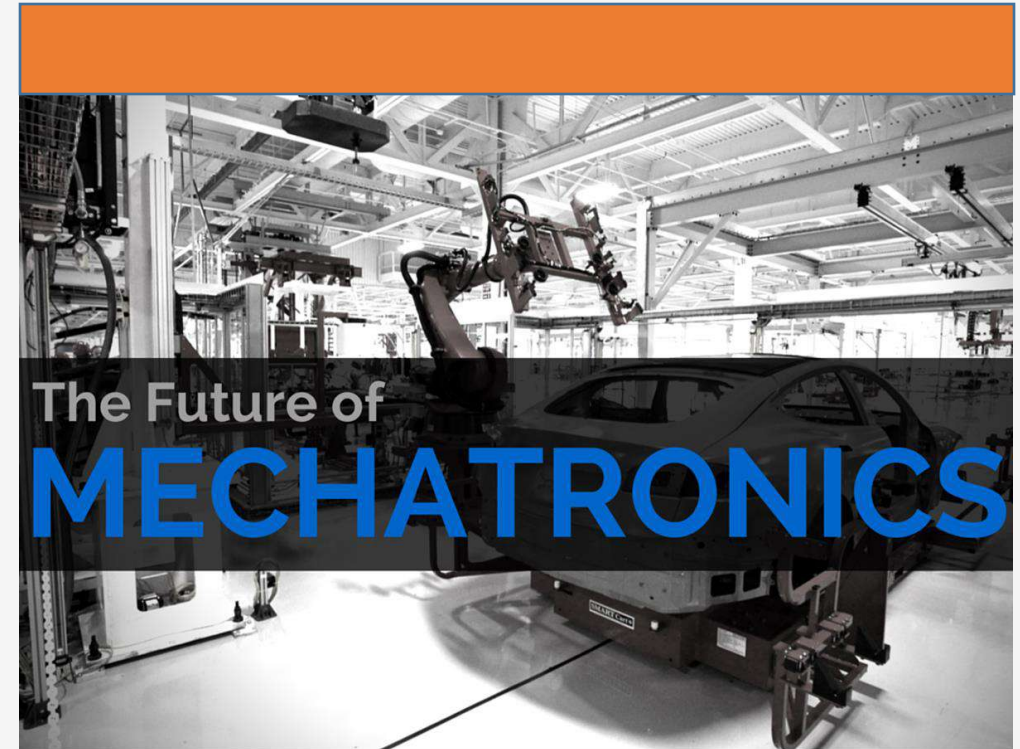


Mechatronics Applications and Sustainability – The Future

Mechatronics is important because it enhances functionality and features. It brings more efficiency. Mechatronics adds intelligence to design of the system, by which efficiency of the system improves. It reduces cost.

Mechatronic is used in:

- laser optical systems
- image and sound processing devices
- intelligent measuring devices like calibration devices,
- medical field : magnetic resonance, ultrasonic probes, arthroscopic devices
- automation
- aeronautics engineering
- defence industry



<https://www.ecpi.edu/blog/what-will-mechatronics-robotics-engineering-look-5-years>

Source: <https://www.ecpi.edu/blog/what-will-mechatronics-robotics-engineering-look-5-years>
<https://www.azukotech.com/post/2019/09/26/mechatronics-applications-and-future-trends>

Sustainability and Edge Cloud Computing

Sustainability and edge cloud computing are two areas that are increasingly interconnected.

Edge cloud computing is a model where data processing and storage occurs closer to the end-users or devices generating the data, rather than in a centralized data center.

From a **sustainability** perspective, edge cloud computing can have several benefits:

- lower energy consumption
- cost savings
- reduced carbon emissions
- less resources
- reducing the latency of the service
- improving the accuracy and
- security of data collection



