Sensors Converge

# MEMS sensors enable the sustainable Onlife era

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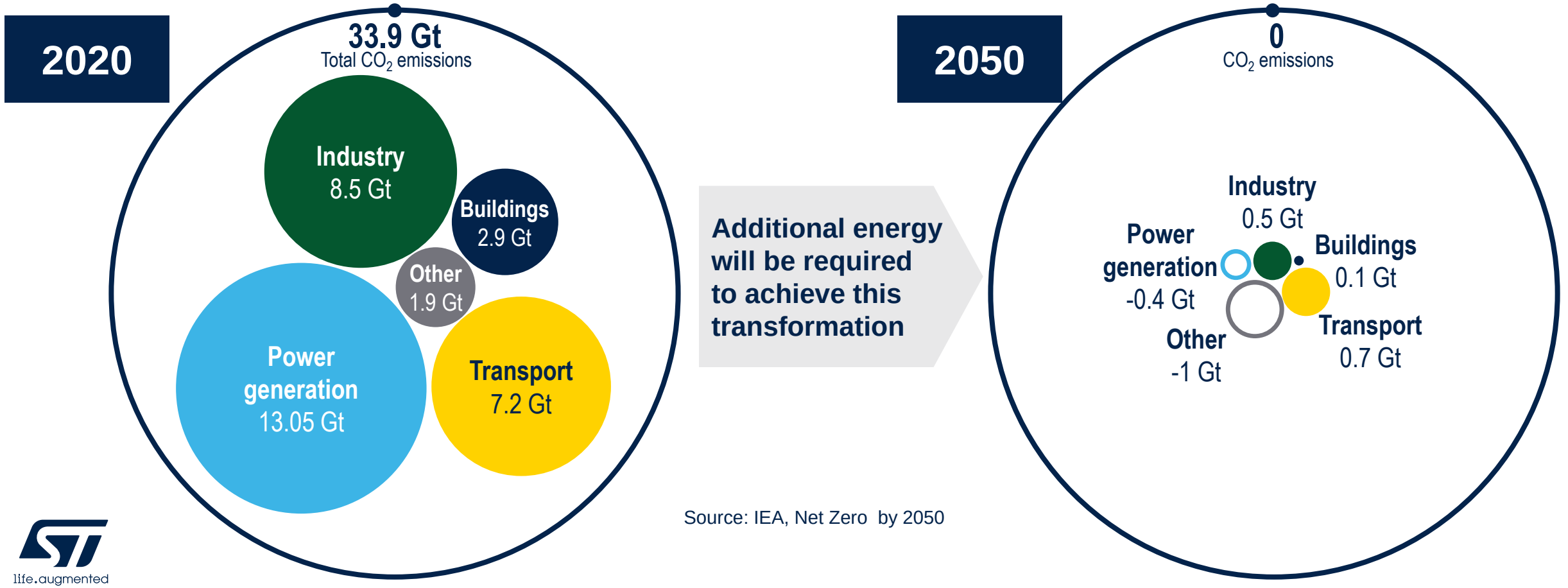
Marco Angelici
Vice President, Analog, MEMS and Sensors Marketing, Americas
STMicroelectronics

#SensorsConverge

# The right path is by no means obvious

# Main focus on $CO_2$ emissions

Carbon dioxide emissions reached ~**34 Gtons** in 2020, where power sector represents the major contributor with 40% of the total




Source: IEA, Net Zero by 2050

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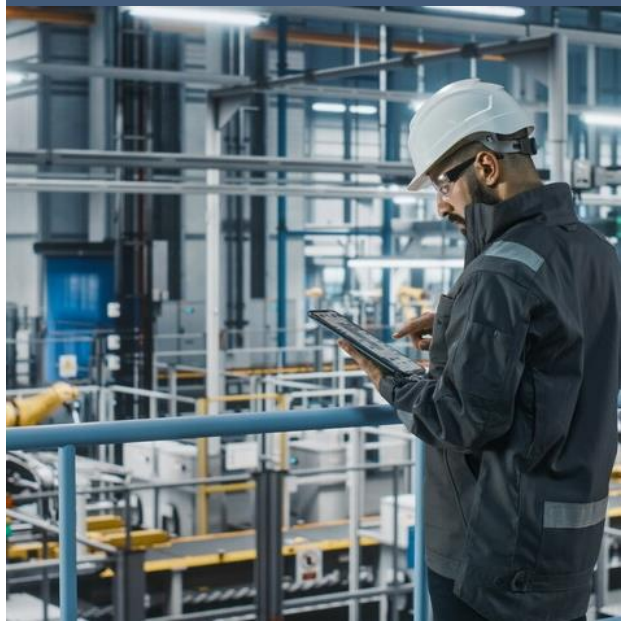
# The path to carbon neutrality

