Welcome to the webinar on
“What you need to know to design a flawless Optical Measurement System.”

Cristina Barbosa

- **Product Manager for HBM Optical Business**
- Degree in Civil Engineering
- 15 years of experience in optical measurement solutions within HBM FiberSensing
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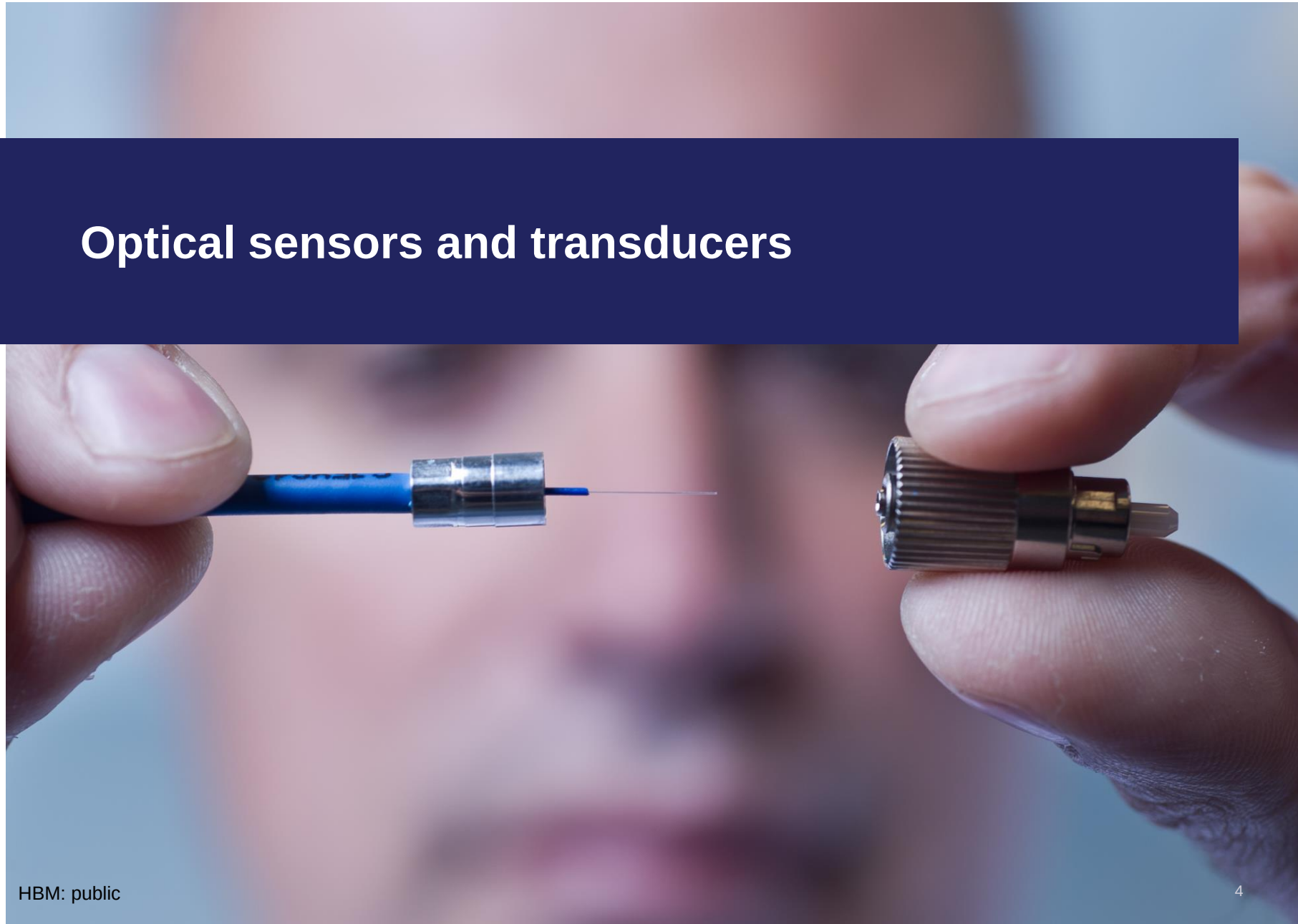
Cristina Barbosa

What you need to know to design a flawless Optical Measurement System

1. Optical sensors and transducers
2. Fiber Bragg Grating (FBG) Technology
3. When does it make sense to use the technology?
4. Components on a measurement chain

Optical sensors and transducers



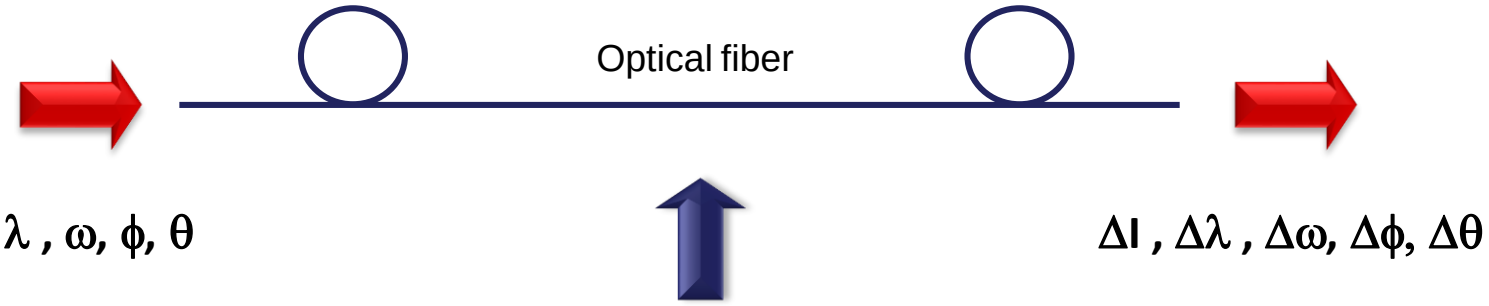
Optical sensors and transducers

Optical fiber…

… is connecting today's world…

Optical sensors and transducers

…but it is also being used in a different way



Amplitude/Intensity
Wavelength
Frequency
Phase
Polarization

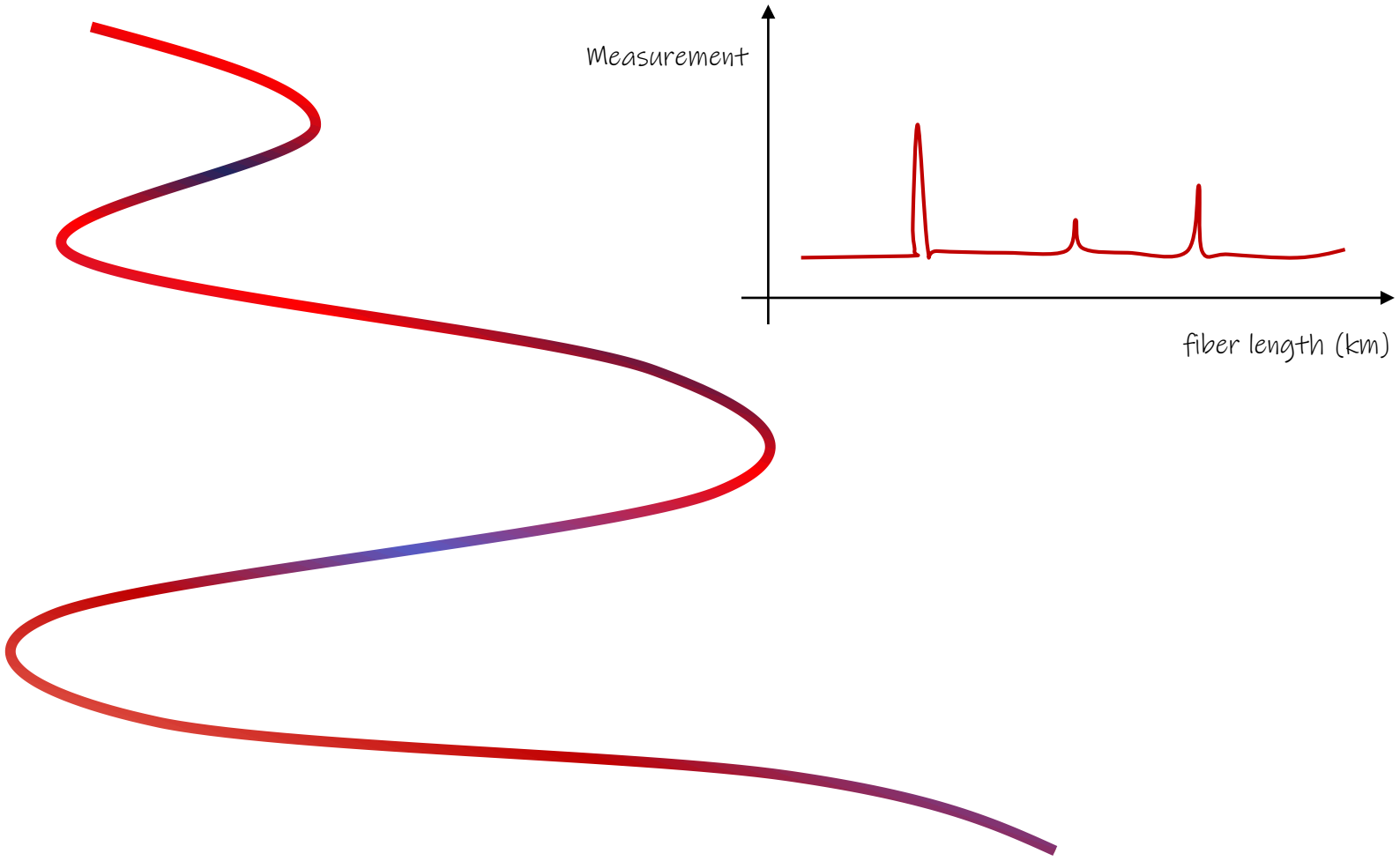
Temperature
Pressure / stress
Strain
Displacement
Force
Magnetic field
…

Optical signal modulation

OPTICAL FIBER ACTS AS A **SENSOR**

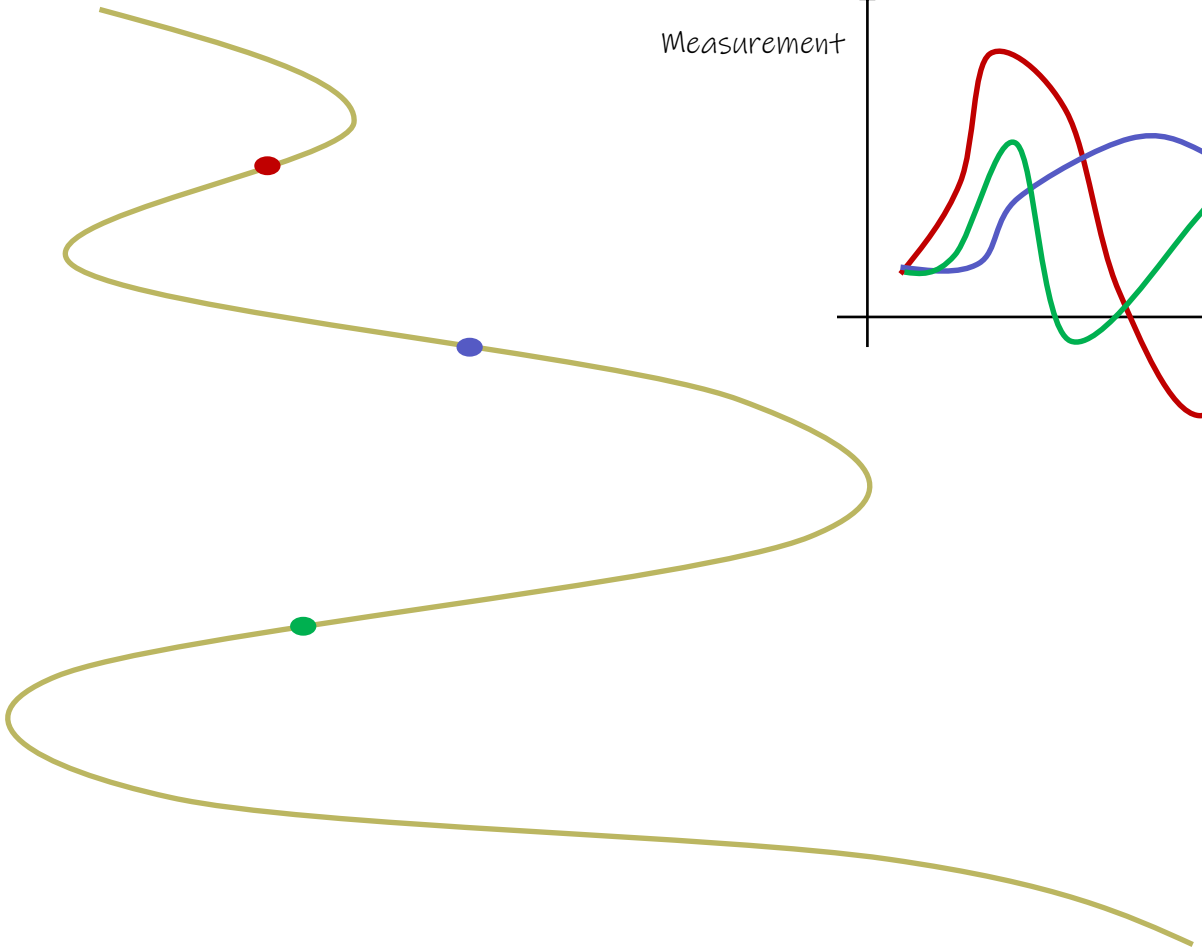
Optical Sensors

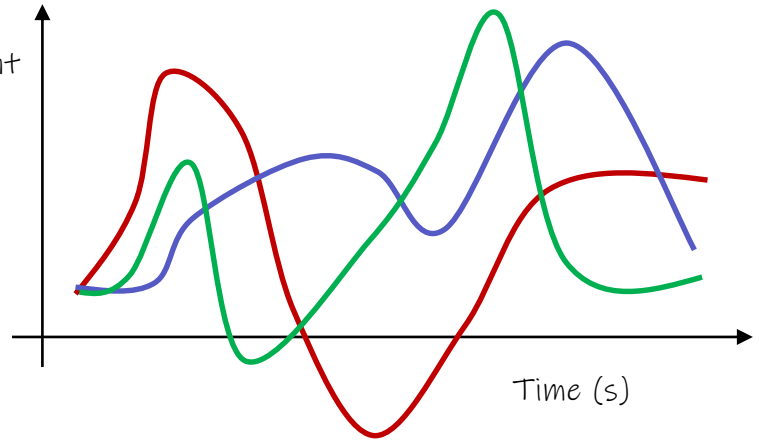
Distributed



Optical Sensors

Point





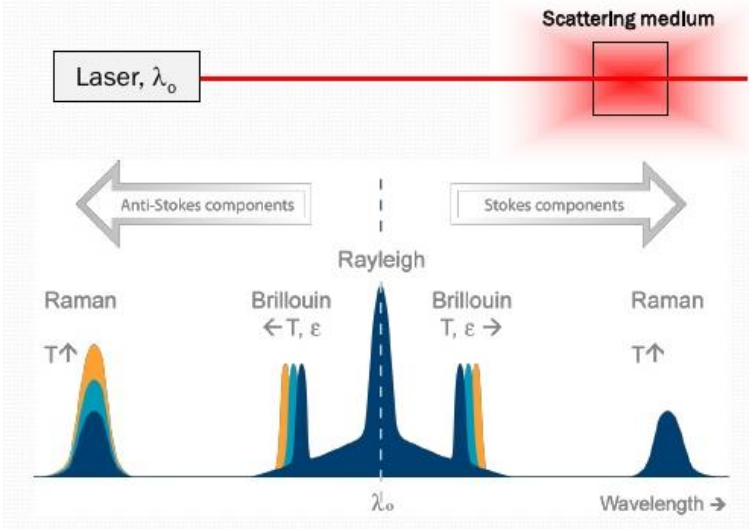
Optical Sensors

Distributed

- Raman (Distributed Temperature Sensing)
- Brillouin (Distributed Temperature and Strain Sensing)
- Rayleigh (Distributed Acoustic Sensing)