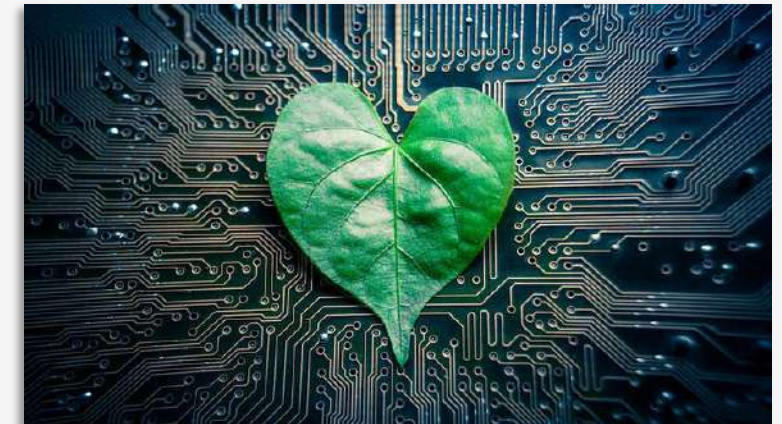
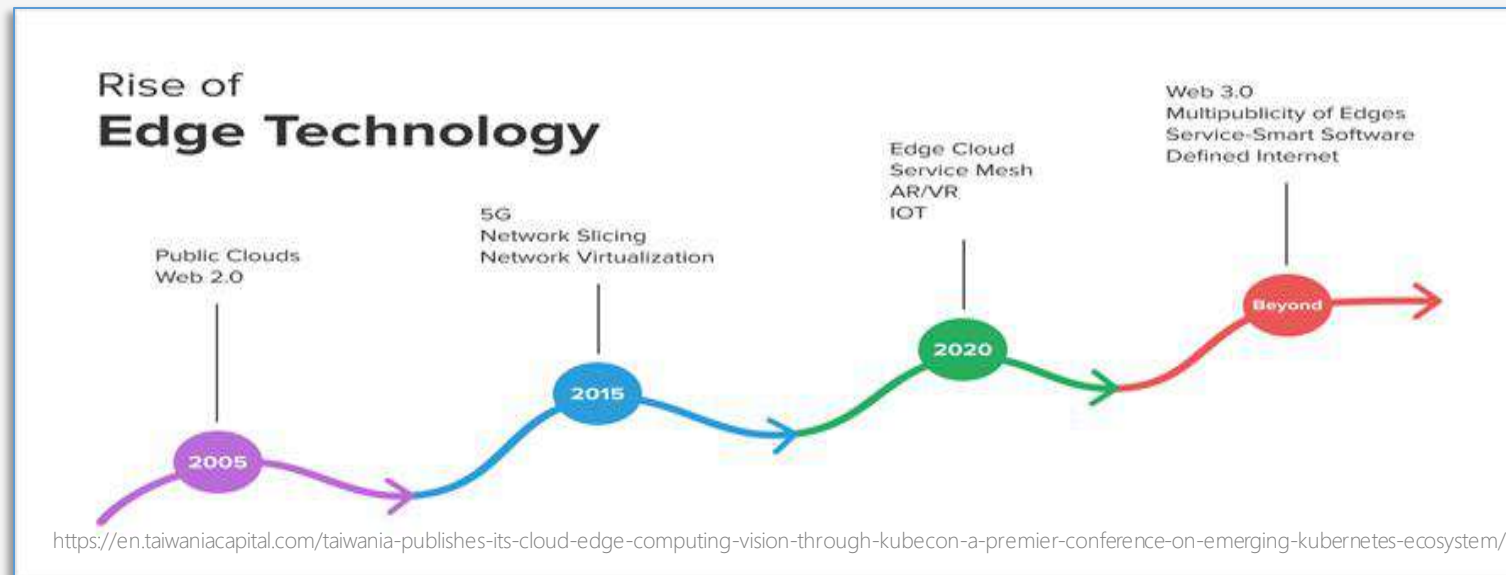
<https://venturebeat.com/business/state-of-the-edge-report-projects-edge-computing-will-reach-800b-by-2028/>

Source: https://sustainability-success.com/how-can-edge-computing-be-used-to-improve-sustainability/?utm_content=cmp-true

What is Edge to Cloud? - What is Data Sustainability?

Edge to cloud refers to the fact that data is no longer confined to the data center; It is being generated at the edge in ever-growing amounts, processed and stored in the cloud, and used by an increasingly distributed global workforce.

Data from IoT devices, smart sensors, and devices on the edge of networks, must be collected, stored, and processed.



<https://www.slingshotsimulations.com/sustainability/7-ways-to-make-data-more-sustainable/>



<https://hbr.org/2020/09/how-green-is-your-software/>

Source: <https://www.tutorialspoint.com/iot-edge-computing-and-data-sustainability> <https://www.hpe.com/us/en/what-is/edge-to-cloud.html>

Edge computing is simply optimizing data processing

Data collected at the edge is categorized:

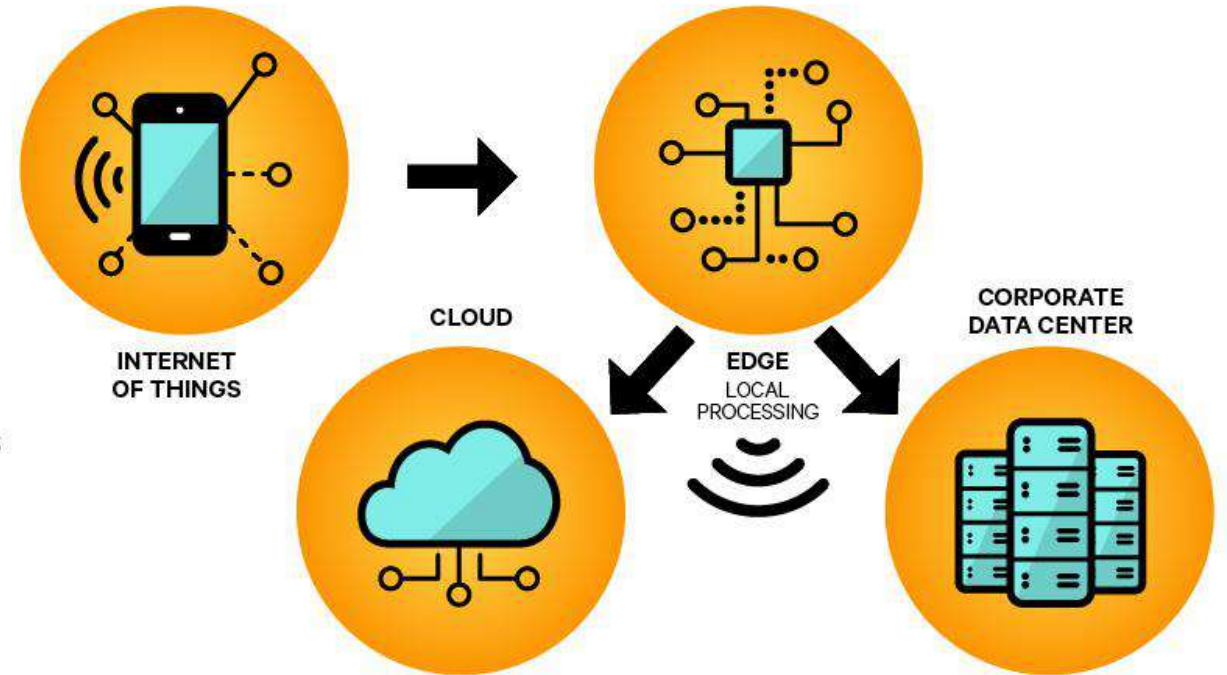
- Immediate attention is needed
- Should be retained for later analysis
- Can be ignored

Edge computing :

- Enabling real-time data processing
- Caching, buffering, and optimizing the data
- Transforming the data into a format for analysis.

HOW EDGE COMPUTING WORKS

Edge computing allows data from Internet of Things devices to be analyzed at the edge of the network before being sent to a data center or the cloud.



Energy Efficiency - Cost Savings

Data centers already consume over 3% of world's total electricity.

2020: around 200TWh of electricity

lower energy consumption → cost savings

- Cloud data centers often run 24/7 even when they are not being used.
- Energy is required for the power and cooling of data centers.
- An edge data center require less energy for cooling, relative to its output and size.



<https://www.racksolutions.com/news/blog/edge-data-center/>

Source: <https://stlpartners.com/articles/edge-computing/edge-computing-changing-the-balance-of-energy-in-networks/>

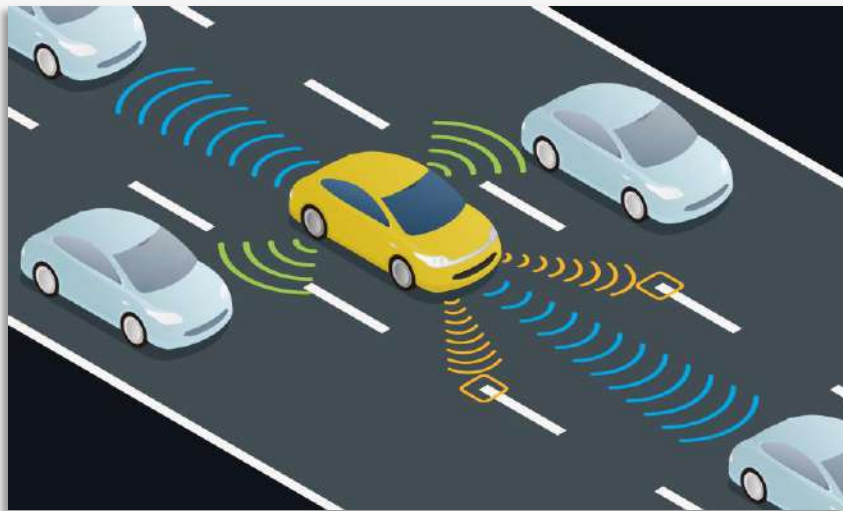
Reduced Latency

Edge cloud computing **reducing the latency required for data processing and storage.**