**Energy generation**

From fossil to renewable energy sources

**Industry**

Use of highly efficient equipment



**Transportation**

Migration to electric vehicle

**Building**

Low emission energy source and efficient systems

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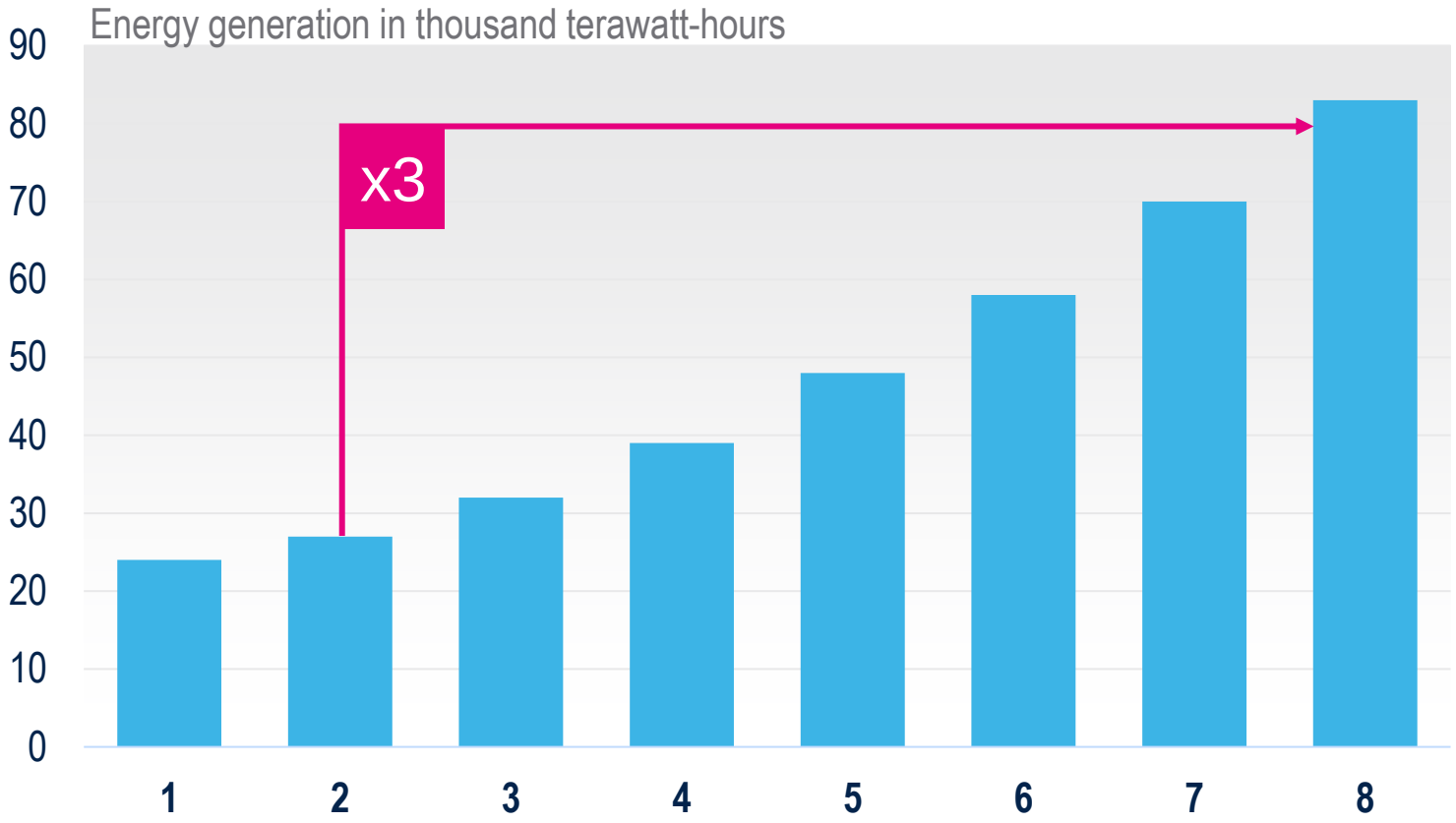
# Electricity generation worldwide trend

Electricity generation worldwide is forecast to triple in the next three decades, reaching **83,000 terawatt-hours by 2050**




**3x power generation** largely **driven by decarbonization efforts** and **electrification** of the transportation and building sectors

