring cores
- ❑ At nominal current, precision is measured high accurate – less than 0.01% ratio error and less than 1 min phase angle error (photo left)
- ❑ At overload, the output till 50 kA still managed to stay well in shape (photo top right - below 1% accuracy)

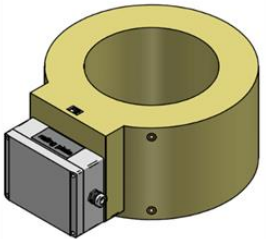
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More details on first manufactured units – application

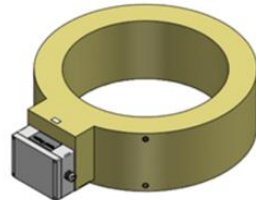


Electronic Box
(current or voltage outputs)

Outdoor Applications
(bushing)



2 or 3 Cores
(power quality + metering
+ protection)

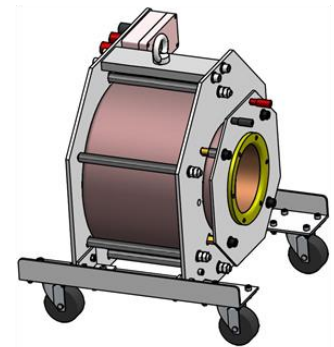


1 Core
(power quality
or HVDC)

Inside PT Applications



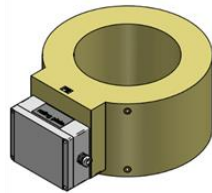
Lab's Applications



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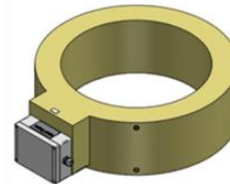
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HV Switchgear



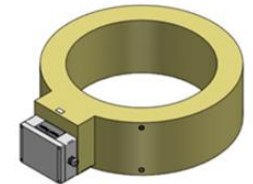
3 Cores for
power quality +
metering + protection

Green Hydrogen



1 Core for
energy metering

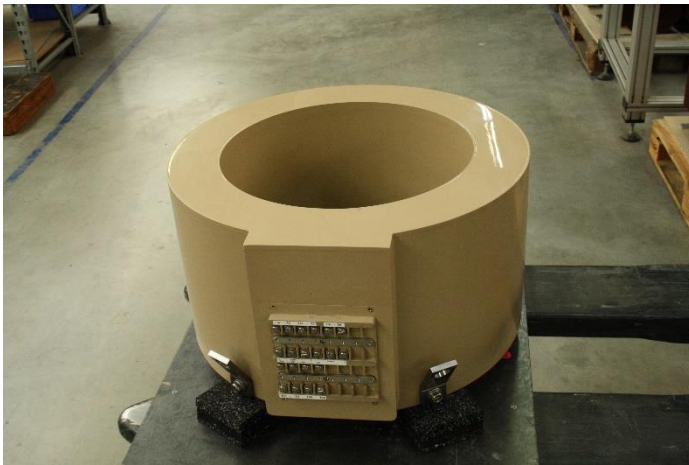
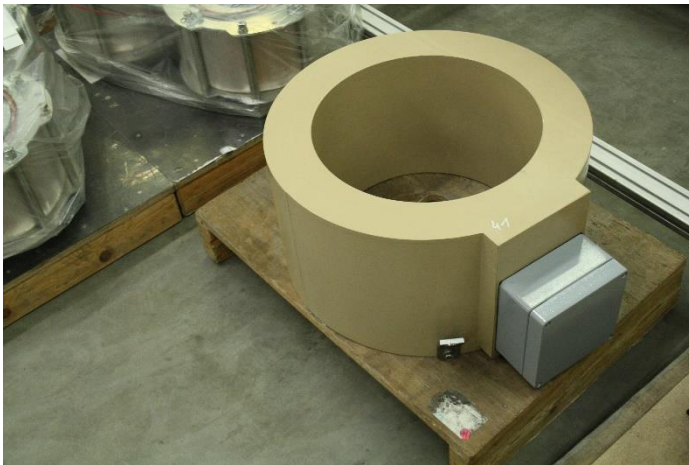
Power Transformer



1 Core for
power quality

A wide range CT (DC, AC, ...)
For metering, protection as well as digitalization and power quality