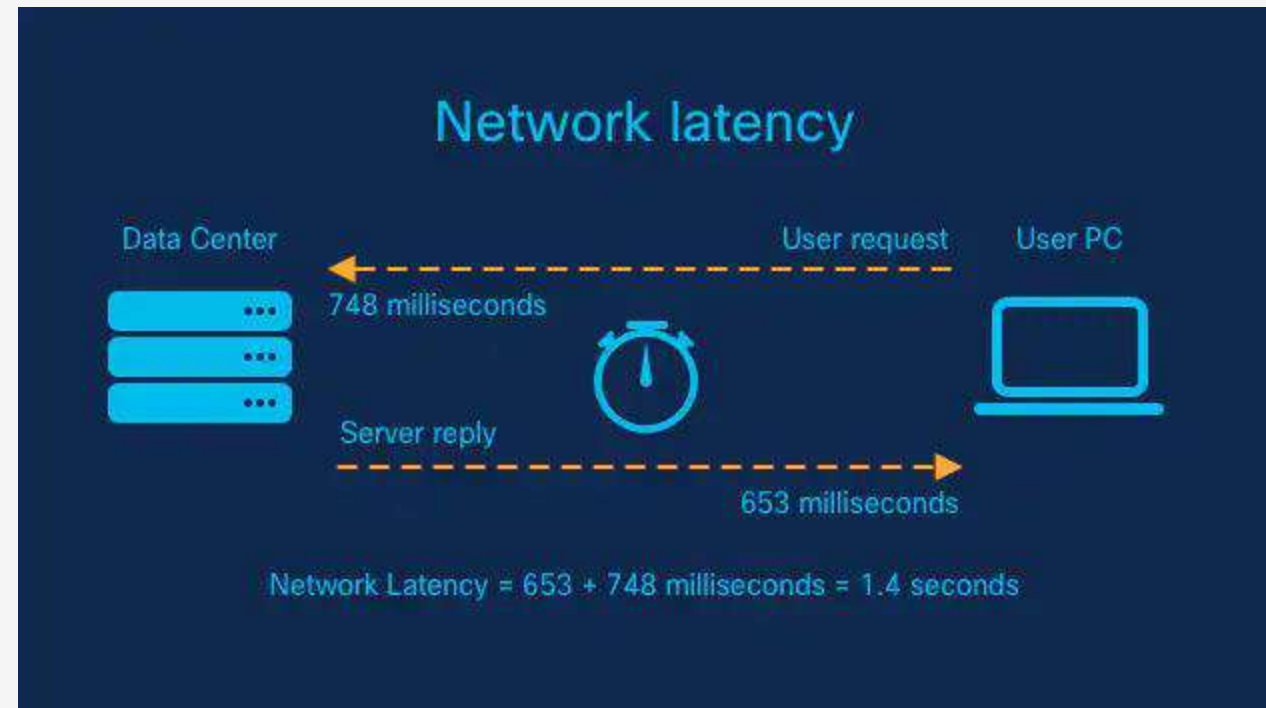
- data closer to the source → reduces the time required to transmit data to centralized data centers for processing
- reduced latency → reduce the overall energy required for data processing and storage

Latency: travel time of data

reduced latency → improved speed



<https://threatpost.com/patched-flaw-in-bosch-diagnostic-dongle-allowed-researchers-to-shut-off-engine/125061/>

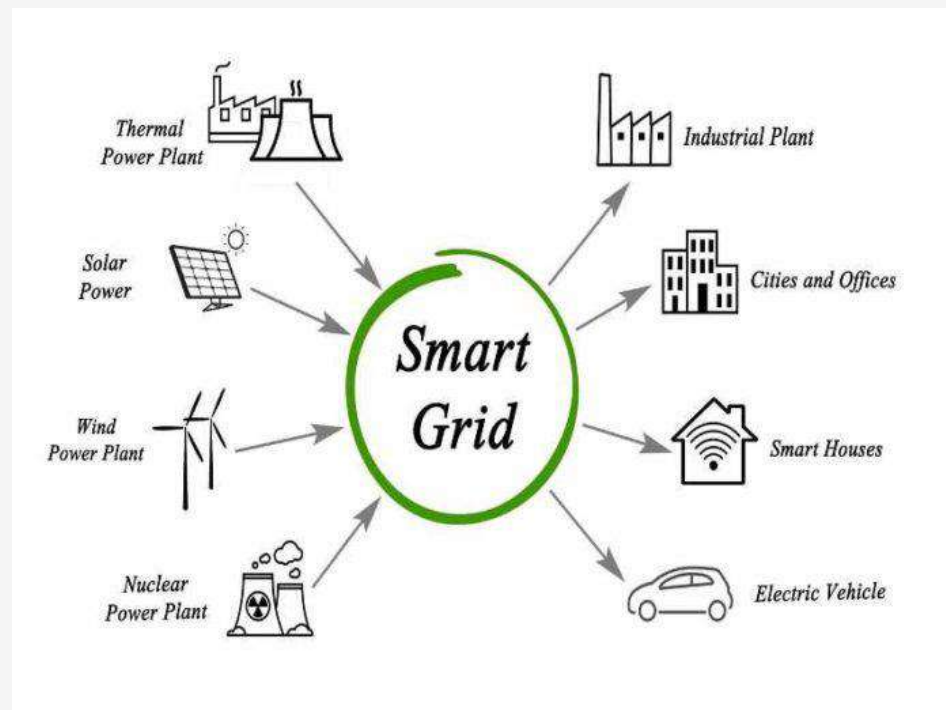


<https://www.cisco.com/c/en/us/solutions/data-center/data-center-networking/what-is-low-latency.html>

Source: <https://www.techtarget.com/iotagenda/tip/Top-5-benefits-of-edge-computing-for-businesses/>

Smart Grids

Edge cloud computing can **support the development of smart grids**. Smart grids are intelligent power distribution networks that can balance the supply and demand of energy, reducing waste and increasing efficiency. Edge cloud computing can be used to process the large amounts of data generated by smart grids.