Source: Statista, Worldwide; McKinsey & Company

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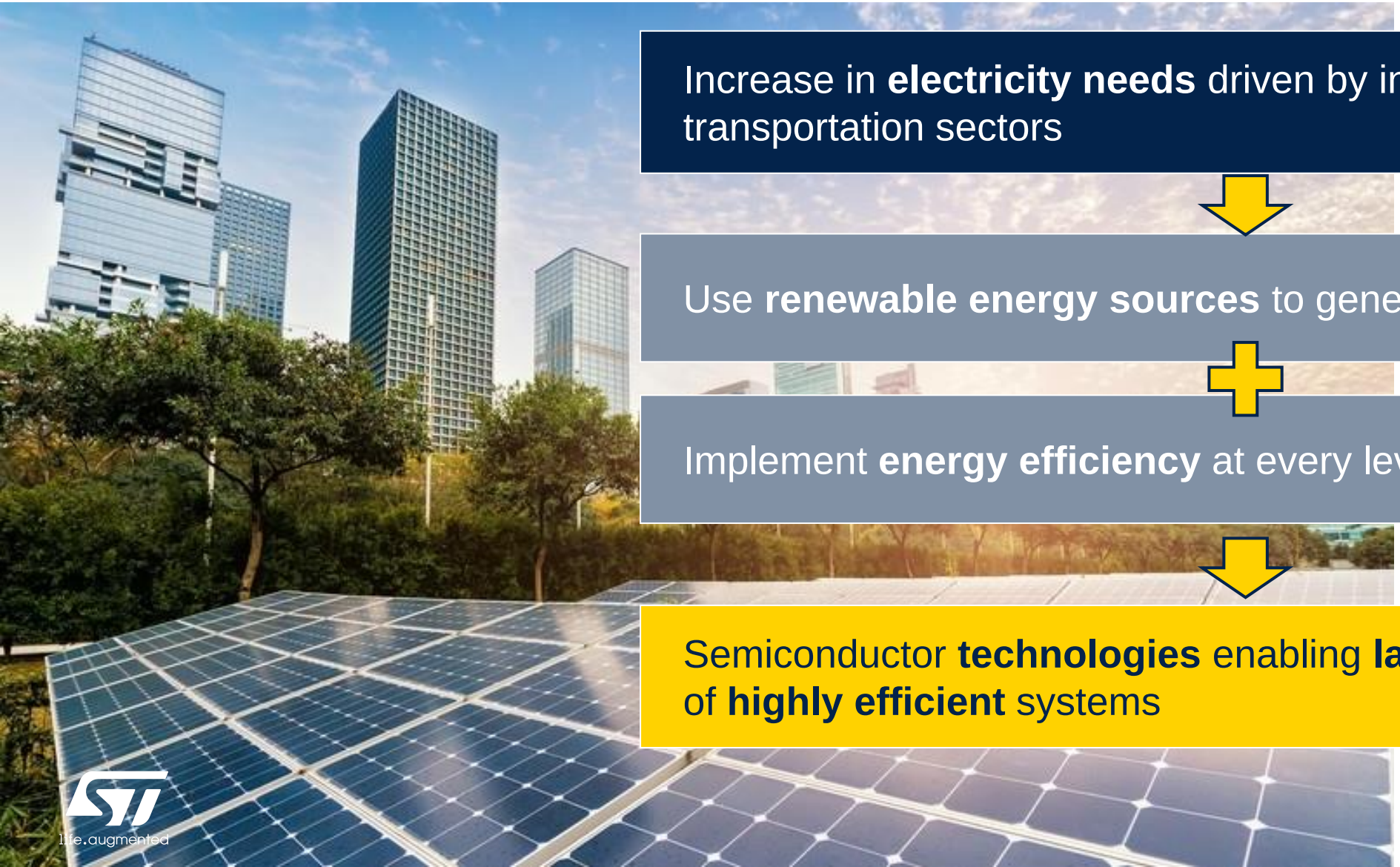
# A complex equation



Increase in **electricity needs** driven by industry, buildings and transportation sectors

Use **renewable energy sources** to generate electricity

Implement **energy efficiency** at every level

Semiconductor **technologies** enabling **large-scale** deployment of **highly efficient** systems