The first delivered projects – final product look

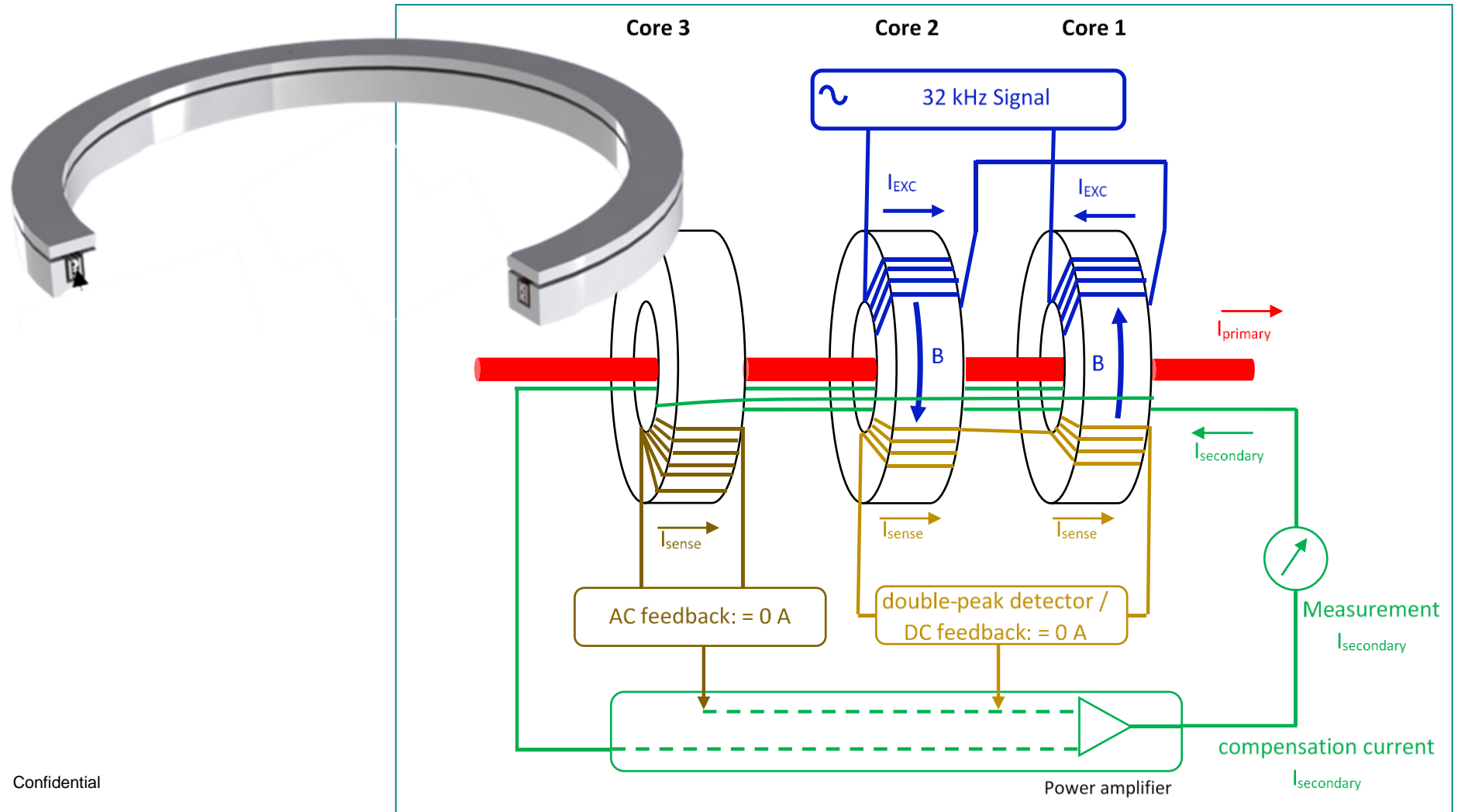


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How does it work?