<https://www.smart-energy.com/features-analysis/getting-ready-to-operate-the-smarter-grid/>



<https://watchwire.ai/smart-grid-explained-how-modernizing-the-electric-grid-will-benefit-us-all/>

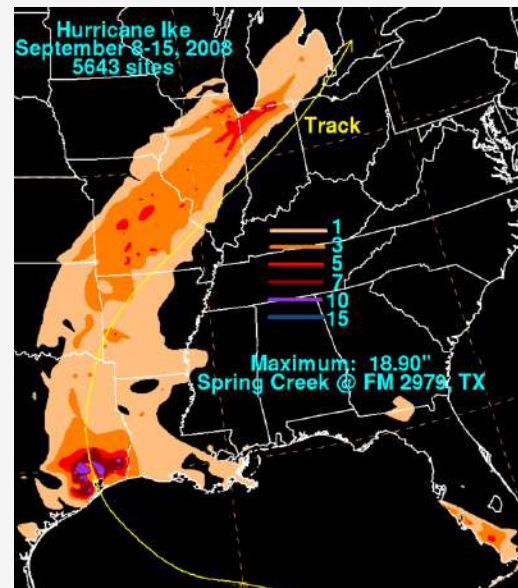
Source: <https://watchwire.ai/smart-grid-explained-how-modernizing-the-electric-grid-will-benefit-us-all/>



Smart Grids and Smart Cities

When Category 4 Hurricane Ike knocked out Houston's entire power grid in 2008, CenterPoint Energy, a provider of electrical power to 2.4 million customers in the Houston area, saw the event as a wake-up call. It was spurred into action to transform its service into an internet of things network steered by intelligent meters and IoT sensors around the power grid.

The new smart grid system that resulted allows for automatic insight into power delivery patterns, service, disruption, infrastructure damage, security breaches, and other information.



https://upload.wikimedia.org/wikipedia/commons/thumb/9/9d/Ike_2008_rainfall.gif/220px-Ike_2008_rainfall.gif



<https://eu.patriotledger.com/story/news/2008/09/13/crews-fan-out-in-texas/40154083007/>

Source: <https://www.hpe.com/us/en/insights/articles/how-edge-to-cloud-computing-powers-smart-grids-and-smart-cities-2204.html>
<https://www.cbsnews.com/news/texas-pounded-by-hurricane-ike/>

Enhancing Sustainability in Buildings



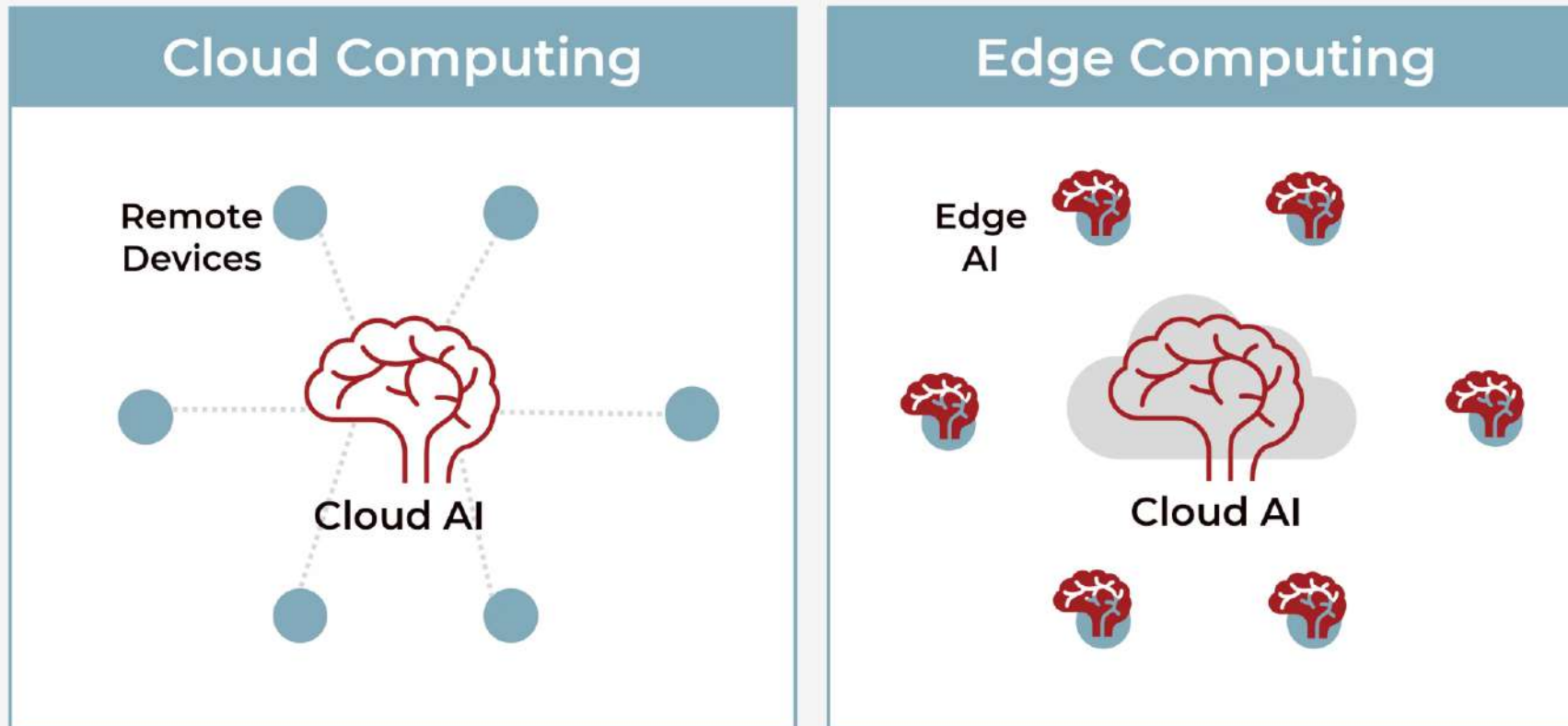
<https://rmjm.com/10-examples-of-sustainable-architecture-around-the-world/>