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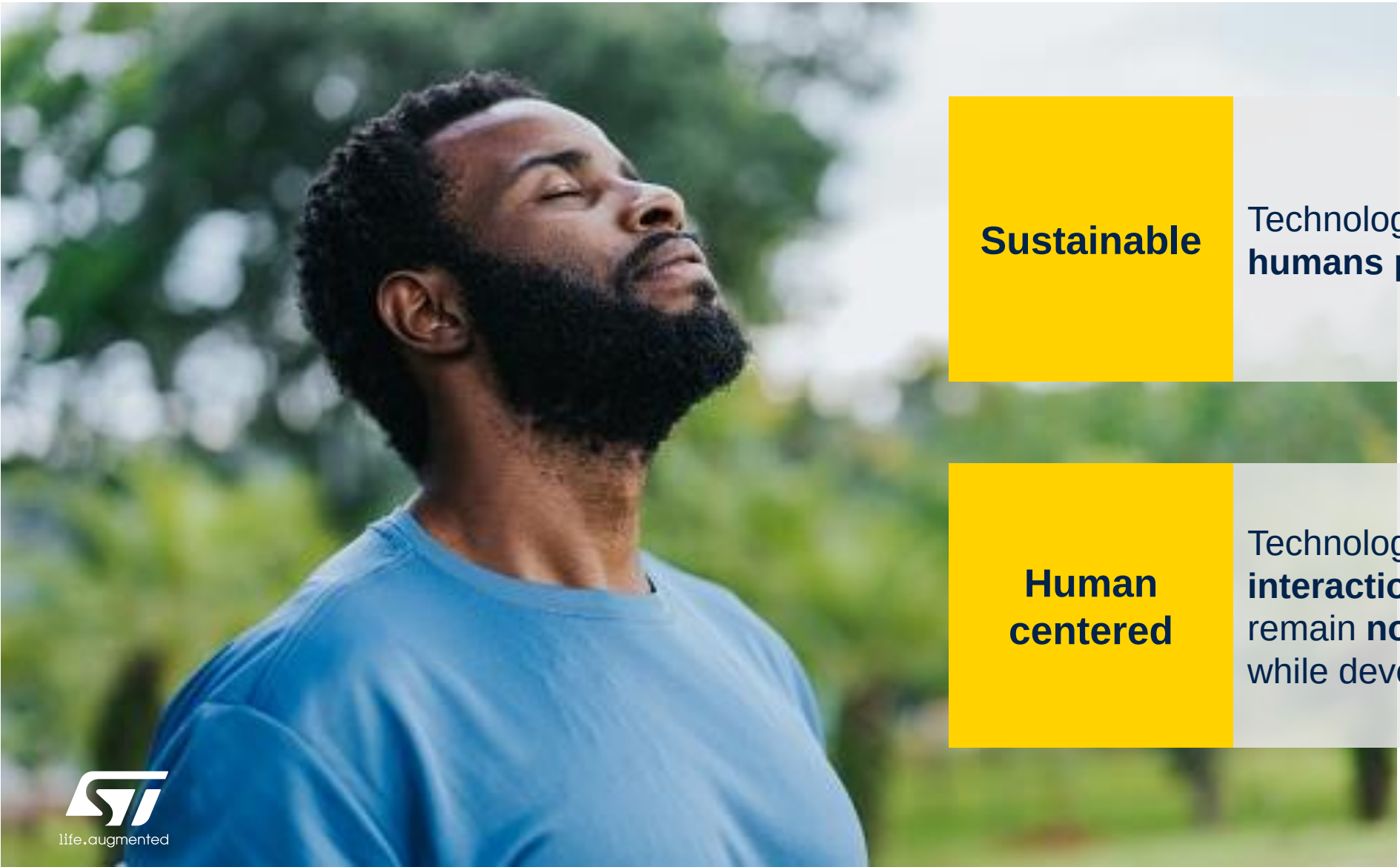
# What do human expect from technology today?



**Sustainable**

Technologies that **protect** and **help humans protect** the planet

**Human centered**

Technologies that improve the **interaction** with the world around us, remain **non-invasive** and **secure** while developing our **creativity**

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# Sensors at the heart of our interactions with the digital world

**Human centered**

**Sensors** are the key components to **bridge** the **physical** and the **digital worlds**

**Sustainable**

Sensors becoming **smart** answer **human expectations** while ensuring a **sustainable future**

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# Smart sensors making our world a better place

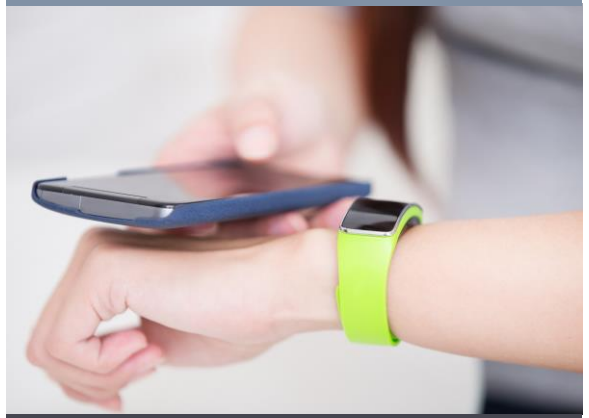
## Offline Era

**2000**

**A paradigm change in the man-machine interface**

MEMS technology: from a concept to a product.

## Online Era

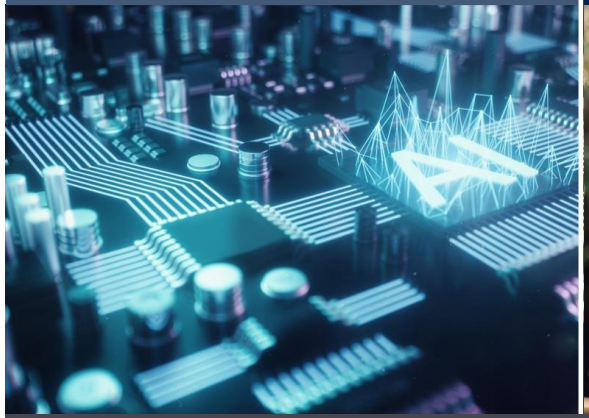


**2010**

**Sensor proliferation and connections to the Cloud**

Performance improvement and technology fusion.

## Onlife Era



**2020**

**The fusion of technology and life**

MEMS sensors able to sense, process, and act.