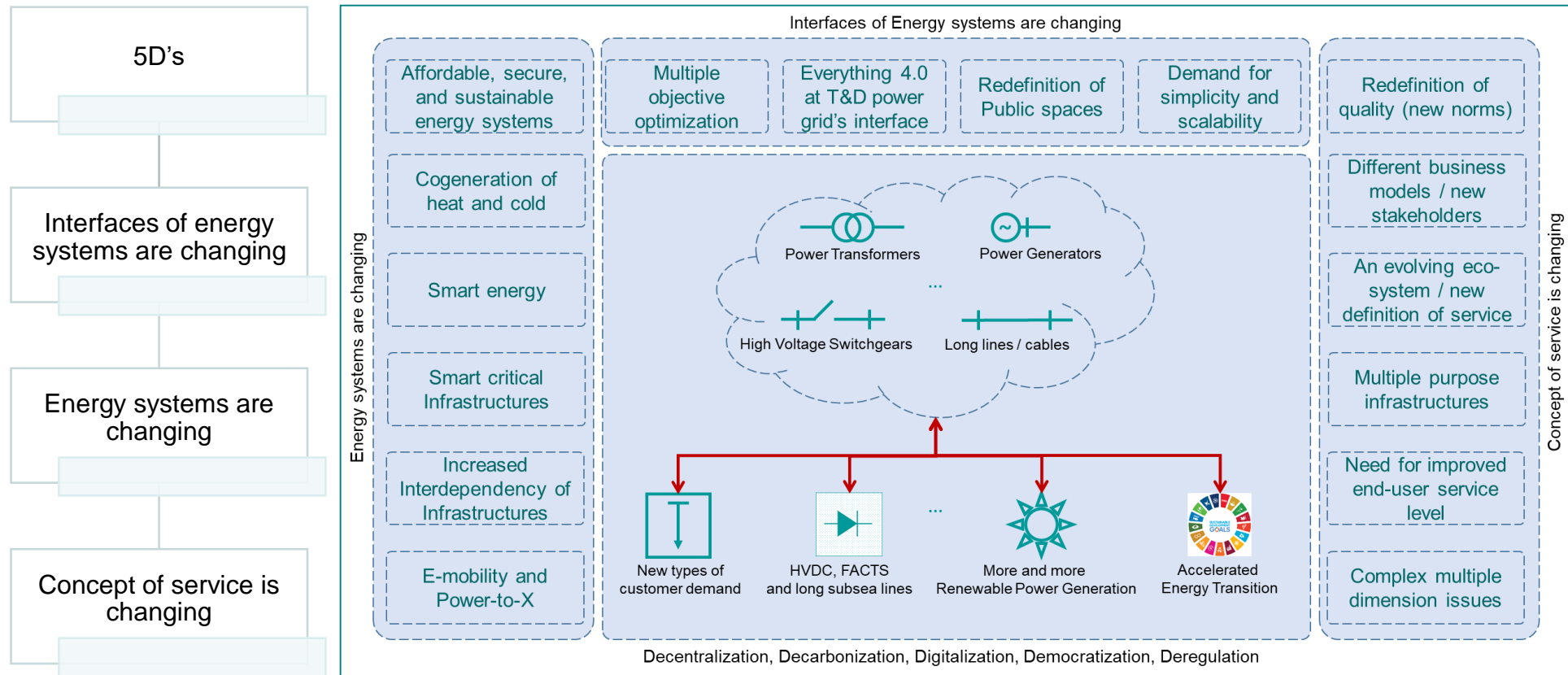


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Open discussions

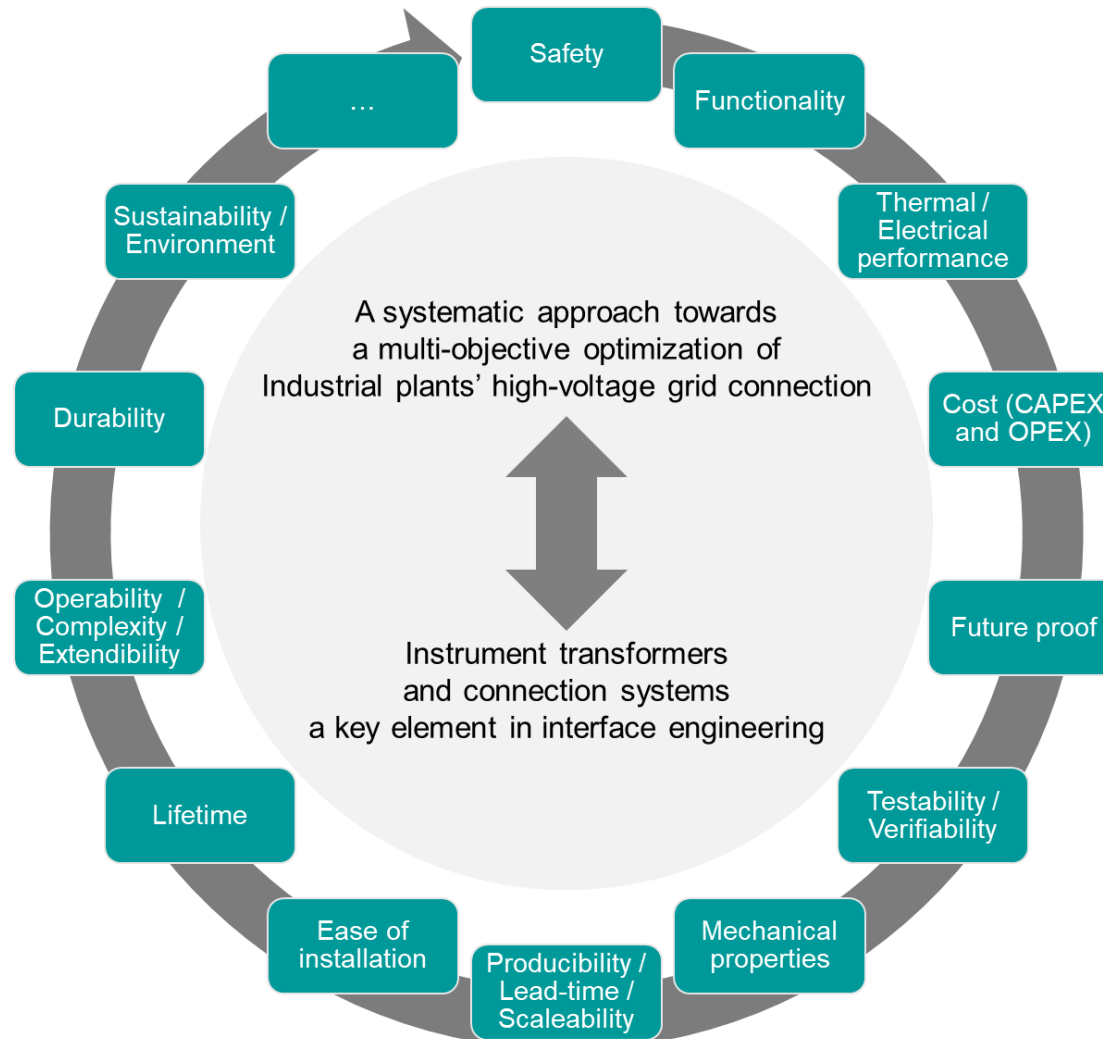
We are facing more unknown unknowns ... while it is also becoming more important to keep energy systems safe, stable, and secure

Energy transition is accelerating ...



We can make it more complex ...

... but let's see if we can find a more simple solution



Any solution starts with measurement ...