Edge cloud computing aids in improving energy management in buildings by providing real-time data on energy usage and enabling the optimization of energy consumption.

This can help reduce energy waste and improve the sustainability of buildings.

Source: <https://iotmktg.com/how-edge-computing-is-driving-sustainability/>
<https://www.free-pik.com/free-photos-vectors/green-building>

At the Edge Vs. In the Cloud: Artificial Intelligence and Machine Learning



Remote devices connect to an AI in the cloud, where data processing occurs.

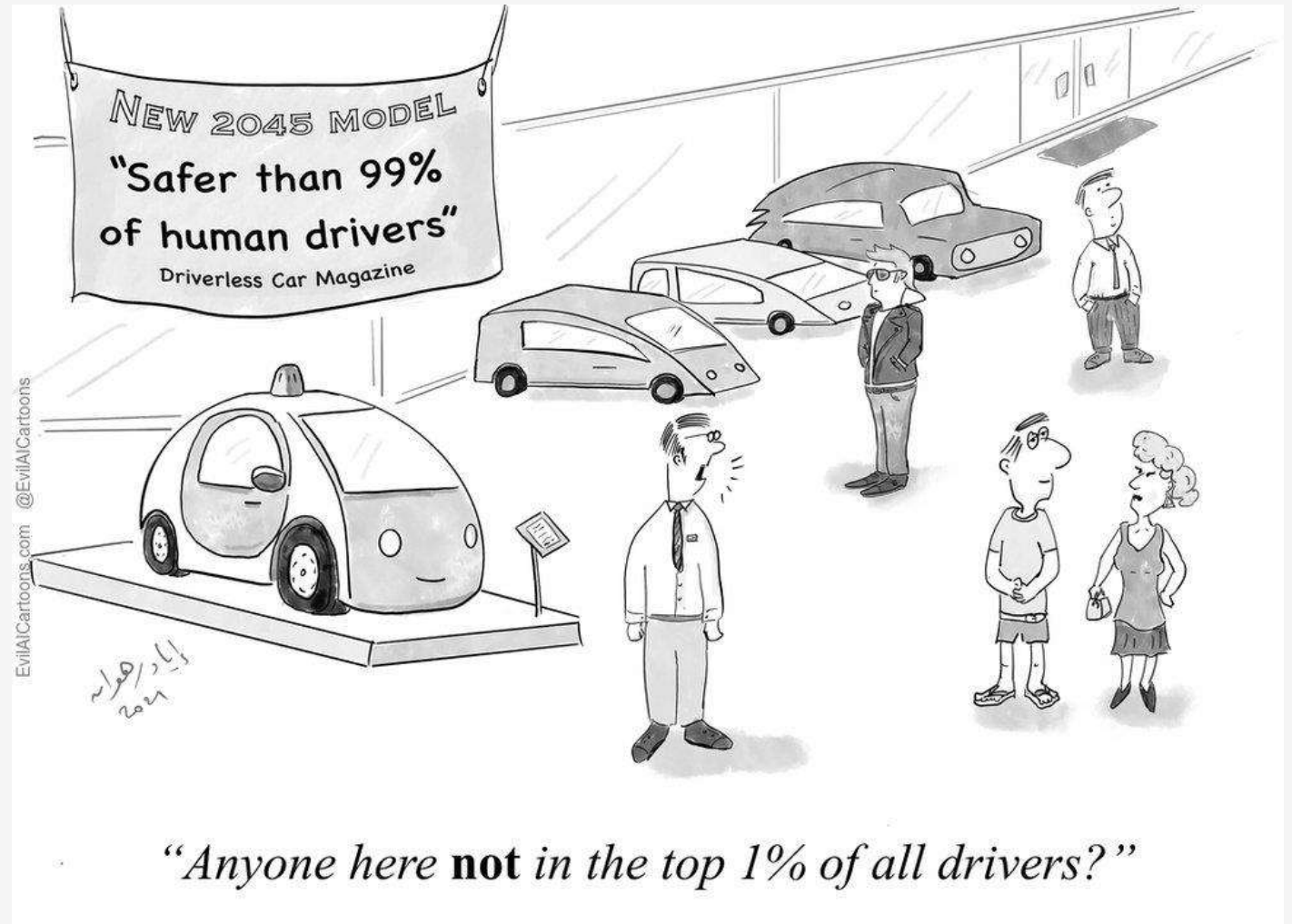
With increasing power and smaller size, AI processors perform computation and inference on the device.