## Sustainable Onlife

**Sustainable sensorization of the world**

MEMS sensors sending only the **meaningful data** to the cloud

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# Key attributes of MEMS sensors

**Smart**

Sensors able to **process data**

**Open**

Sensors configured to **your needs**

**Accurate**

Sensors providing a **correct set of data**

**Meaningful data provided in an optimal way**

Human centered

Sustainable

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# Smart

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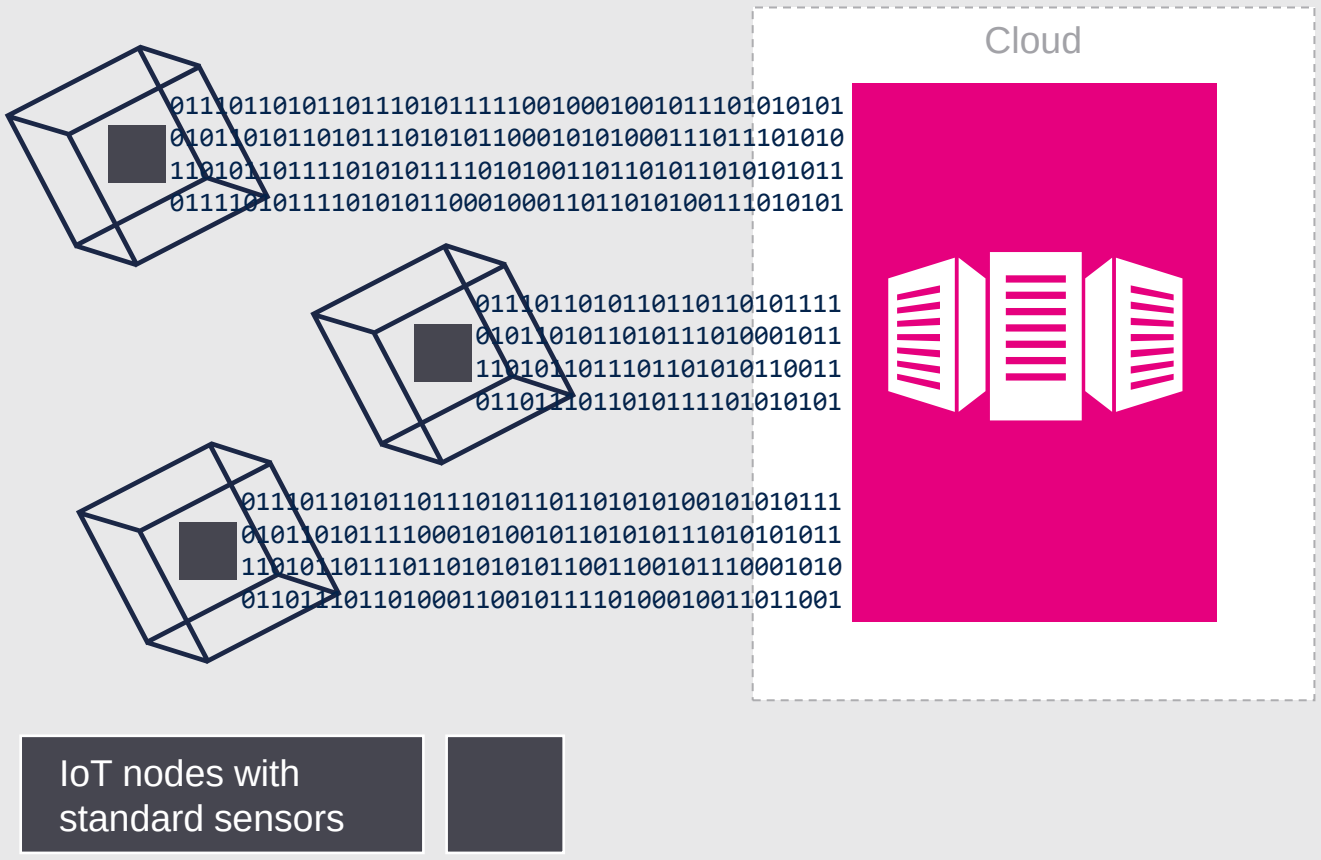
# More data = more power




Sensors embedded in more and more IoT nodes

Data to process are increasing exponentially

With a centralized processing approach, the required cloud infrastructure is huge

Associated power consumption is not sustainable

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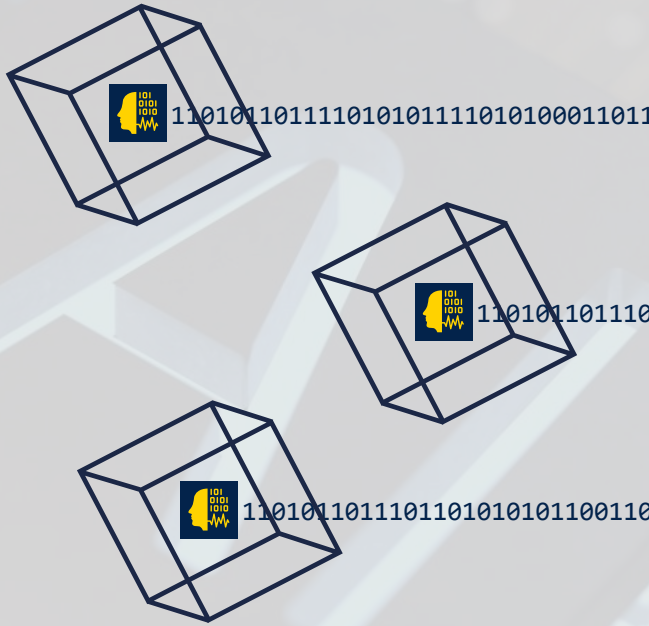
# Adding intelligence to make sensorization sustainable