Accurate measurements is strategic and necessary

The economic losses for industries have dramatically increased due to the poor power supply quality

Accurate measurements are required for taking decisions, for diagnostic purposes, for metering purposes, and for reliability analysis.

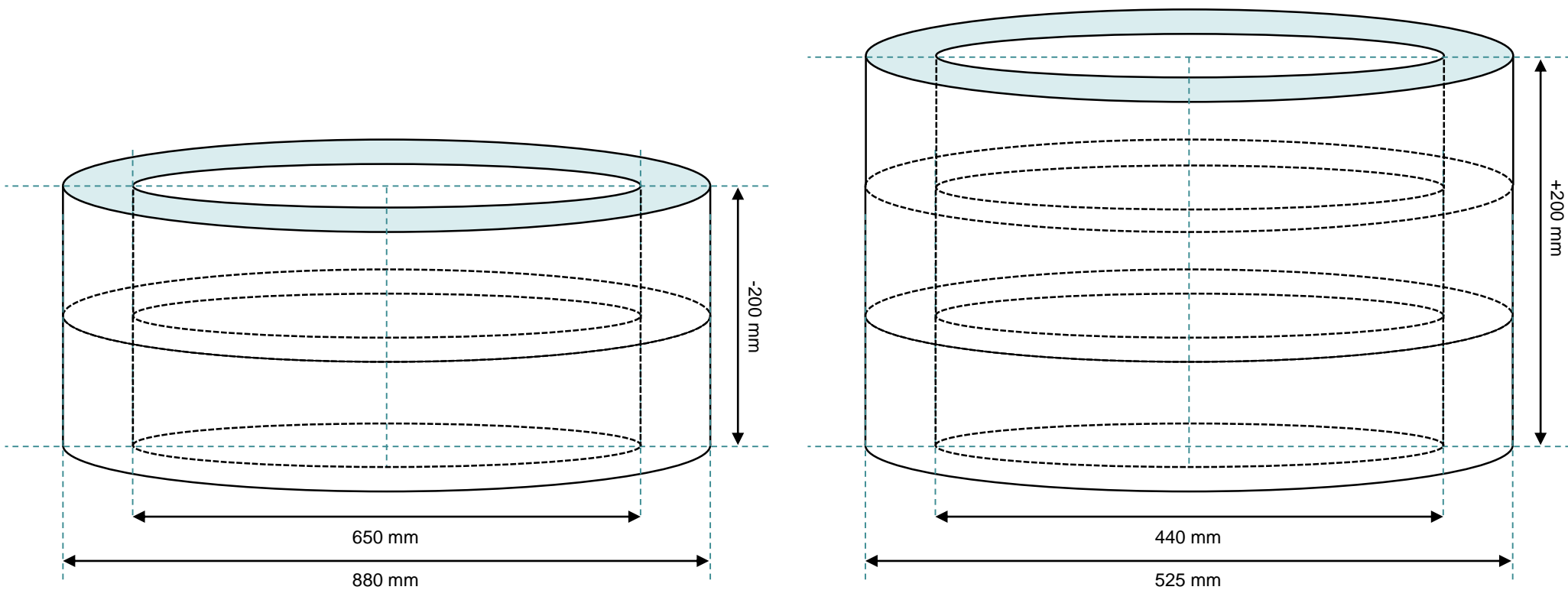
Electronic systems at consumption side get highly sensitive to power quality characteristics – it is more important to keep the power quality as high as promised