Source: <https://www.cardinalpeak.com/blog/at-the-edge-vs-in-the-cloud-artificial-intelligence-and-machine-learning>

Case study: Autonomous vehicles (AVs)

A self-driving car needs to stop in a split second for a red light, pedestrian crossing or a stray moose on the road. It can't afford to send data to the cloud and wait for instructions.

Further, edge technology also helps the car make instant decisions (and communicate with other AVs) based on weather conditions, traffic, detours and accidents in the area.

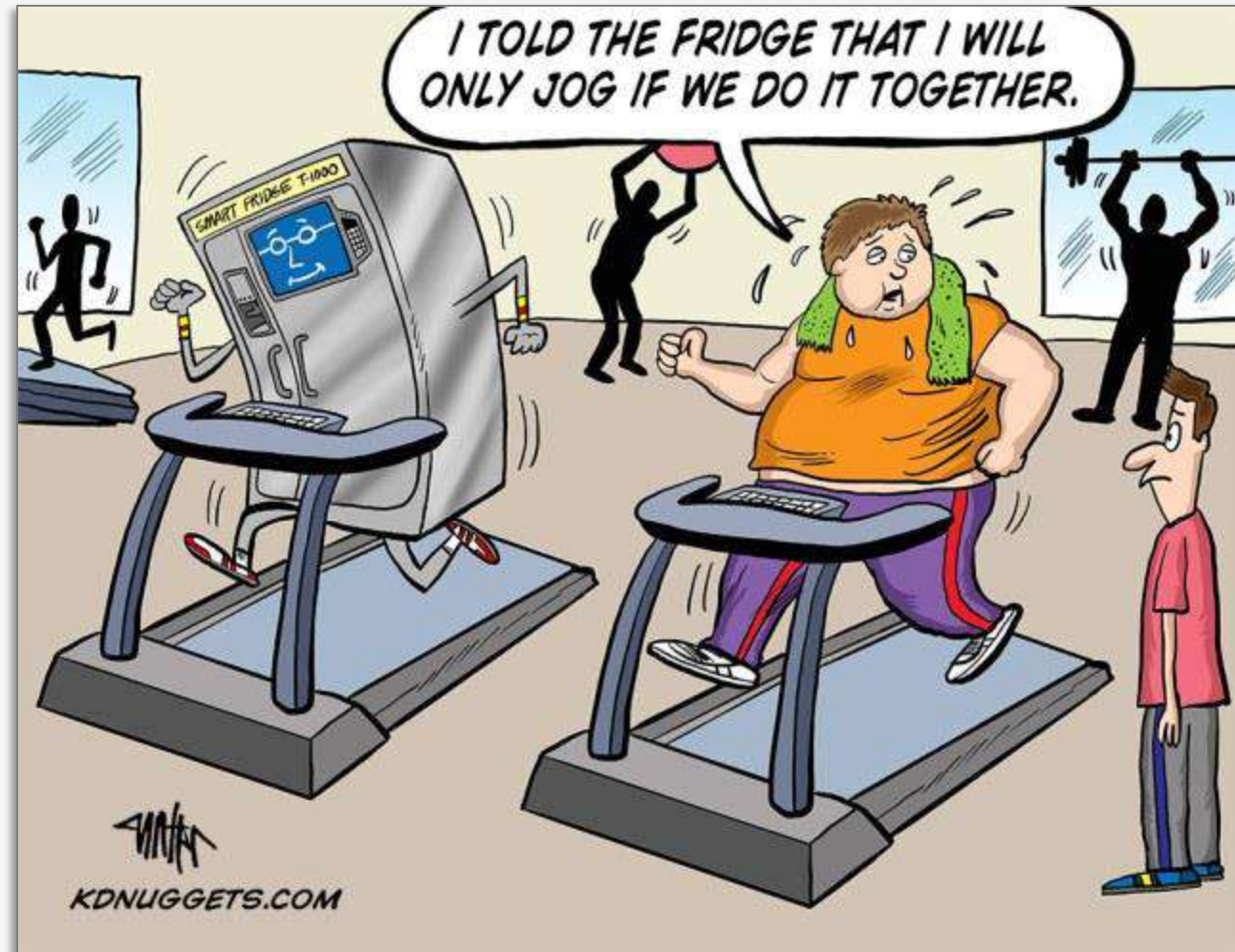


<https://www.evilaicartoons.com/archive/tame-human-overconfidence>

Source: <https://www.nutanix.com/theforecastbynutanix/technology/edge-and-cloud-computing-together>
Liu, P., Yang, R. & Xu, Z. How safe is safe enough for self-driving vehicles? Risk Anal. 39, 315–325 (2019).