IoT nodes with **smart sensors**

Smart sensors process the data in the edge

Only a reduced, meaningful set of data is transferred to the network

The required cloud infrastructure is limited

In-the-edge processing makes the sensorization of the world sustainable

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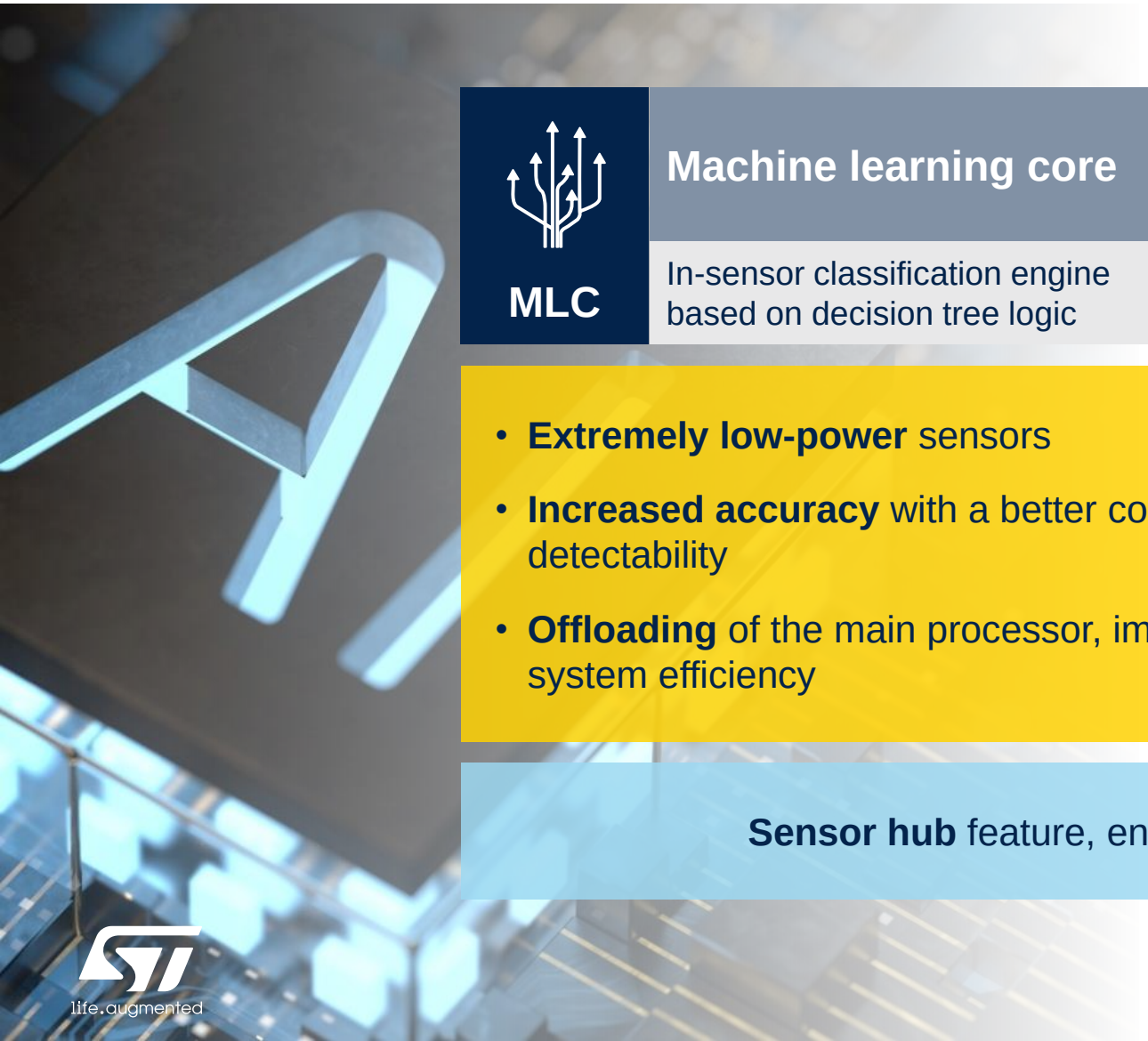
# Bringing intelligence in the edge



## MLC

### Machine learning core

In-sensor classification engine based on decision tree logic

- **Extremely low-power** sensors
- **Increased accuracy** with a better context detectability
- **Offloading** of the main processor, improving system efficiency

## ISPU

### Intelligent sensor processing unit

Highly specialized DSP for machine learning and processing

- **Ultra-low power** consumption at **system level**, thanks to **optimized data transfer**
- High-processing capability with **AI-enabled programmable core**
- Comprehensive **ecosystem**

**Sensor hub** feature, enabling connection of external standard sensors

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# Open

# ST opens the sensor ecosystem till (in) the edge

**Sensor hub**

Sensors **host** other sensors data making them **intelligent and processed** in the edge.