Strain

Temperature



Scattering
effect on the fiber

deflection of a ray from a straight path

Pipe and cable integrity

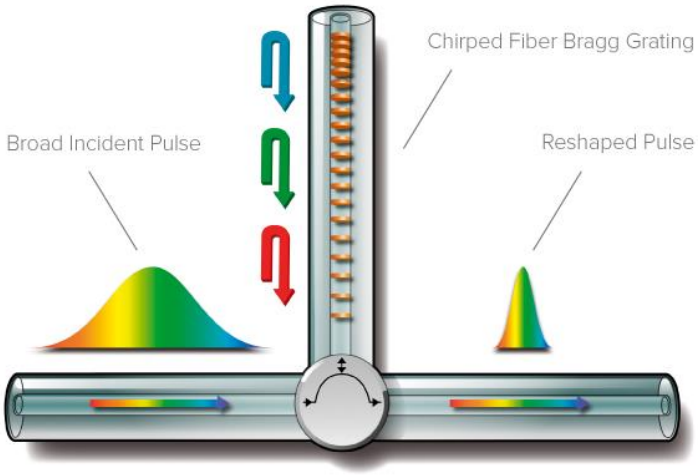
Intrusion detection

Geotechnical applications

Optical Sensors

Distributed

- High density FBG arrays



Aerospace

Automotive

Composites

Wavelength reflection

reflected light pulse changes with the measurement

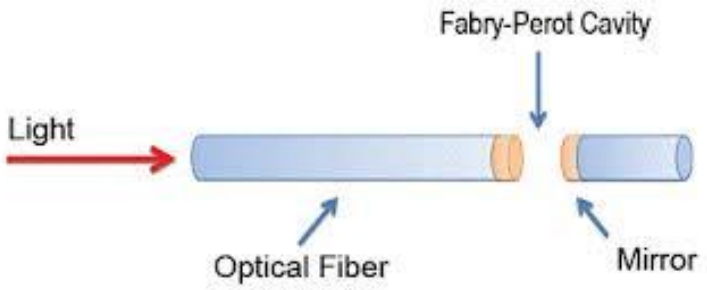
Strain

Temperature

Optical Sensors

Point

- Fabry-Perot



Inter-ference

light reflects on both ends of the cavity creating a pattern that is proportional to the cavity length

Small

Terminal

Strain

Temperature

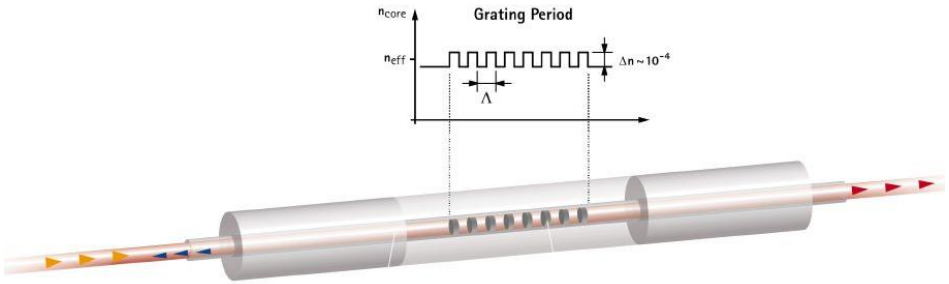
Pressure

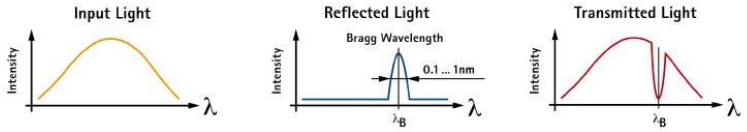
Medical Applications

Optical Sensors

Point

- Fiber Bragg Grating (FBG)





Narrow **wavelength** reflection

light reflects on the FBG with a well-defined wavelength

Small

Several in a fiber

Multifunctional

Strain; Temperature

Tilt; Acceleration; Displacement

Energy

Wind

Railway

Automotive

Civil

Fiber Bragg Grating (FBG) Technology

FIBER BRAGG GRATING TECHNOLOGY

FiberSensing

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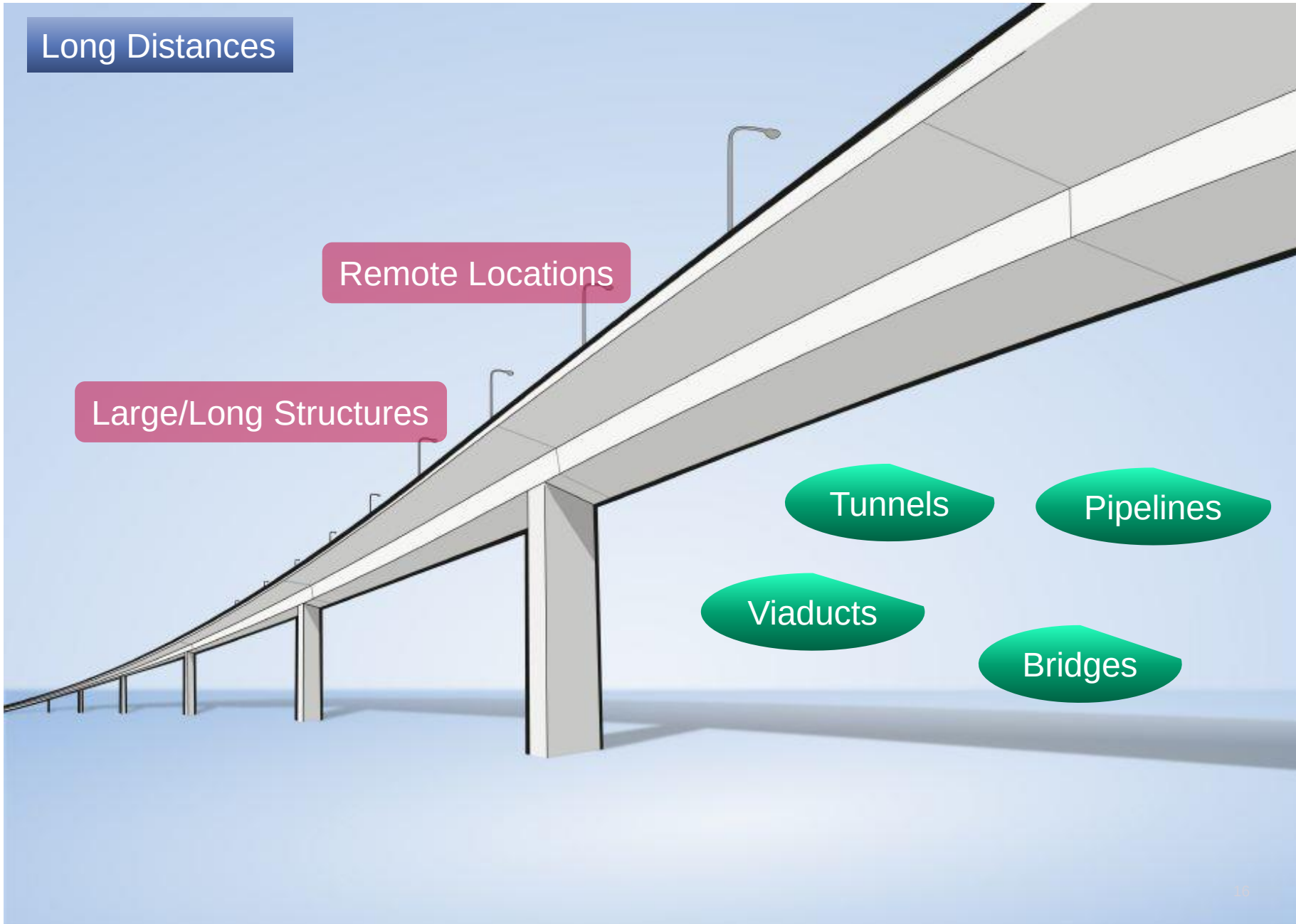
When does it make sense to use the technology?

When does it make sense to use the technology?



When does it make sense to use the technology?

Long Distances

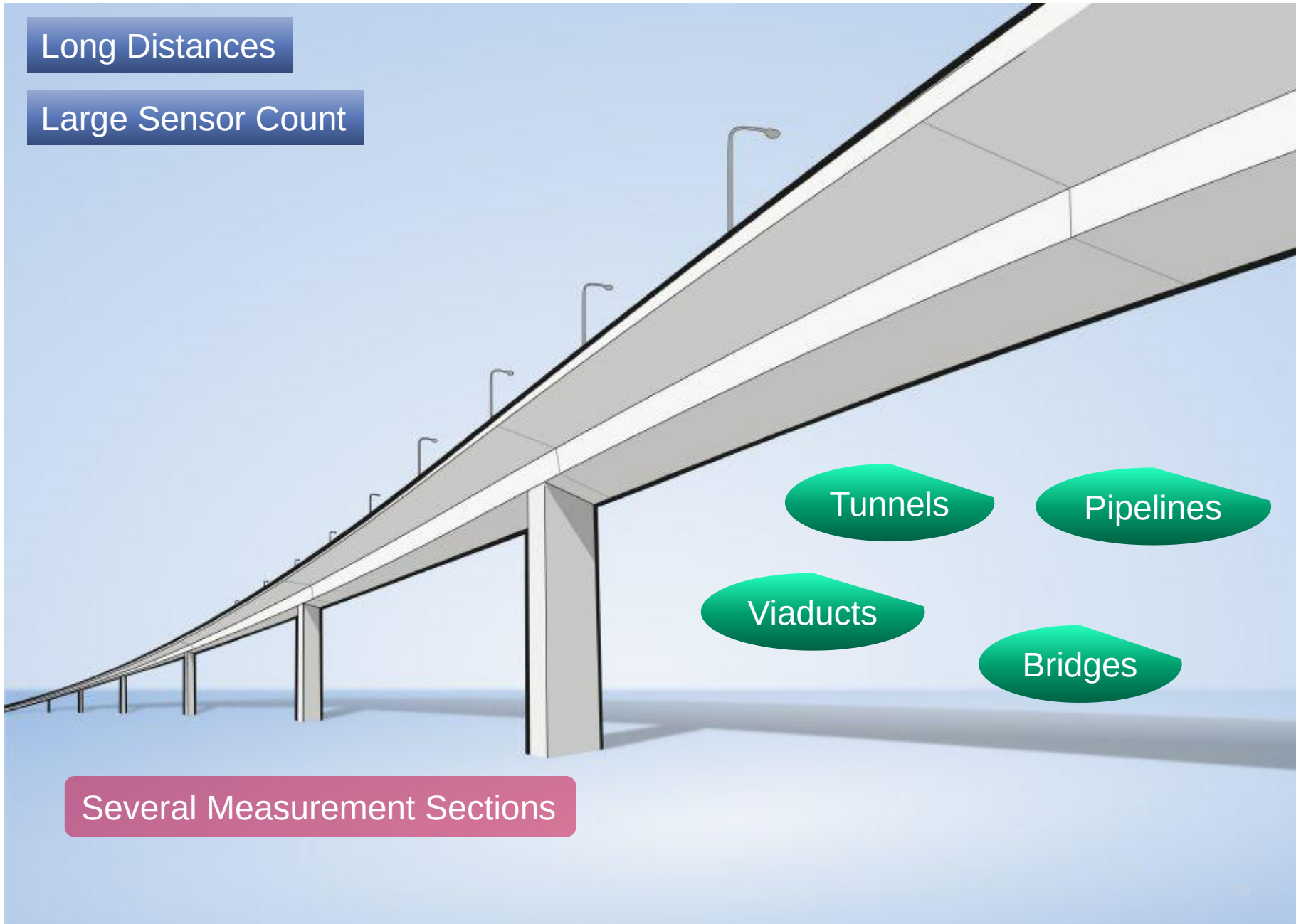
Data acquisition system installed far from sensors

When does it make sense to use the technology?

Long Distances

Low attenuation of the optical fibers

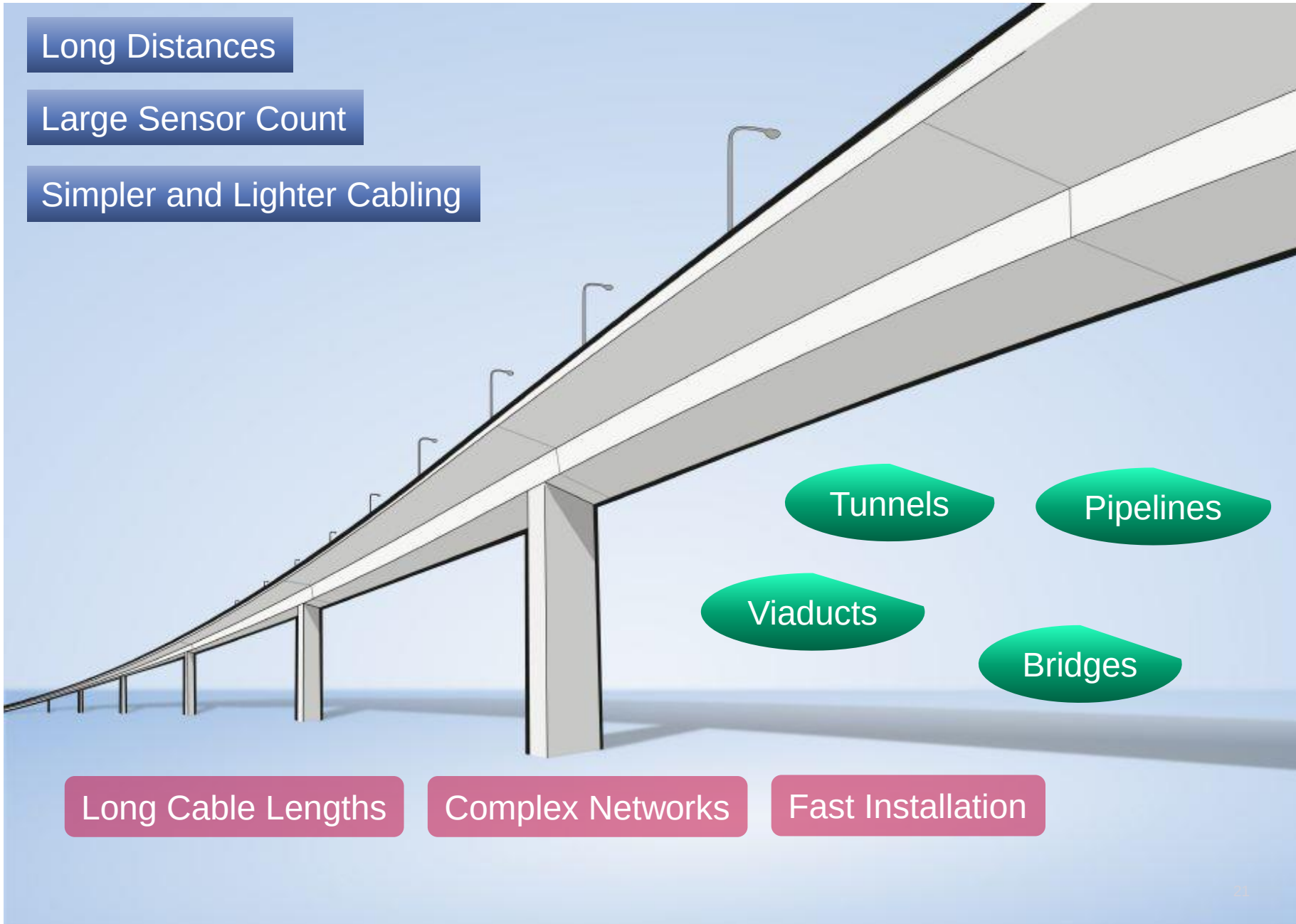
When does it make sense to use the technology?



When does it make sense to use the technology?

- Long Distances
- Large Sensor Count
- Replicated sections along the structure

When does it make sense to use the technology?



When does it make sense to use the technology?