The attention was mainly limited to the analysis of waveforms, interruptions and continuity of service – however, as load and supply increase, it is getting more important to deliver more accurate measurement

Demand and consumption of electric energy has grown exponentially – this includes as well none conventional power electronic based power generation and power consumption

A wide range CT (DC, AC, ...)
For metering, protection as well as digitalization and power quality

More details on first manufactured units – dimensions



A wide range CT (DC, AC, ...)
 For metering, protection as well as digitalization and power quality

More details on first manufactured units – application

T&M



- High voltage test bench
- Wind power
- Power transformers
- Mobile sub-station

HV/MV Substation



- Power quality
- Metering
- Protection
- Power transformer
- Switchgears

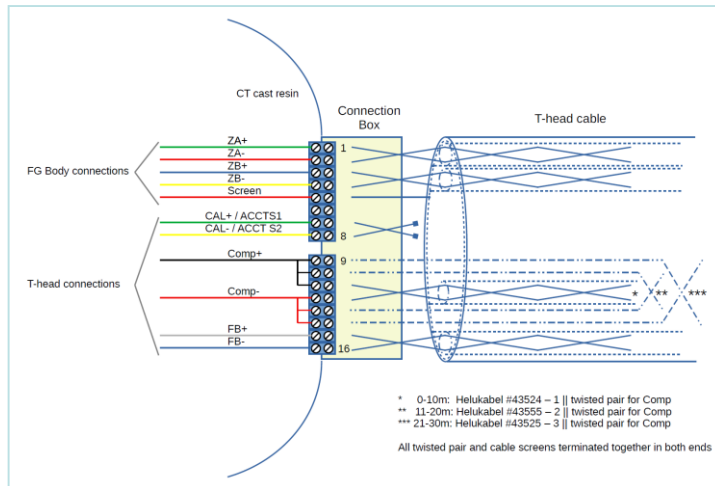
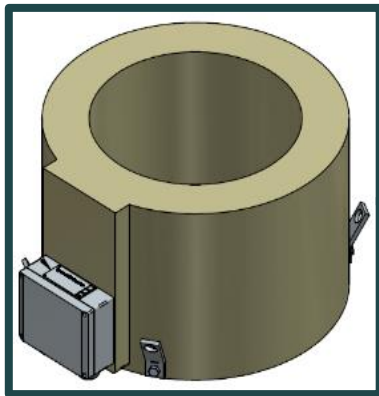
HVDC



- Power converters
- STATCOMS
- DC switchgears

A wide range CT (DC, AC, ...)
 For metering, protection as well as digitalization and power quality

More details on first manufactured units – electronics



Rack mounted
 490 x 90 x 250 mm
 6 kg
 IP20
 Burden <4 Ohms
 85-264 VAC or 120-370 VDC
 Analog current / voltage output options
 Built in filtering possibility