**Sensor ecosystem**

An **open ecosystem** to accelerate innovations with **partners** and **customers,** gaining a sustainable competitive advantage.

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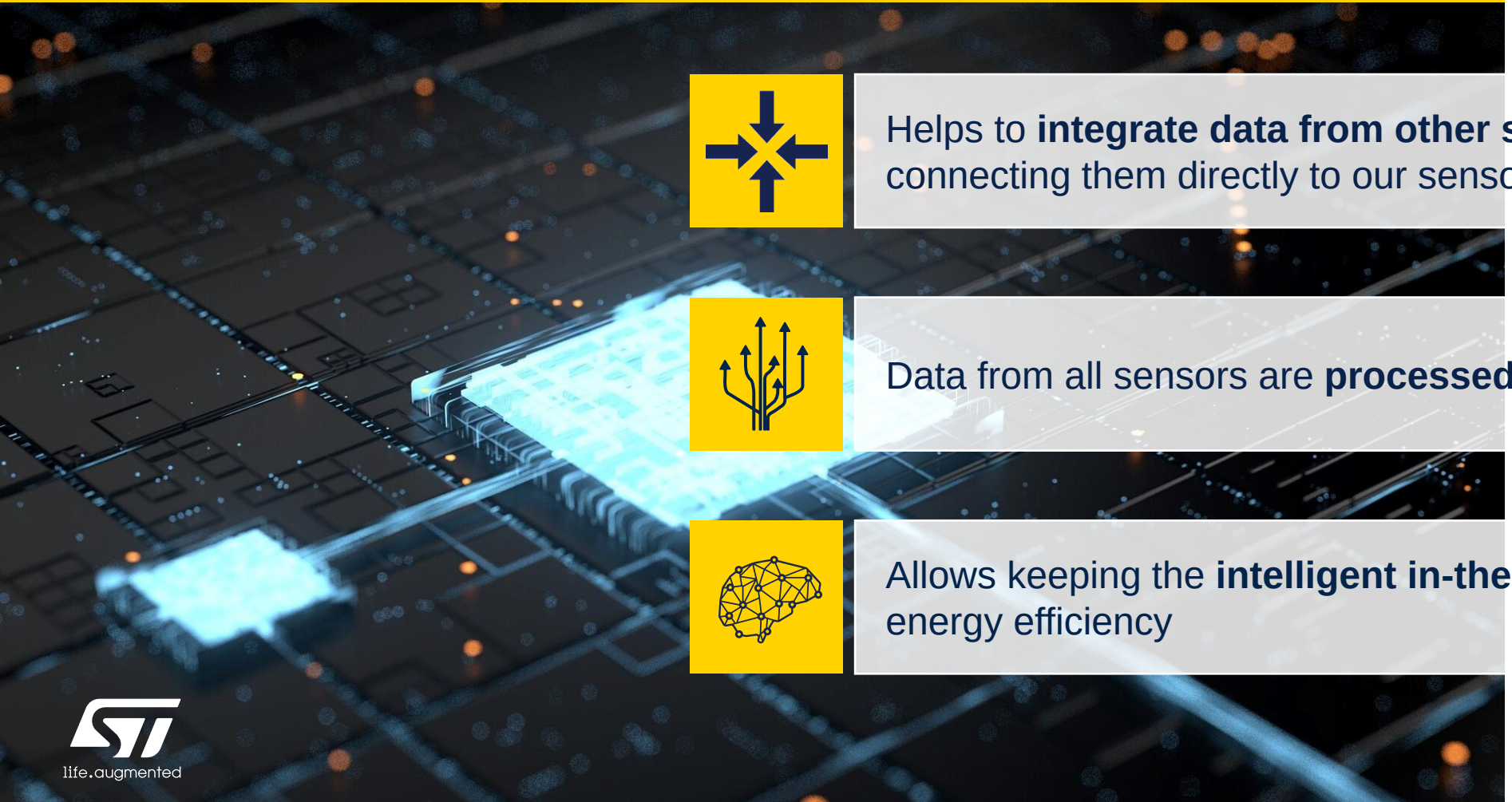
# ST MEMS sensor hub

## Enabling connection of external standard sensors



Helps to **integrate data from other sensors** (up to 4) by connecting them directly to our sensors

Data from all sensors are **processed in ST MEMS sensor**

Allows keeping the **intelligent in-the-edge**, further improving energy efficiency