Long Distances

Large Sensor Count

Simpler and Lighter Cabling

Airplanes

Satellites

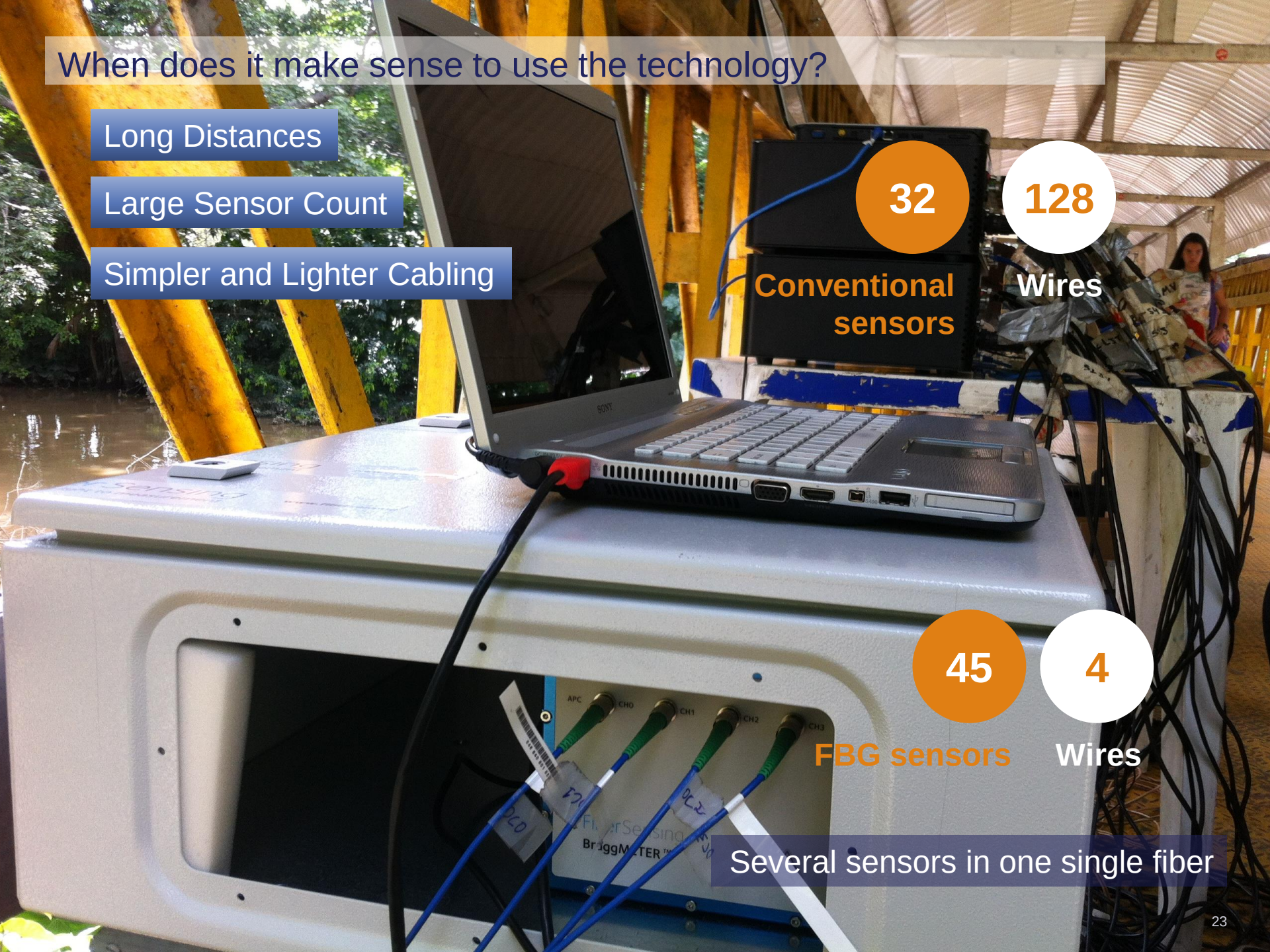
Long Cable Lengths

Complex Networks

Fast Installation

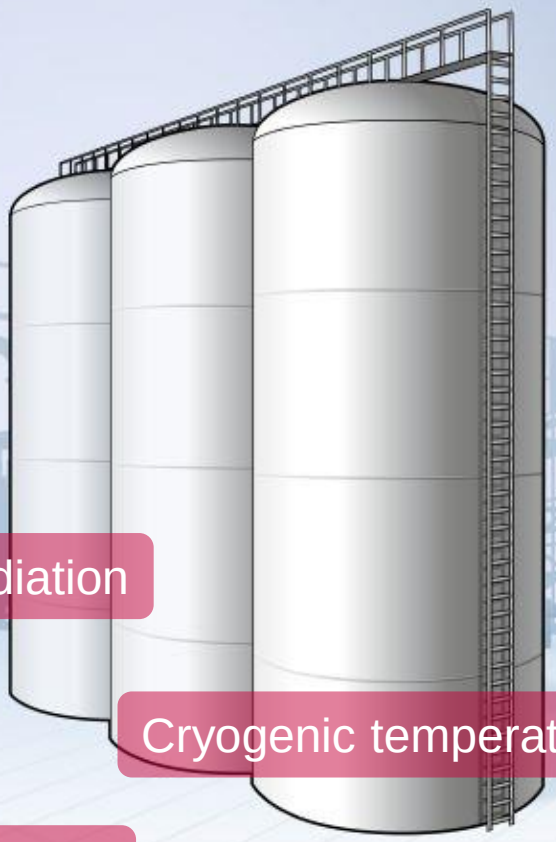
When does it make sense to use the technology?

- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling



When does it make sense to use the technology?

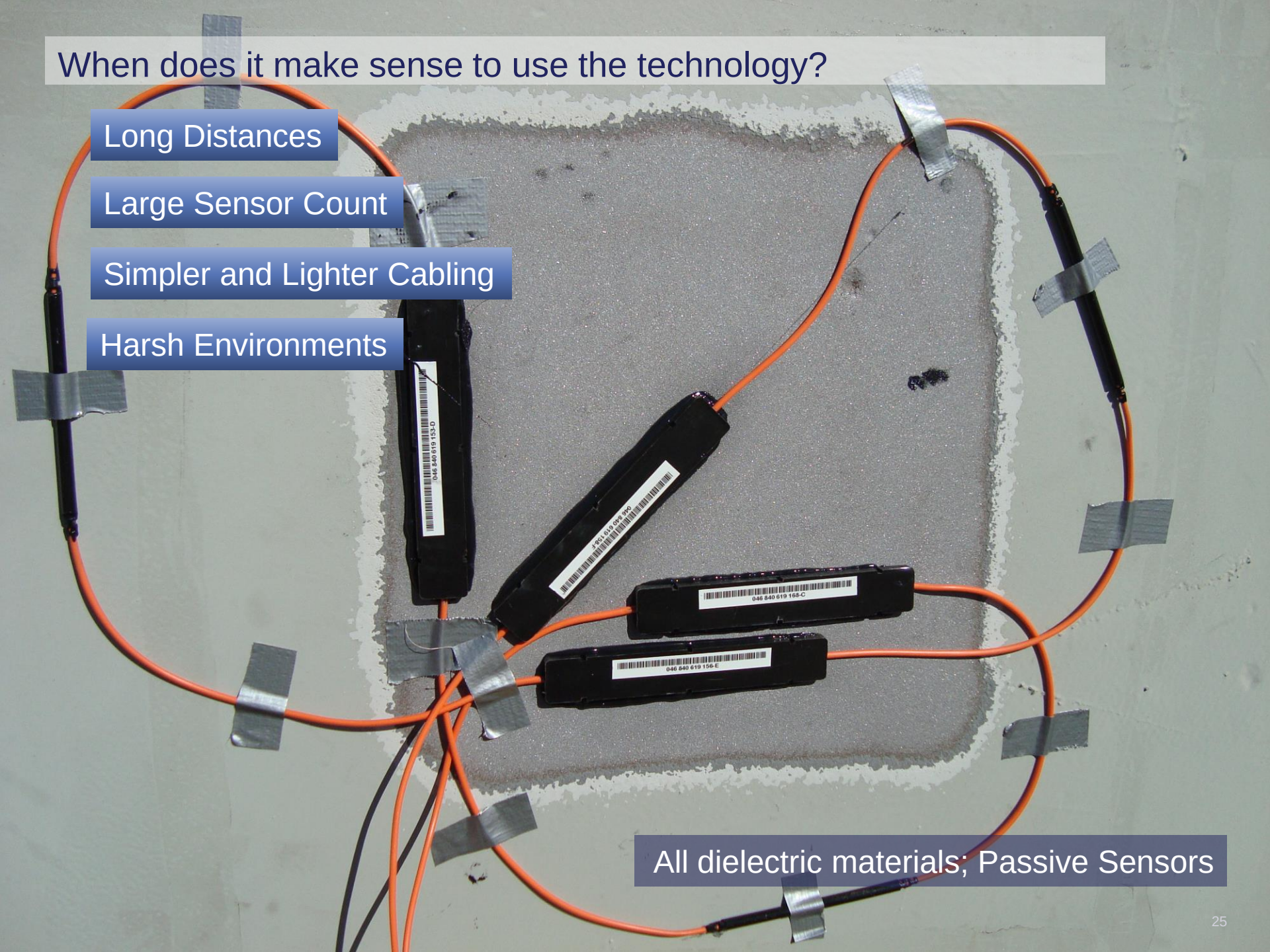
- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments



- Nuclear plants
- LNG tanks
- Radiation
- Cryogenic temperatures
- ATEX

When does it make sense to use the technology?

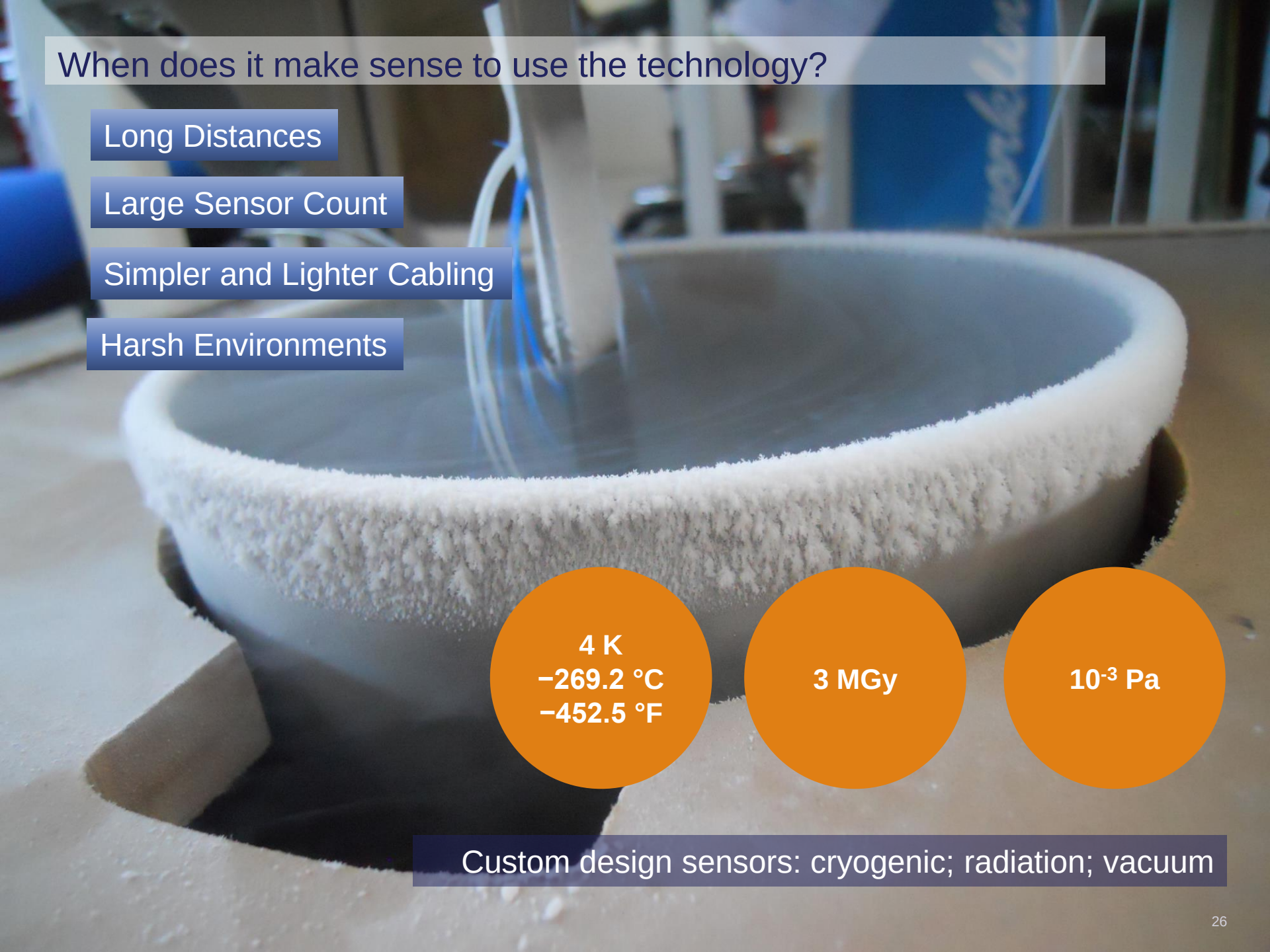
- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments



All dielectric materials; Passive Sensors

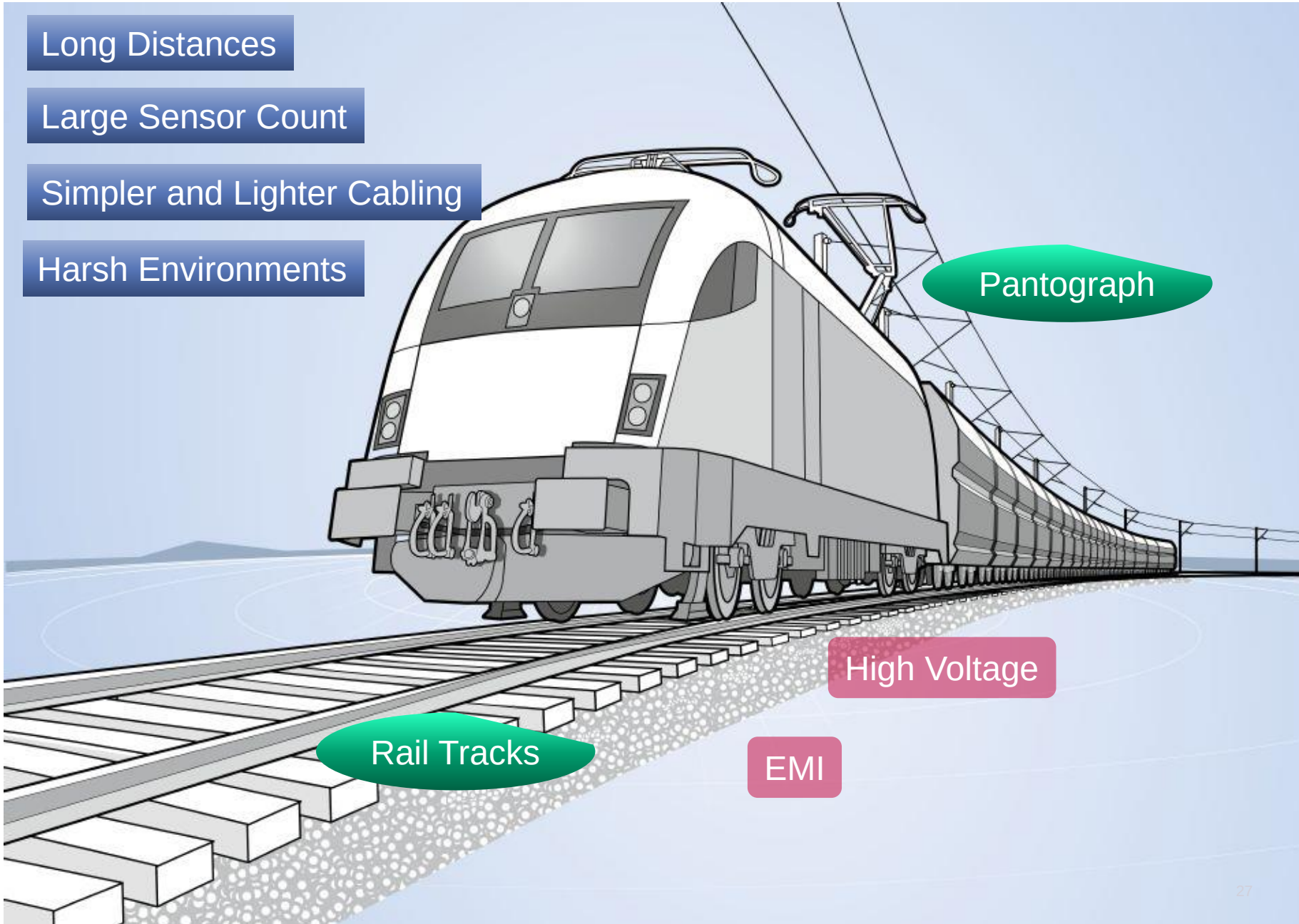
When does it make sense to use the technology?

- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments



Custom design sensors: cryogenic; radiation; vacuum

When does it make sense to use the technology?



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- Long Distances
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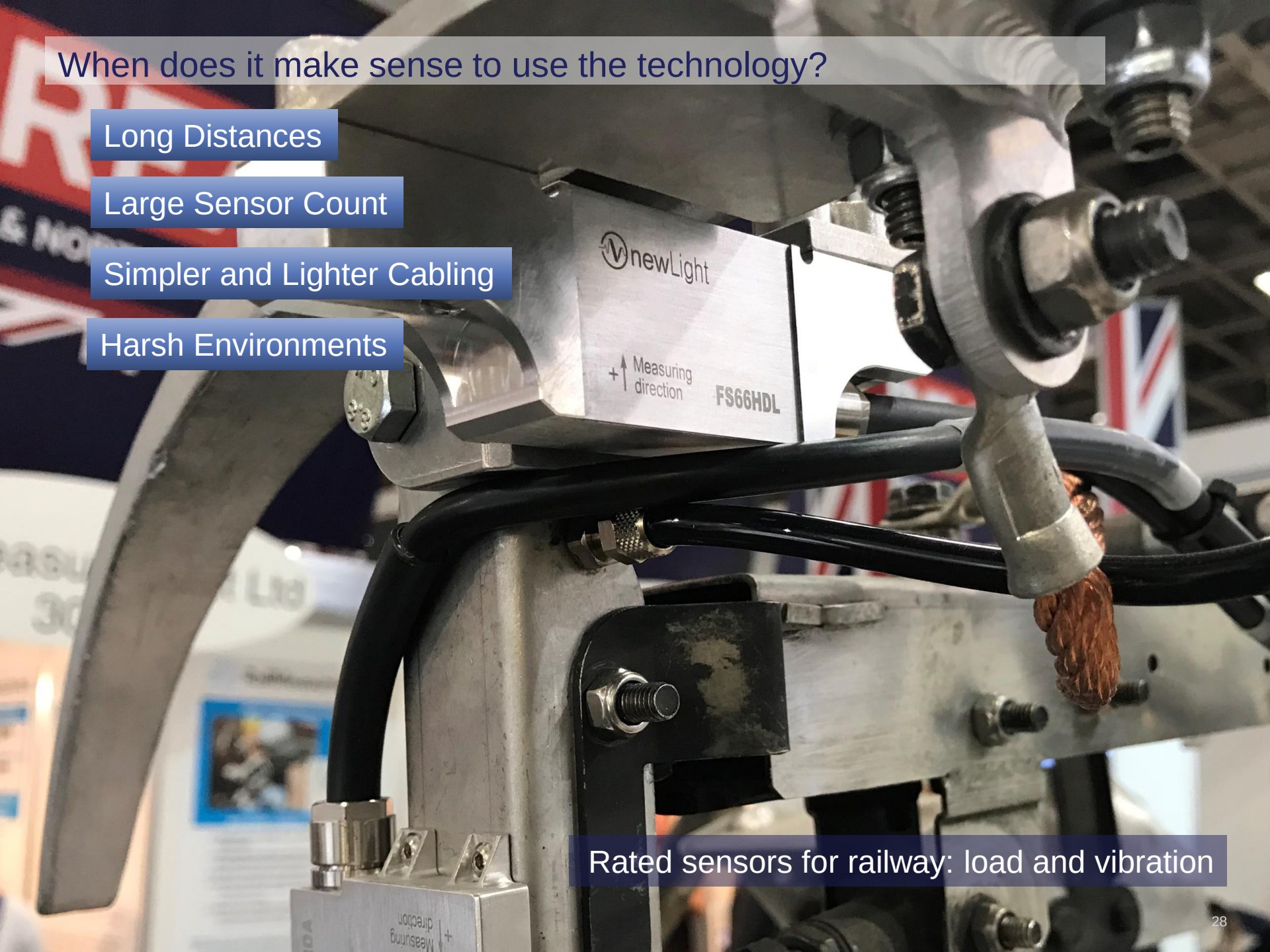
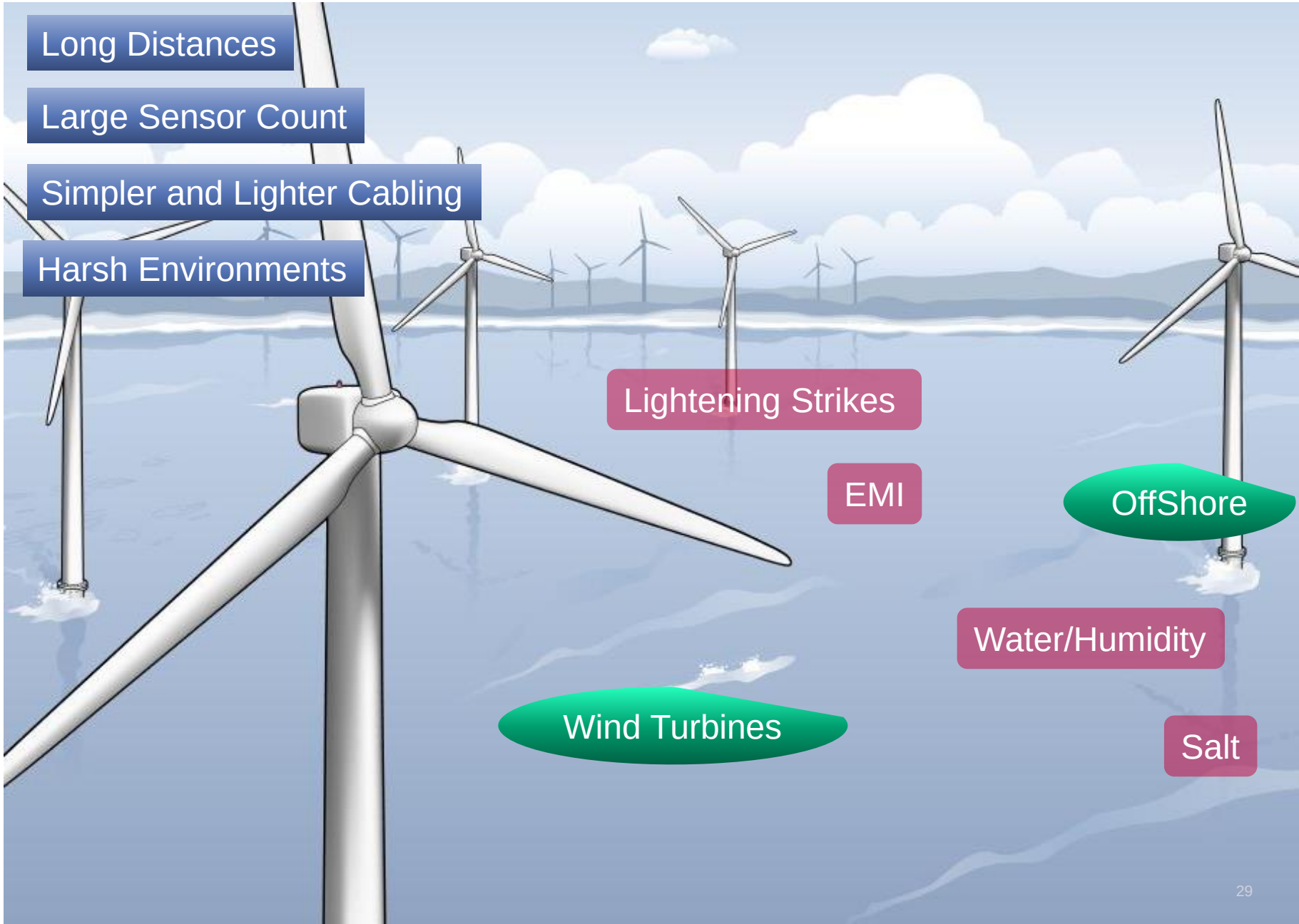


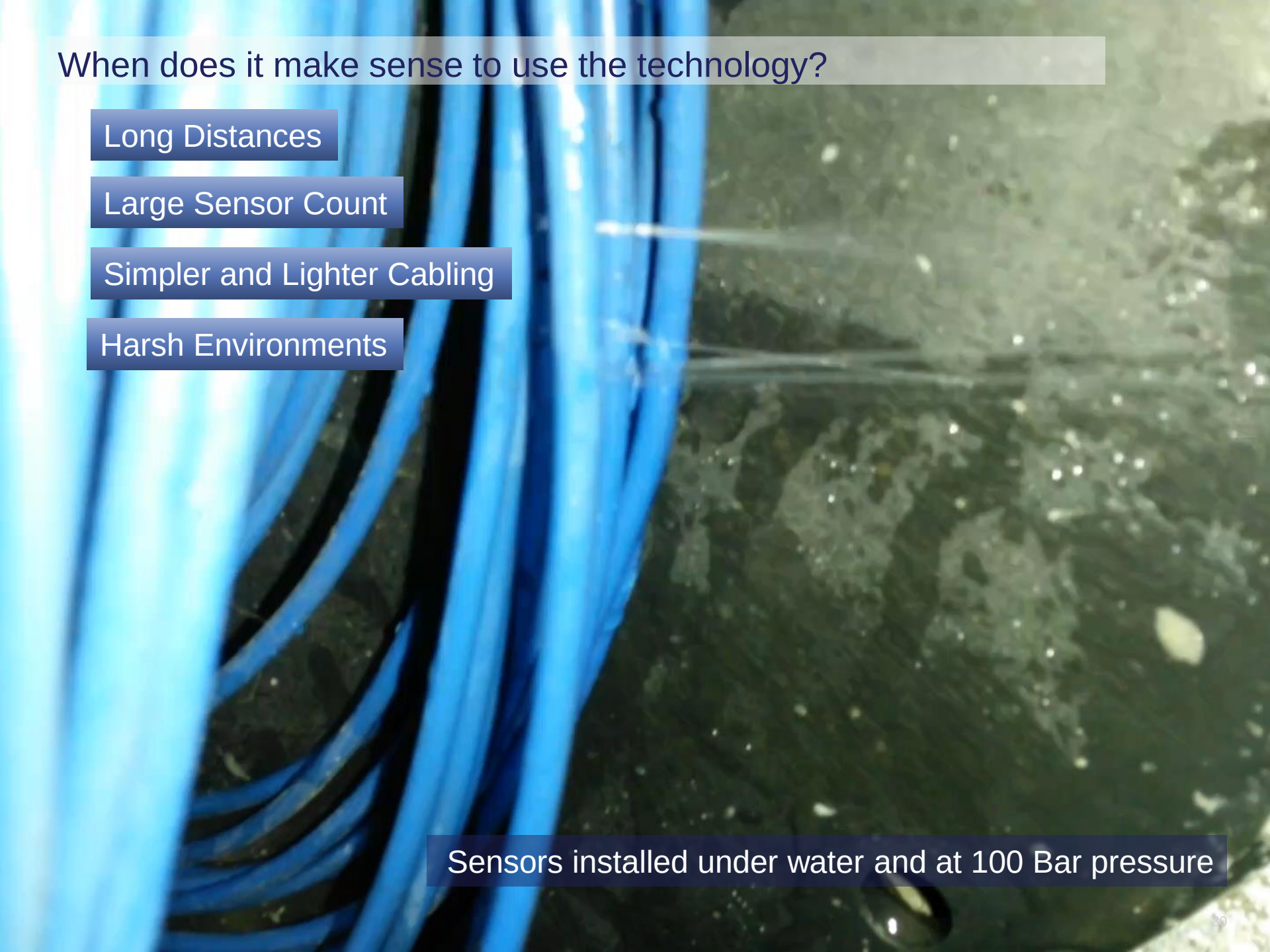
Rated sensors for railway: load and vibration

When does it make sense to use the technology?



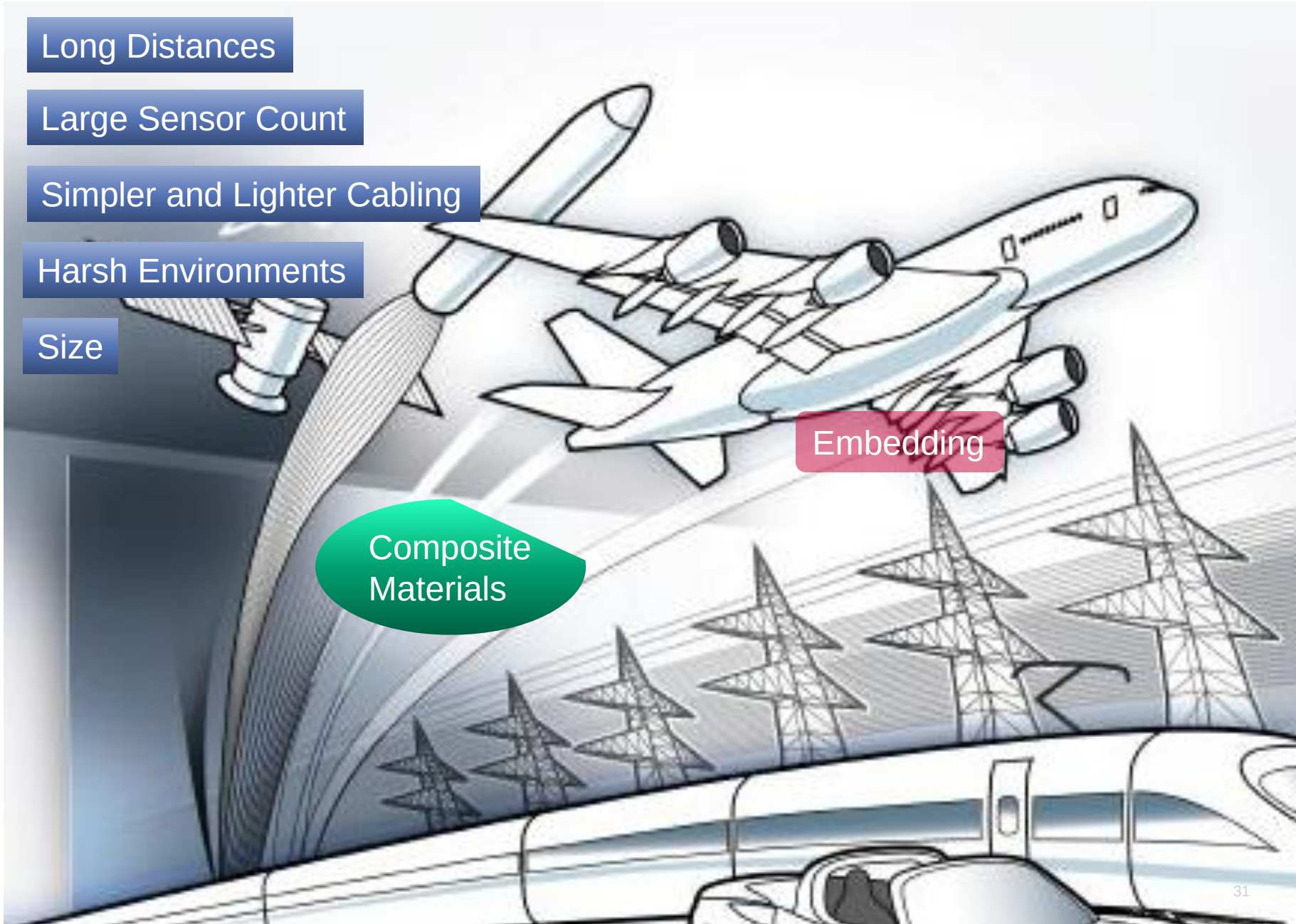
When does it make sense to use the technology?

- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments



Sensors installed under water and at 100 Bar pressure

When does it make sense to use the technology?



When does it make sense to use the technology?

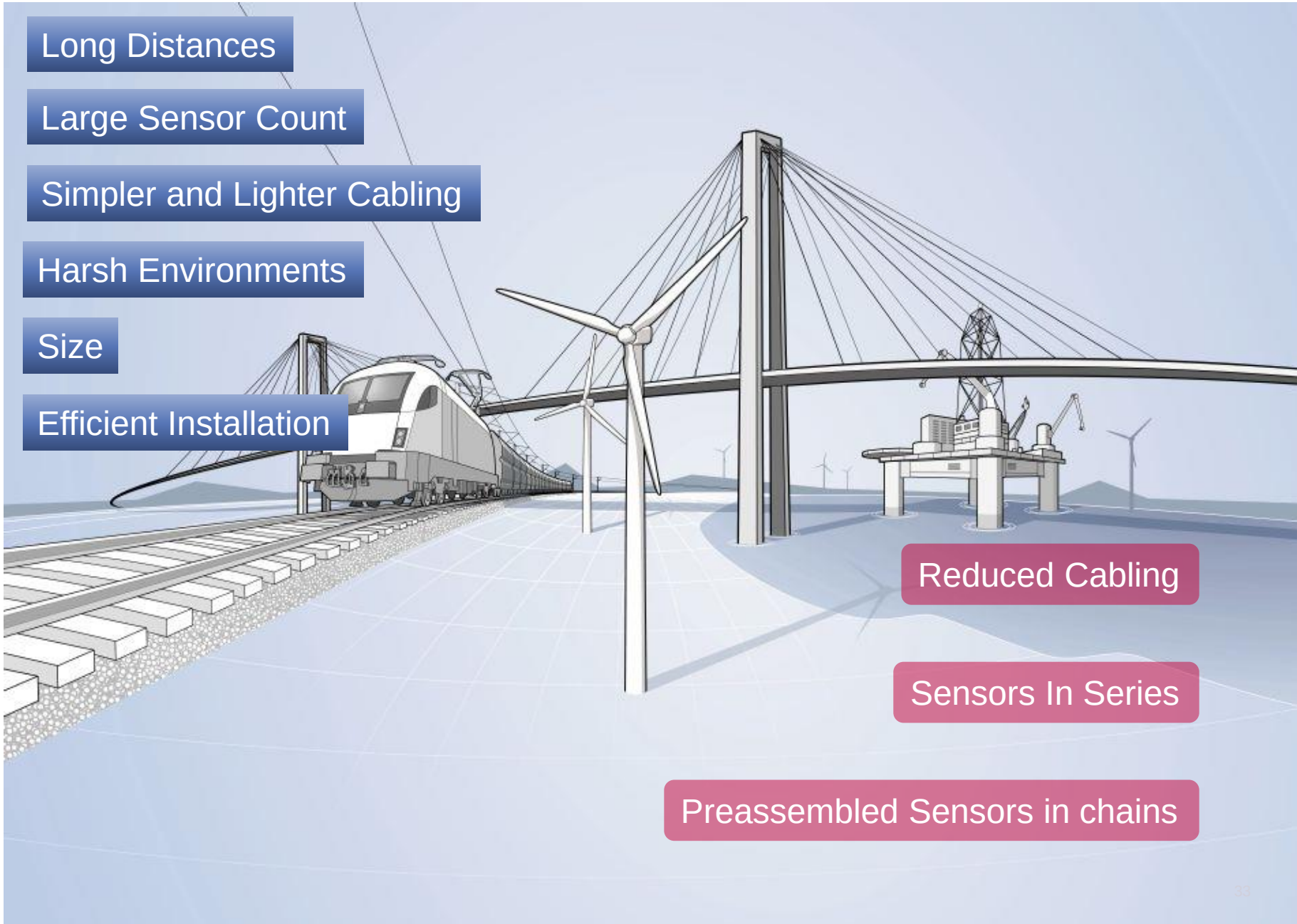
- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments
- Size

190µm

5mm

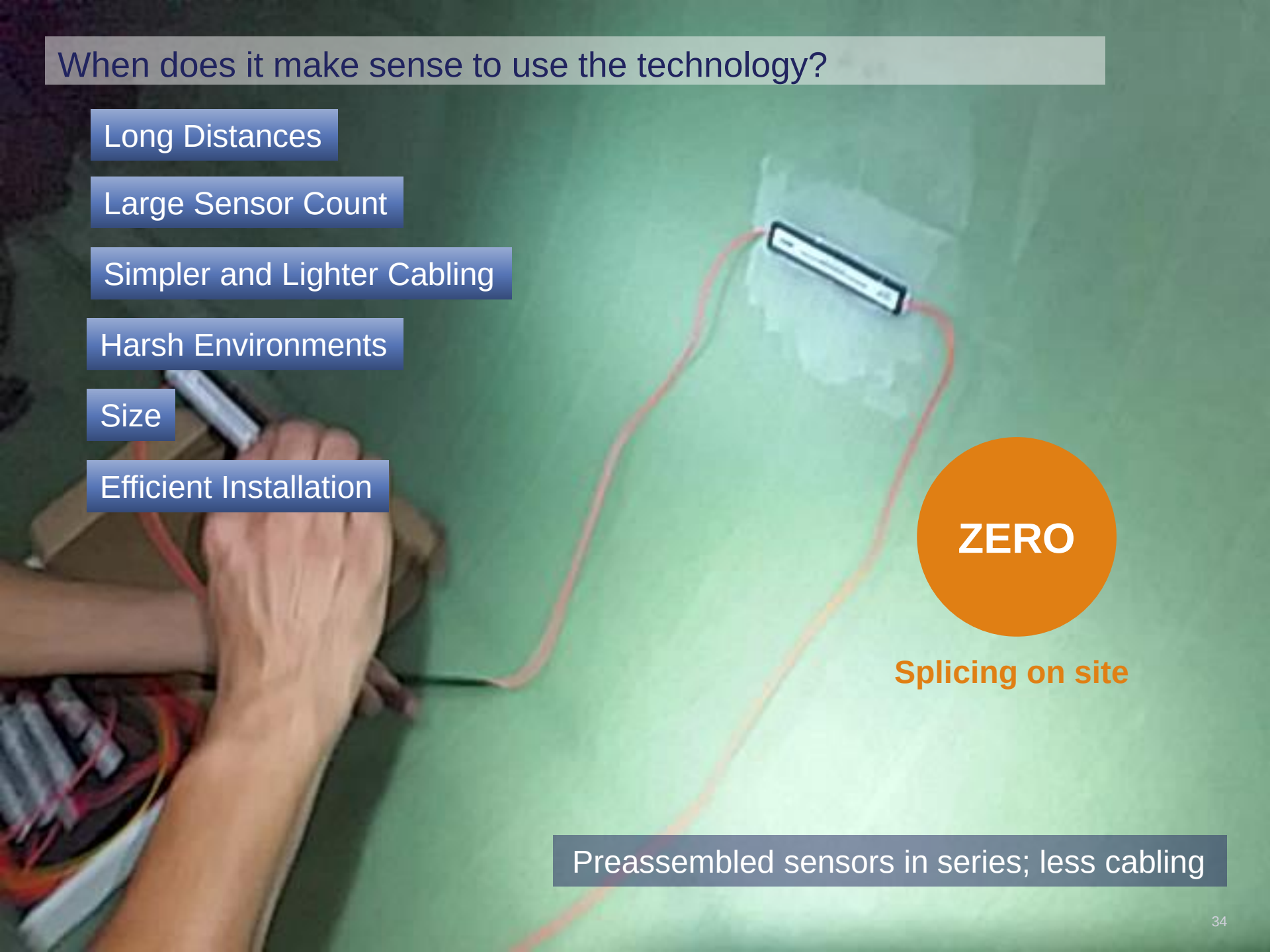
No intrusion on the material

When does it make sense to use the technology?



When does it make sense to use the technology?

- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments
- Size
- Efficient Installation

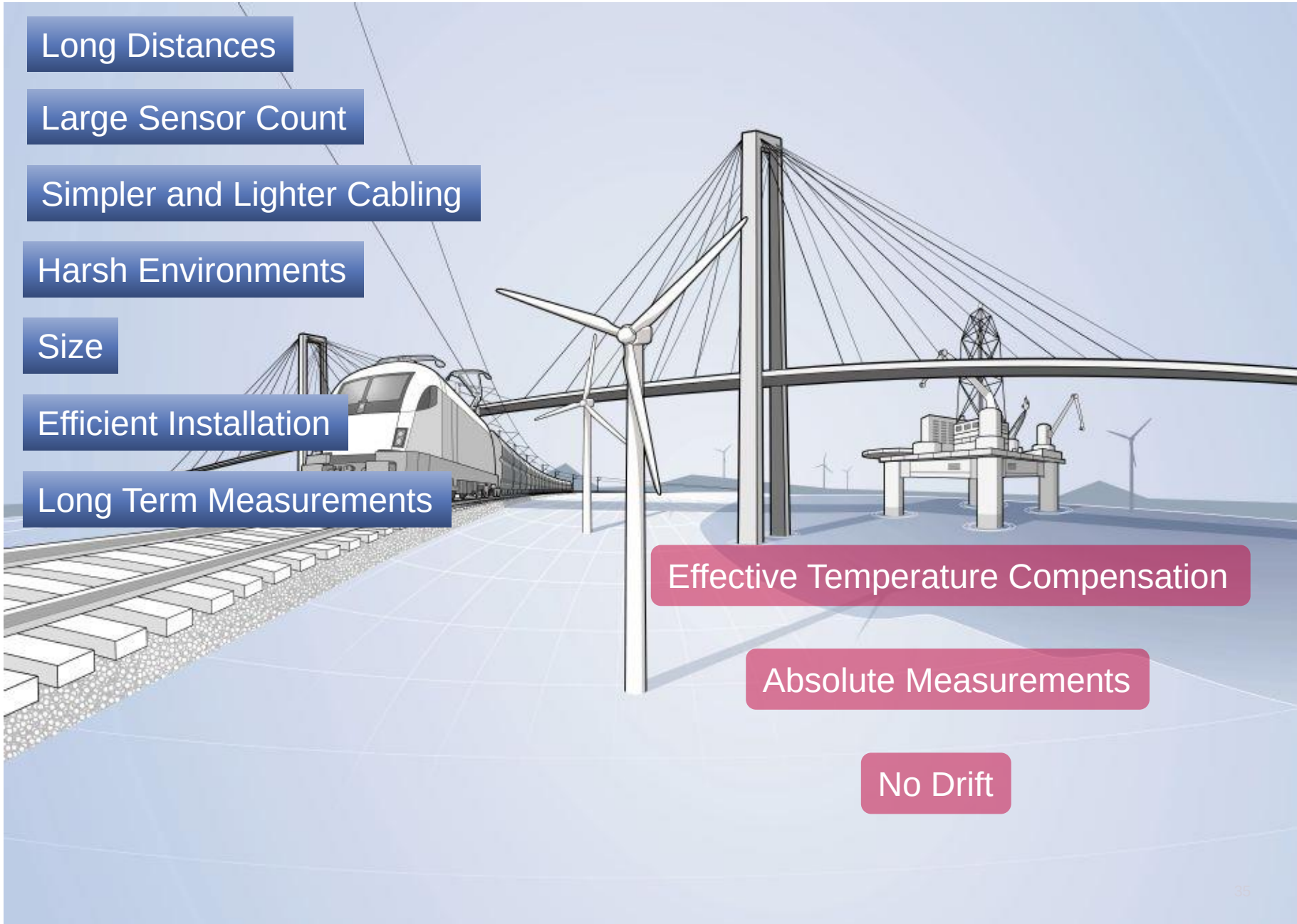


ZERO

Splicing on site

Preassembled sensors in series; less cabling

When does it make sense to use the technology?



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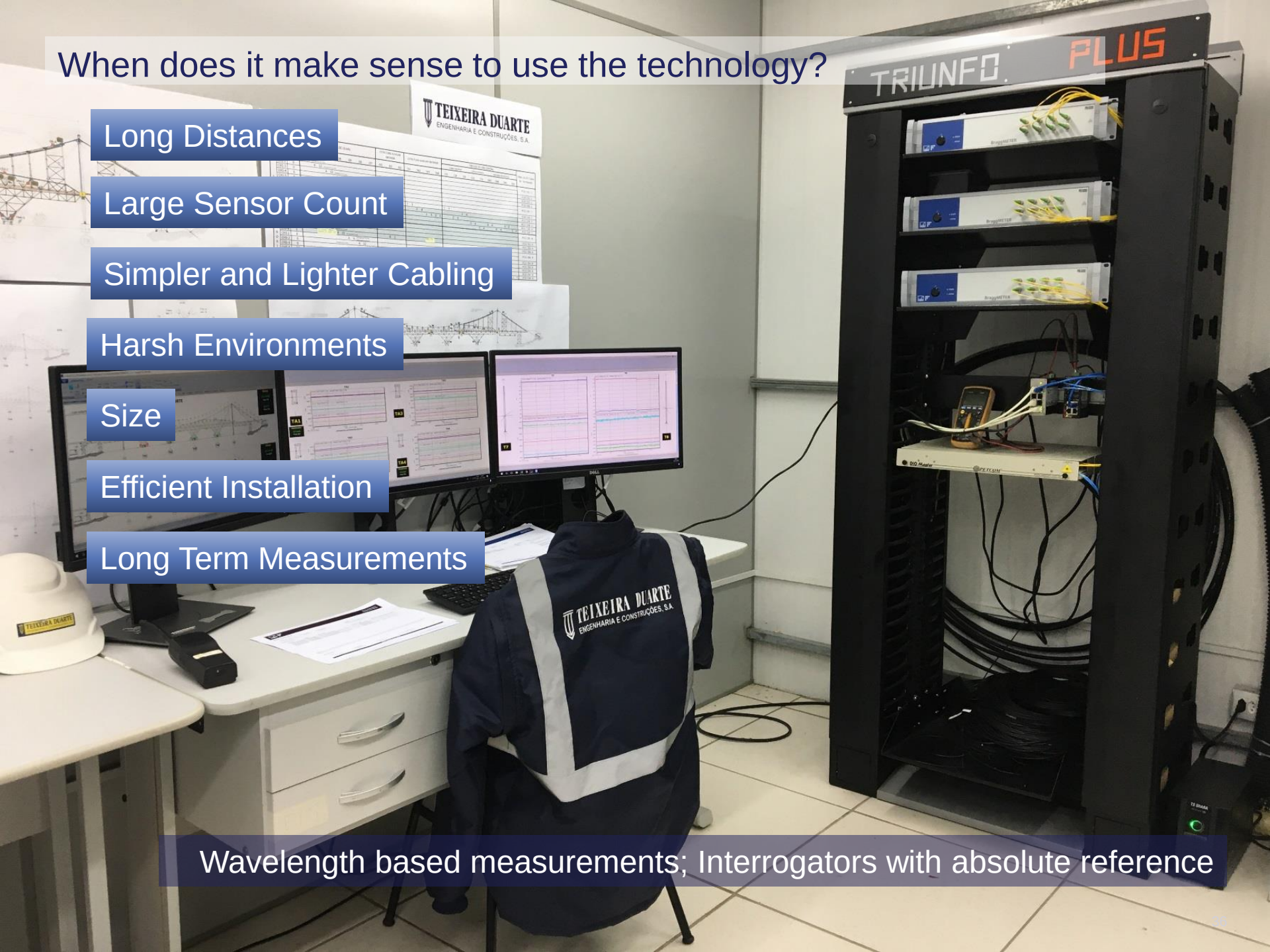
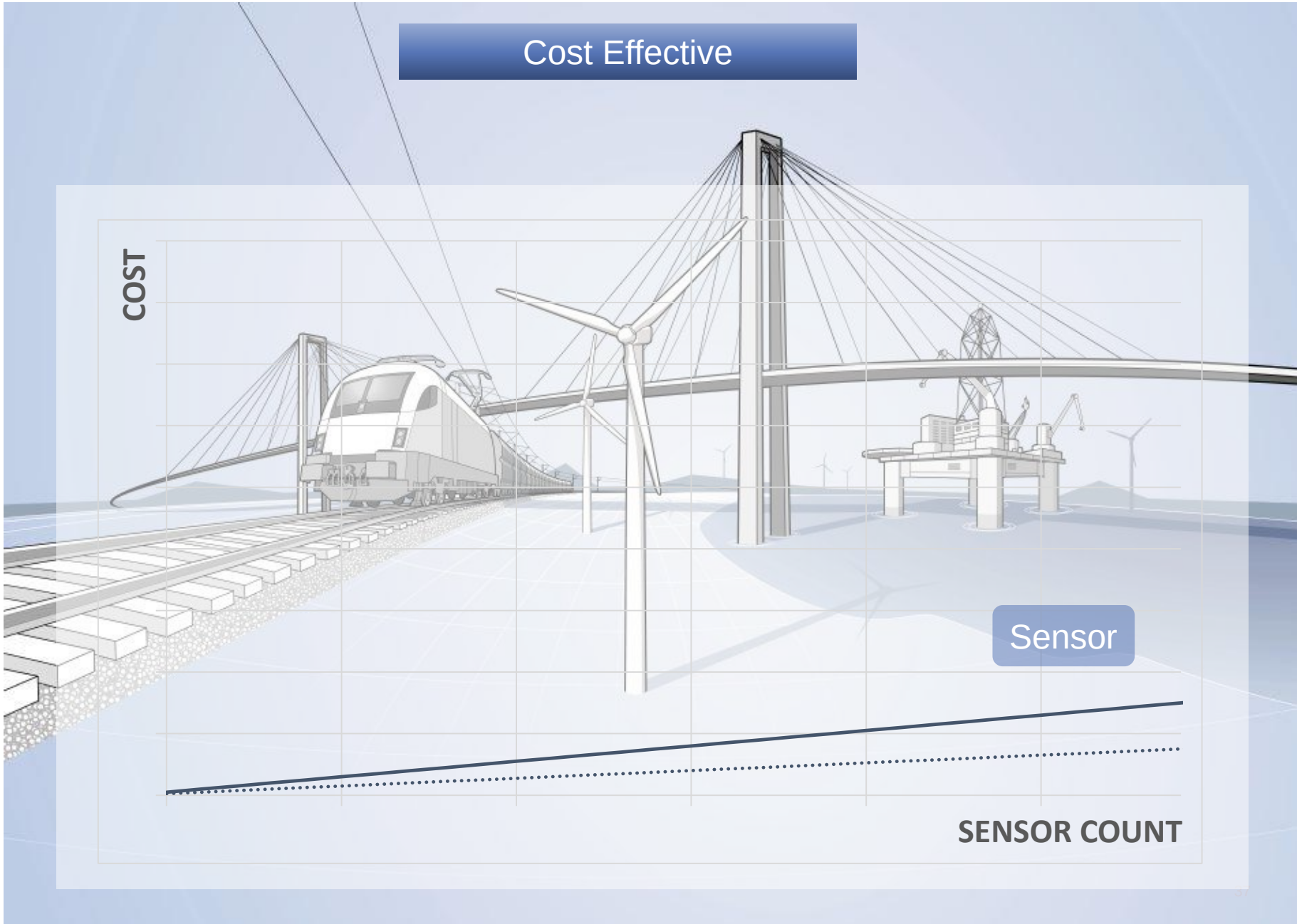