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# ST MEMS sensor ecosystem

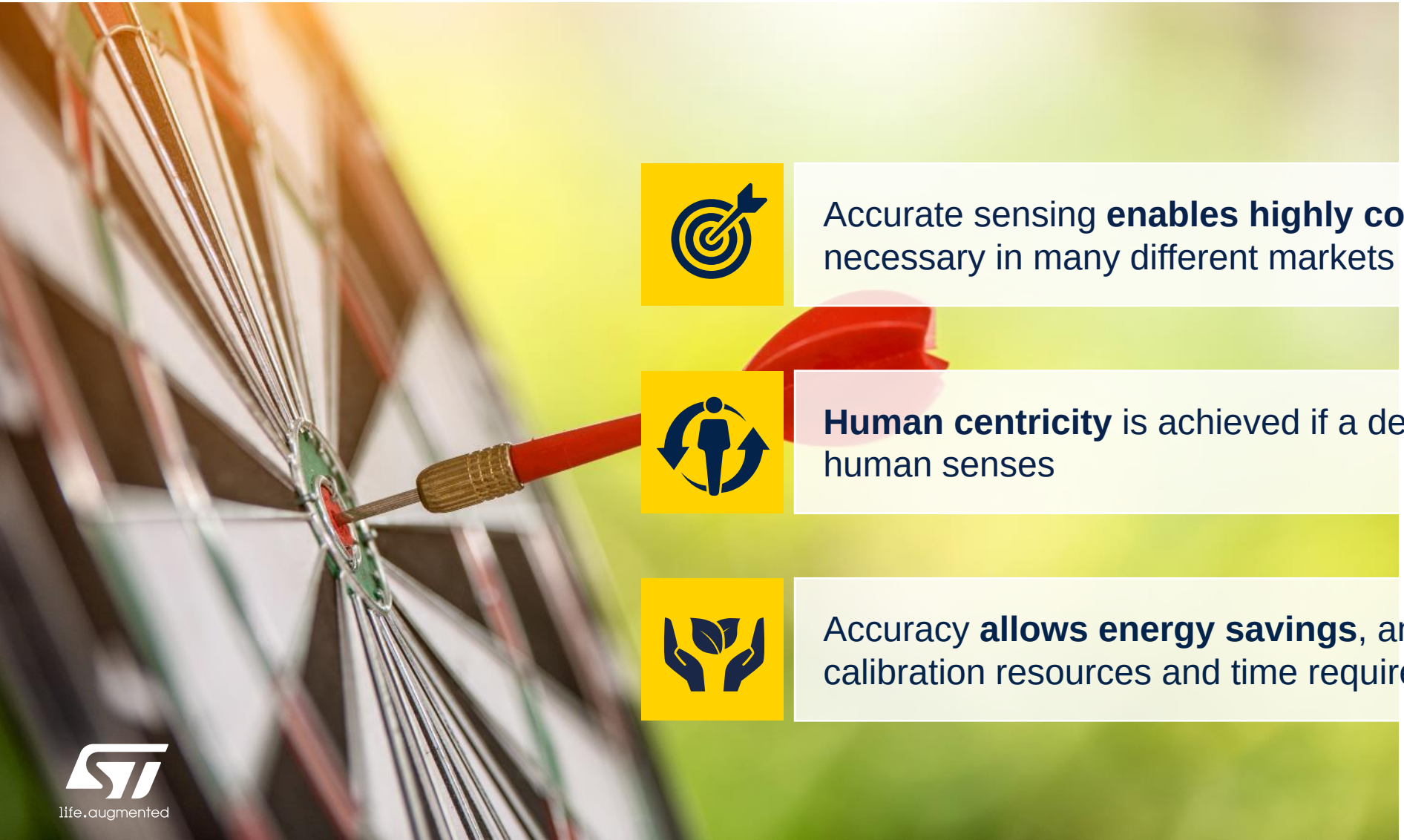
## OPEN

**Jointly create value for customers**

- Leveraging **on partners**
- **Sharing** state-of-the-art, high-quality components
- Shortening customer's **time-to-market**
- New strategic set-up**: flexibility and sustainability**

# Accurate

# Accurate



Accurate sensing **enables highly complex algorithms**, necessary in many different markets

**Human centricity** is achieved if a device is capable of imitating human senses

Accuracy **allows energy savings**, and reduces the factory calibration resources and time required

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# ST smart sensors contributing to carbon neutrality

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# In personal electronics

You can save up to **70k tons of $CO_2$** with ST smart sensor implementing ST in-bag detection algorithm for laptop

It happens that the laptop doesn't go to standby when closed and drains in the bag overnight

Supposing it might drain in 8 hours in case of no standby, and it happens once a quarter

Estimated 70k tons $CO_2$ emission saved in 1 year, if all laptop (260Mu estimated in 2023) implement ST solution

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# In smart buildings

You can save up to **264k tons of $CO_2$** with ST smart sensor monitoring the presence in office in low power mode

Assuming to retrofit all the lighting points in the 90k offices estimated in the world

Estimating 10% of the lighting points can be automatically turned off for 1h/day

Operating **TMOS** in the edge can contribute to saving 264k tons of $CO_2$ in 1 year without compromising on people comfort

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# Takeaways

Today's technology must keep us safe and protect our planet to ensure a **sustainable** future

In the sustainable Onlife era, with the increasing **fusion** of technology into our daily lives, energy efficiency should be considered at every level

**Smart** and **accurate** sensors, together with **open ecosystems** are key for a sustainable sensorization of the world

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# Our technology starts with You

Find out more at www.st.com/MEMS



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