- Long Distances
- Large Sensor Count
- Simpler and Lighter Cabling
- Harsh Environments
- Size
- Efficient Installation
- Long Term Measurements

Wavelength based measurements; Interrogators with absolute reference

When does it make sense to use the technology?



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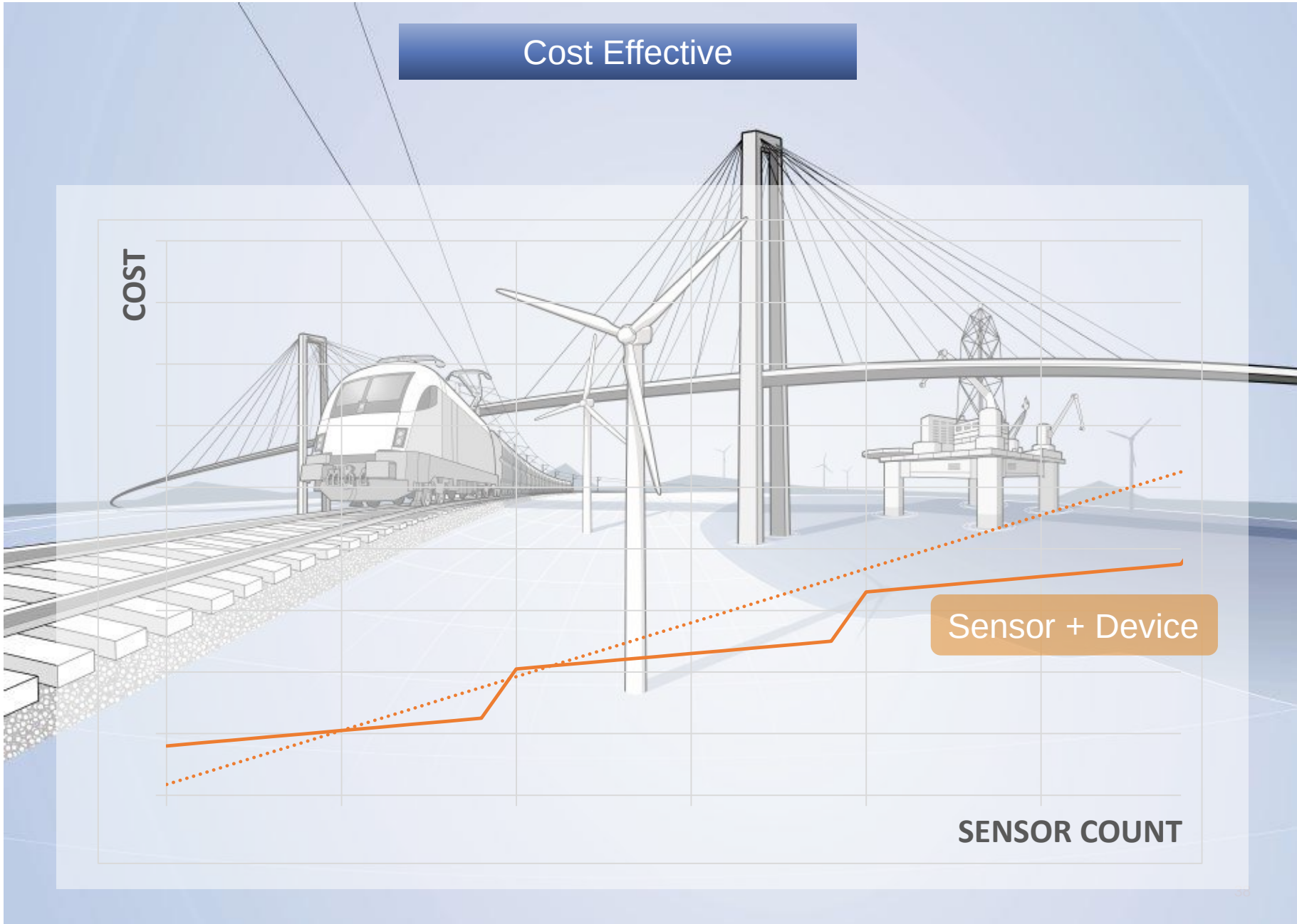

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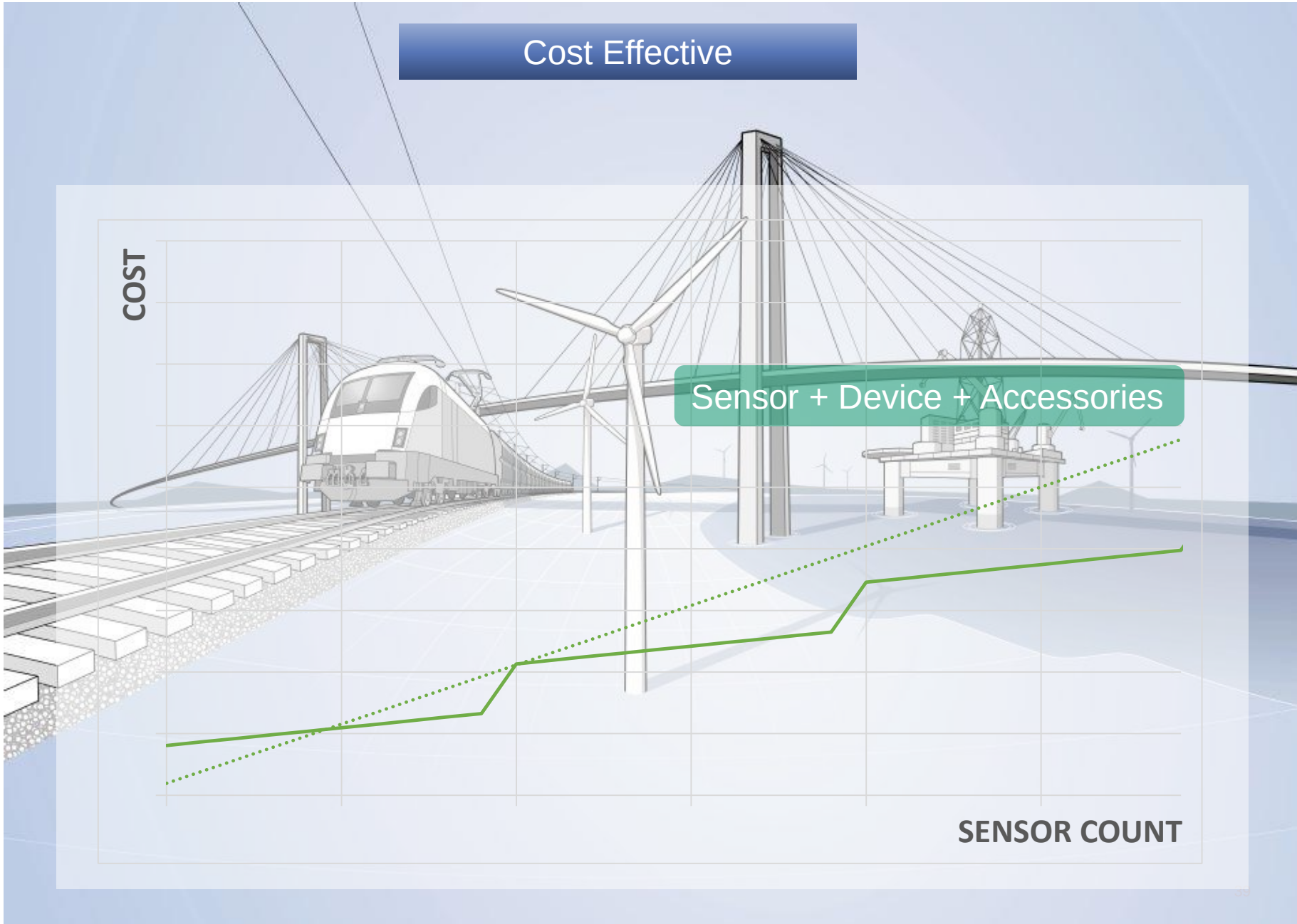

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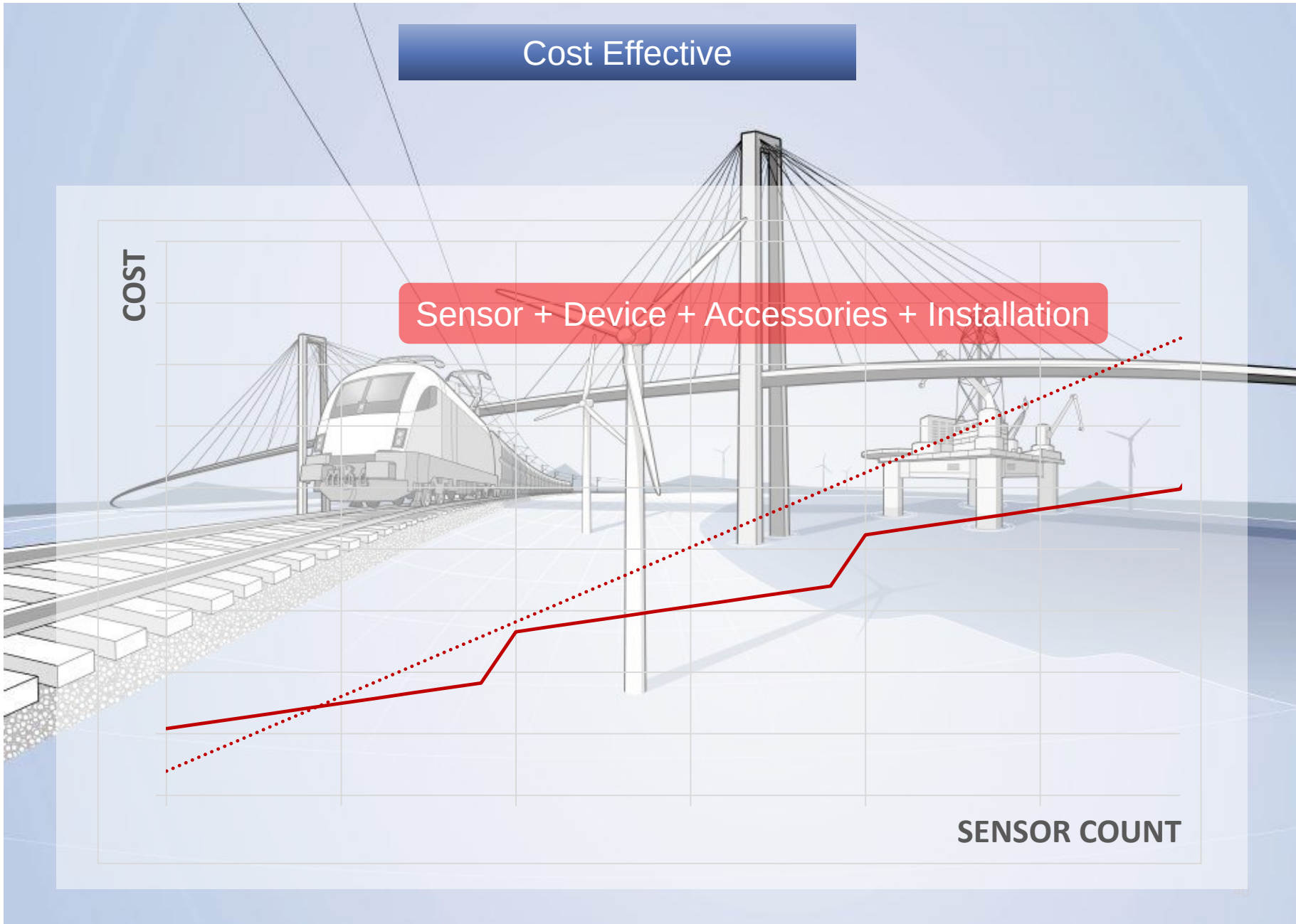

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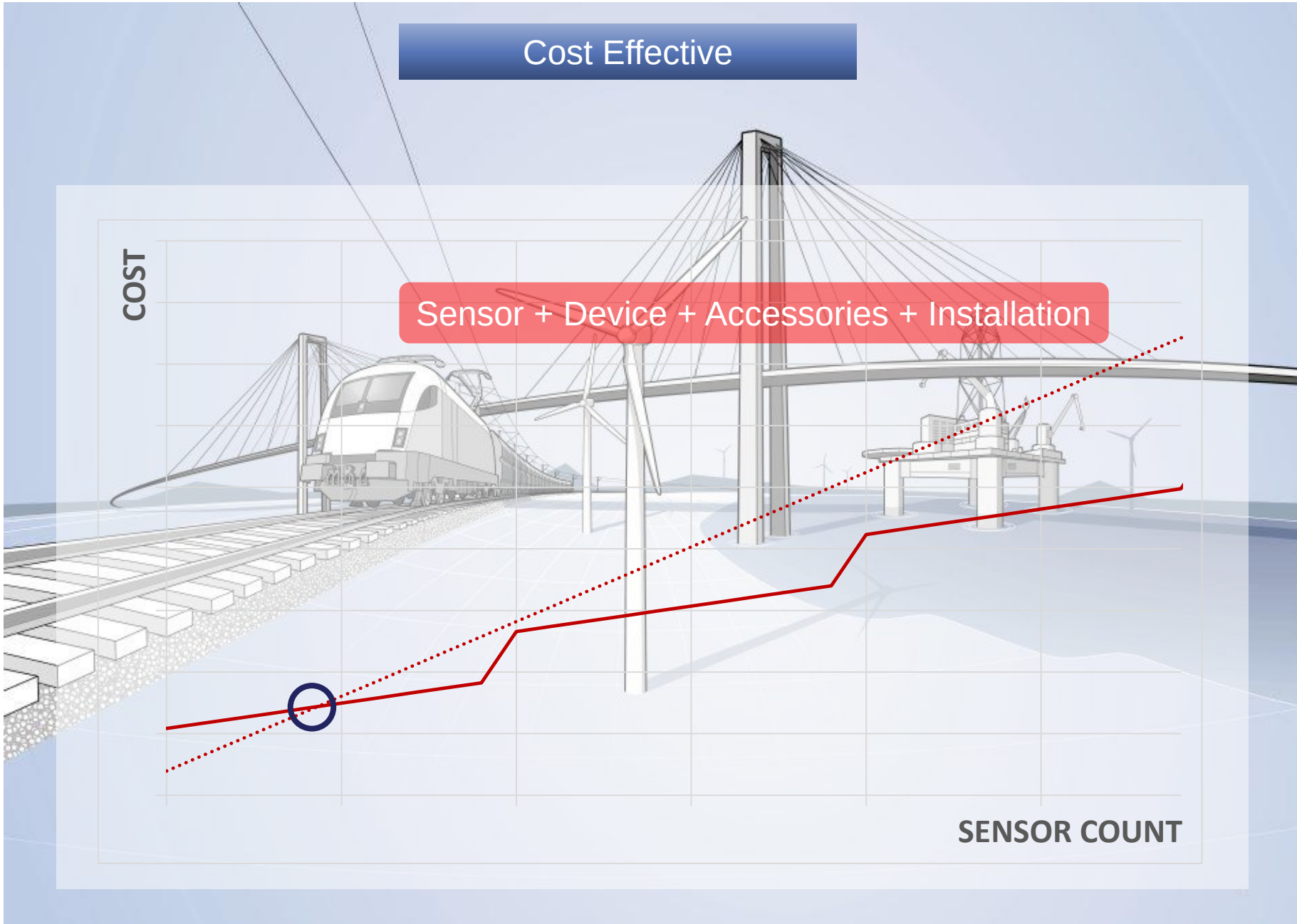

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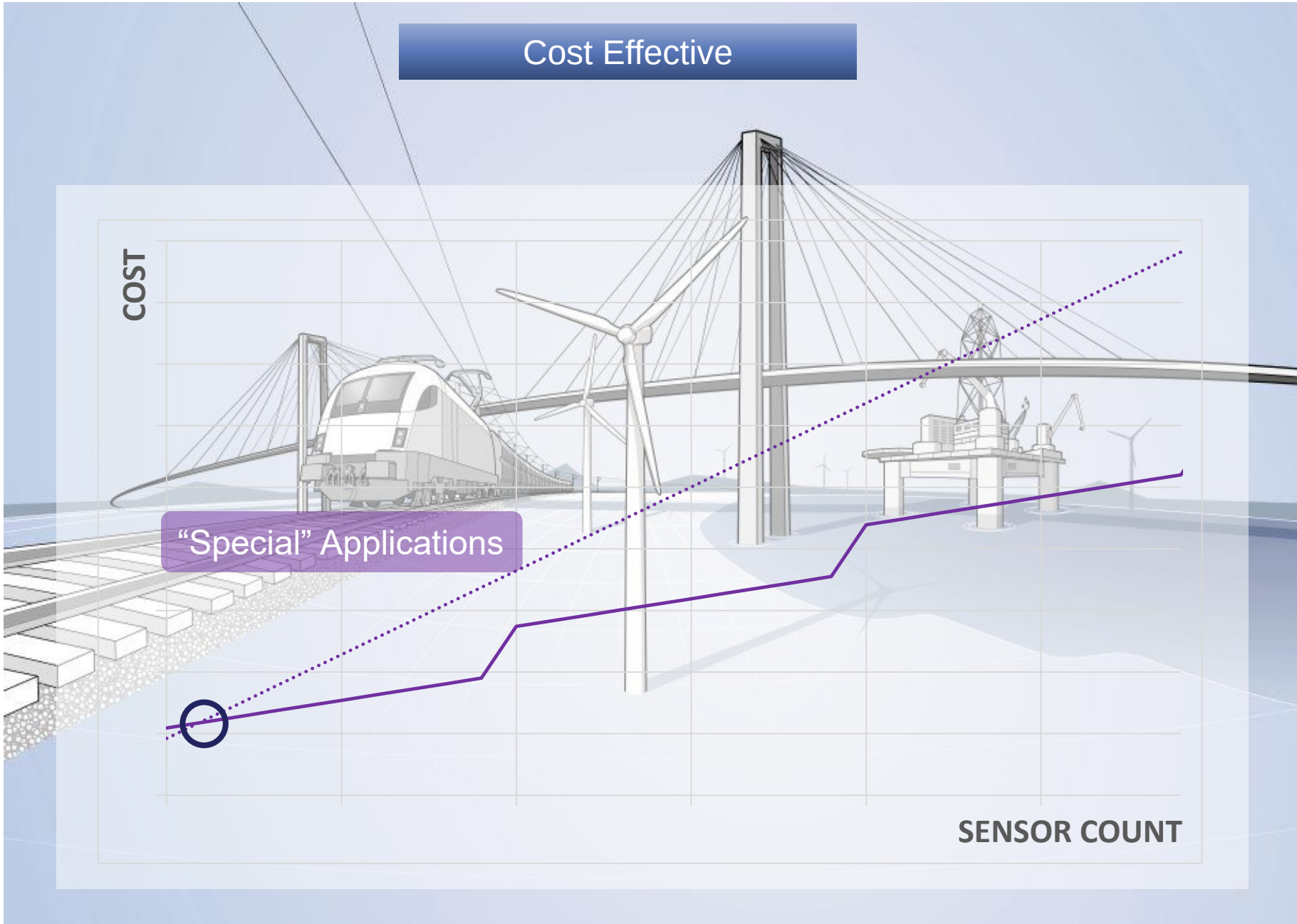
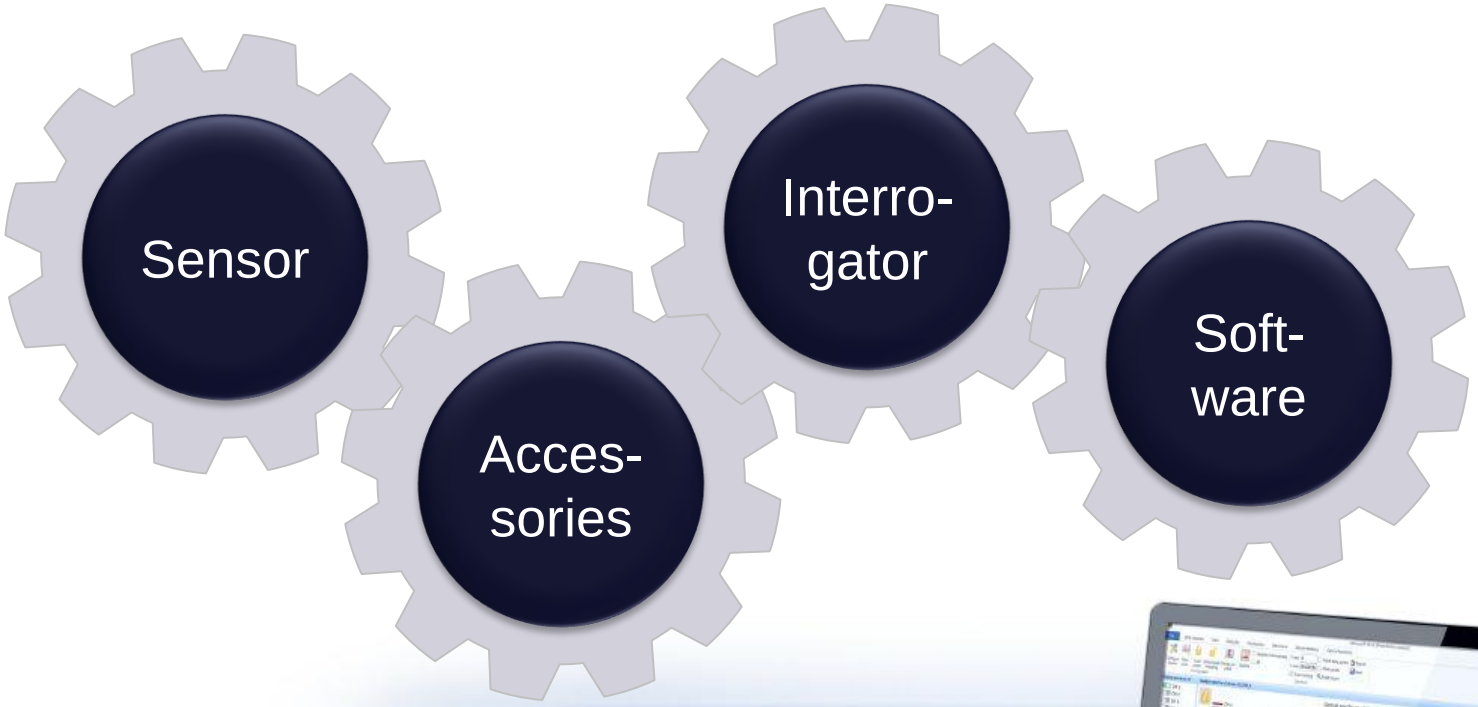


Components on a measurement chain

Components on a measurement chain



Full Measurement Chain

Sensors

Single Sensors

Strain Sensors

Temperature Sensors

Tilt Sensors

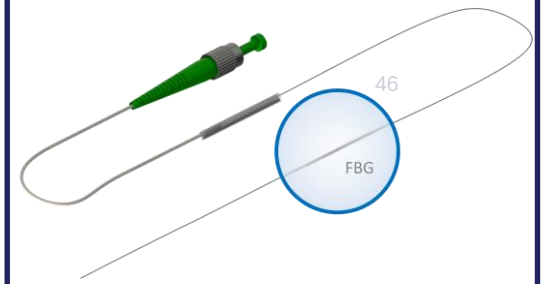
Acceleration Sensors

Components on a measurement chain

Sensors

Group of Sensors

Bare FBG

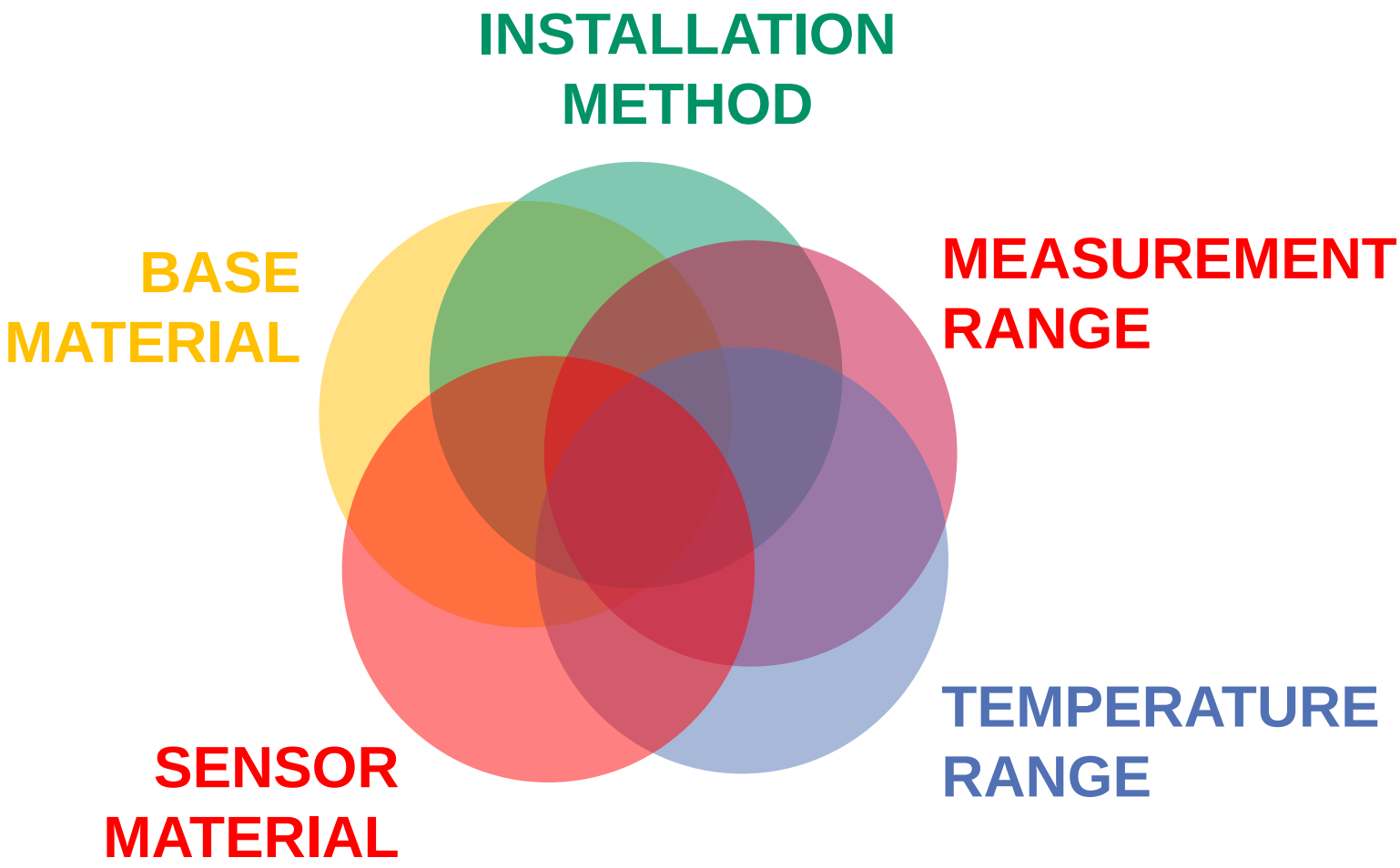


Chain of Sensors

Components on a measurement chain

Sensors

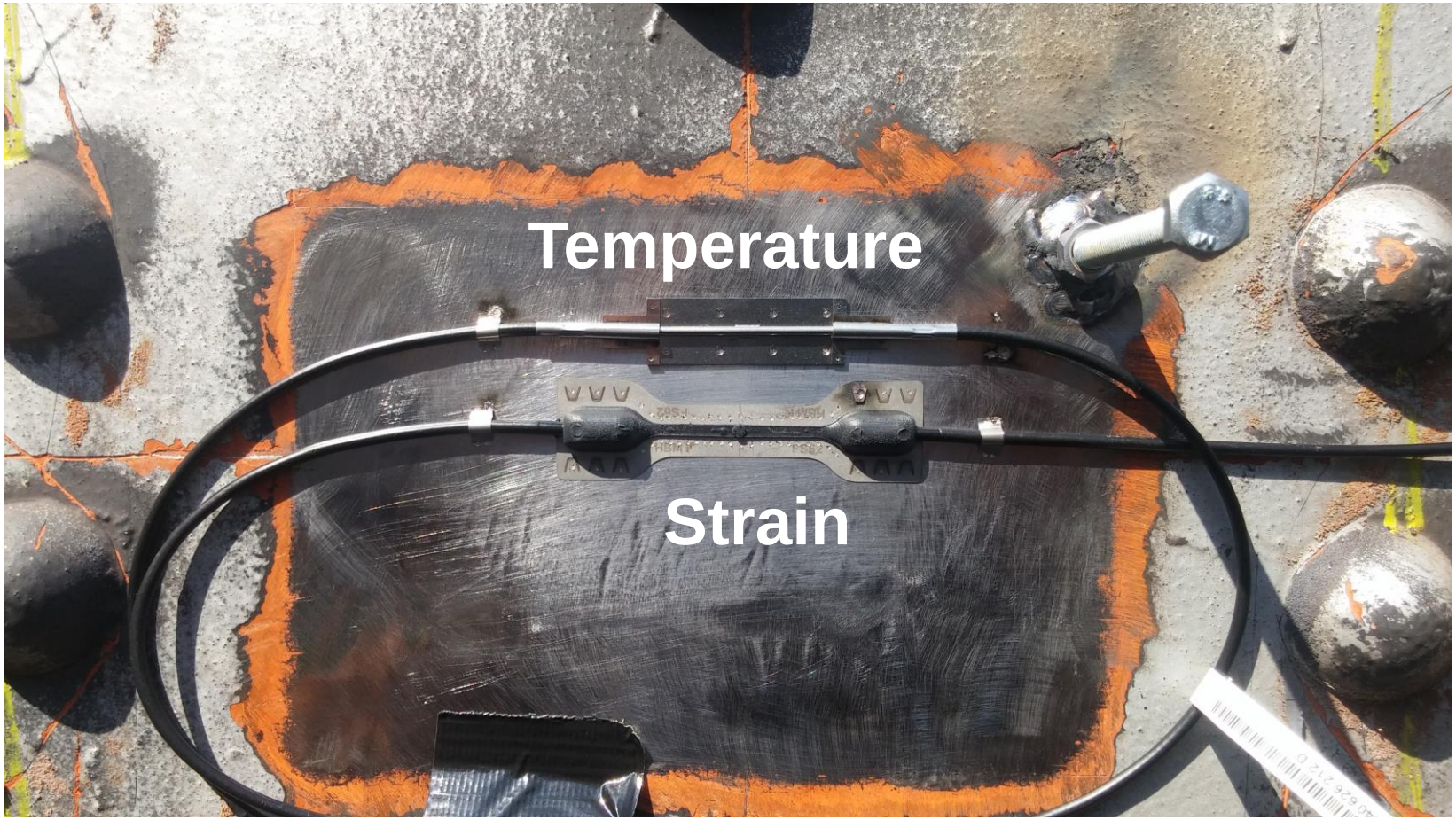
Sensor type selection



Sensors

Temperature compensation

1 Strain → 1 Temperature

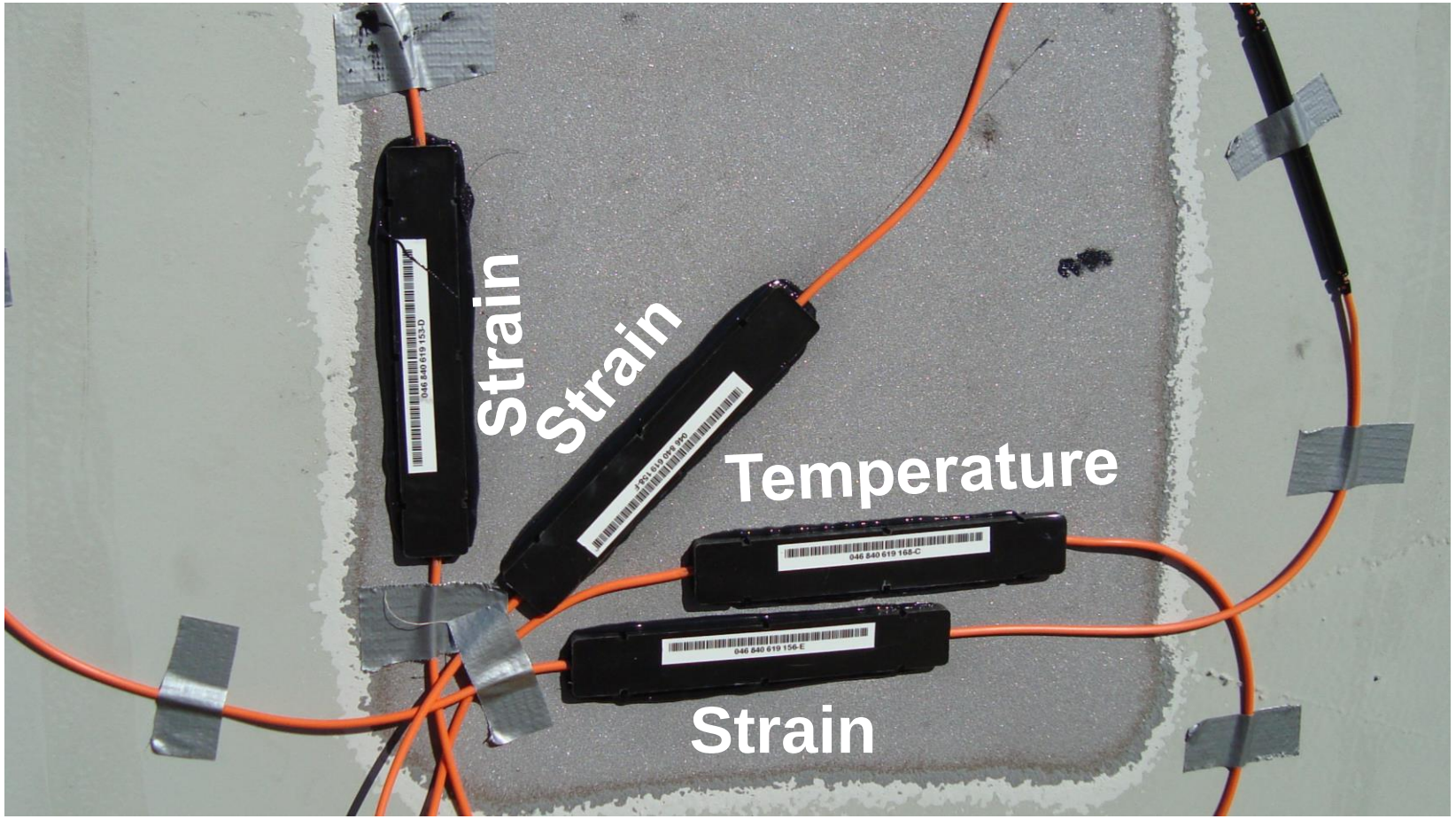


Sensors

Temperature compensation

3 Strain → 1 Temperature

Under the same temperature!



Components on a measurement chain

Accessories

Cables

Components on a measurement chain

Accessories

Cables

Connections

Adapters

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**
  - **Equipment**
    - **Splice Machine**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**
  - **Equipment**
    - **Splice Machine**
    - **Welding Machine**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**
  - **Equipment**
    - **Splice Machine**
    - **Welding Machine**
    - **Drilling Machine**
    - **Grinding Wheel**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**
  - **Equipment**
    - **Splice Machine**
    - **Welding Machine**
    - **Drilling Machine**
    - **Grinding Wheel**
  - **Protections**
    - **Sensor**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**
  - **Equipment**
    - **Splice Machine**
    - **Welding Machine**
    - **Drilling Machine**
    - **Grinding Wheel**
  - **Protections**
    - **Sensor**
    - **Cables**

Components on a measurement chain

- **Accessories**
  - **Cables**
  - **Connections**
    - **Adapters**
    - **Splices**
  - **Glue**
  - **Equipment**
    - **Splice Machine**
    - **Welding Machine**
    - **Drilling Machine**
    - **Grinding Wheel**
  - **Protections**
    - **Sensor**
    - **Cables**
    - **Connections**

Components on a measurement chain

- **Accessories**
  - **Cables**
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  - **Glue**
  - **Equipment**
    - **Splice Machine**
    - **Welding Machine**
    - **Drilling Machine**
    - **Grinding Wheel**
  - **Protections**
    - **Sensor**
    - **Cables**
    - **Connections**
    - **Equipment**

Components on a measurement chain

Interrogators

FS22 BraggMETER

FS42 BraggMETER

Components on a measurement chain

Interrogators

Acquisition rate

Static (1 to 10S/s)

Components on a measurement chain

Interrogators

Acquisition rate

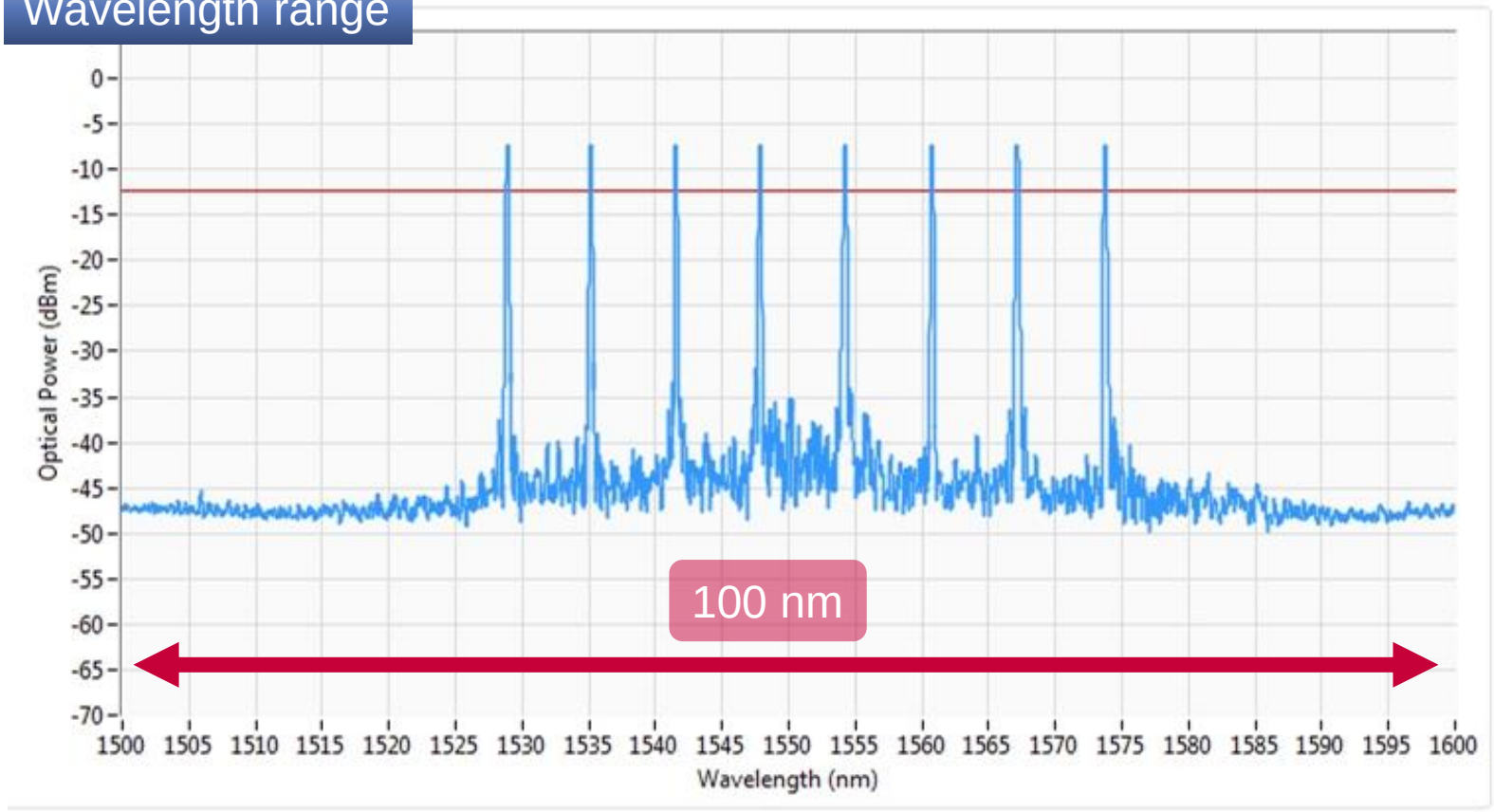
Static (1 to 10S/s)

Dynamic (higher)

Interrogators

Acquisition rate

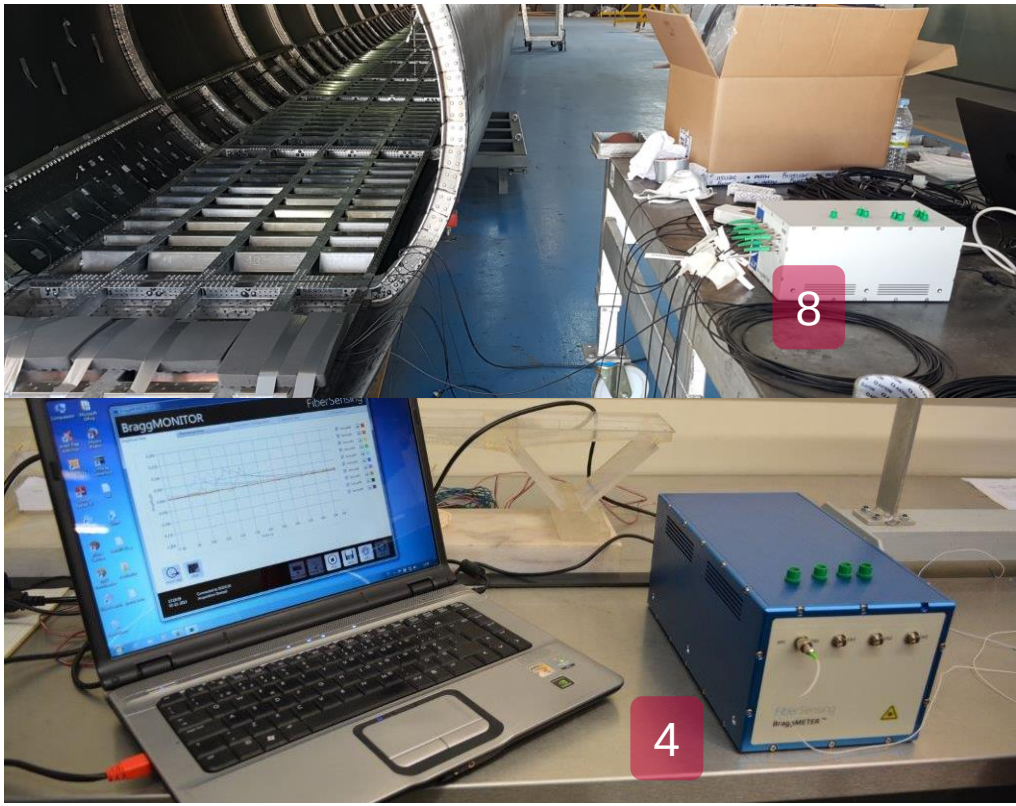
Wavelength range



Components on a measurement chain

Interrogators

- Acquisition rate
- Wavelength range
- Number of connectors



Components on a measurement chain

Interrogators

- Acquisition rate
- Wavelength range
- Number of connectors
- Connector type

Components on a measurement chain

Interrogators

- Acquisition rate
- Wavelength range
- Number of connectors
- Connector type
- Form factor

Components on a measurement chain

Interrogators

- Acquisition rate
- Wavelength range
- Number of connectors
- Connector type
- Form factor

Components on a measurement chain

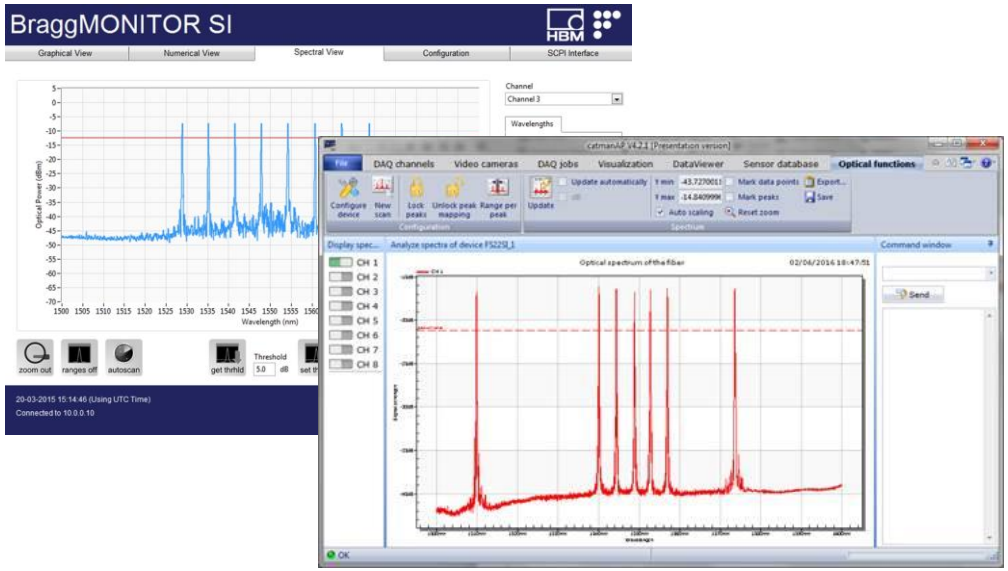
Interrogators

- Acquisition rate
- Wavelength range
- Number of connectors
- Connector type
- Form factor

Components on a measurement chain

Software

Ready-to-use



BraggMONITOR

catman

EVIDAS

To integrate

API

SCPI commands

Drivers

Common API

Thank you!

Any questions?

- If you have any questions, please do not hesitate to contact us: webinar@hbm.com
- Or email the presenter directly: cristina.barbosa@hbm.com

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