Case study: Home automation

Home automation is driven by IoT. Smart home devices such as thermostats, refrigerators, smart speakers, light bulbs and so on can analyze the data they collect and make decisions. Sending all the data they collect to a cloud would clog up network bandwidth within no time, defeating their purpose.



<https://www.kdnuggets.com/2018/01/cartoon-ai-at-home.html>

Source: <https://www.nutanix.com/theforecastbynutanix/technology/edge-and-cloud-computing-together>

The major computer vision usage types – Applications for edge cloud computing



Detection

Ex: Quality control
Default detection
Intruder detection
Event detection
Covid mask
detection



Recognition

Ex: Facial
recognition
Object recognition



Localization

Ex: Person searching
Product localization
in storage or store

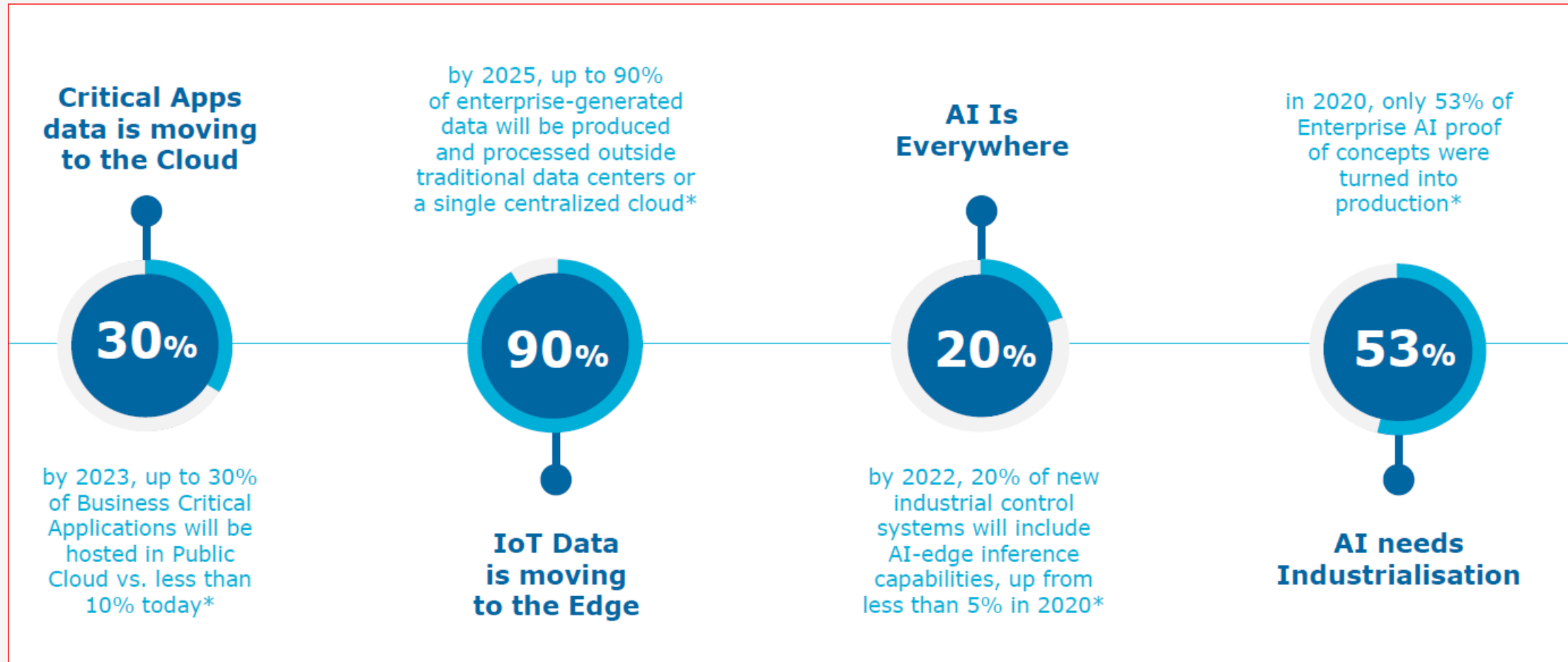


Motion analysis

Ex: Person tracking
Flow management
Crowd management
Customer path in
retail store



Big Data Revolution: Analytics and AI Everywhere



Source: The major computer vision usage types <https://motion-x.net/wp-content/uploads/2021/10/Atos-Edge-Computing-offering.pdf>



Edge computing: The five pillars

Latency

Data is analyzed at its source, which enables the lowest latency possible.

Bandwidth

Only pre-processed data is sent to cloud or datacenter for mid-term analysis. It allows to maintain costs whatever the data amount.

Security and privacy

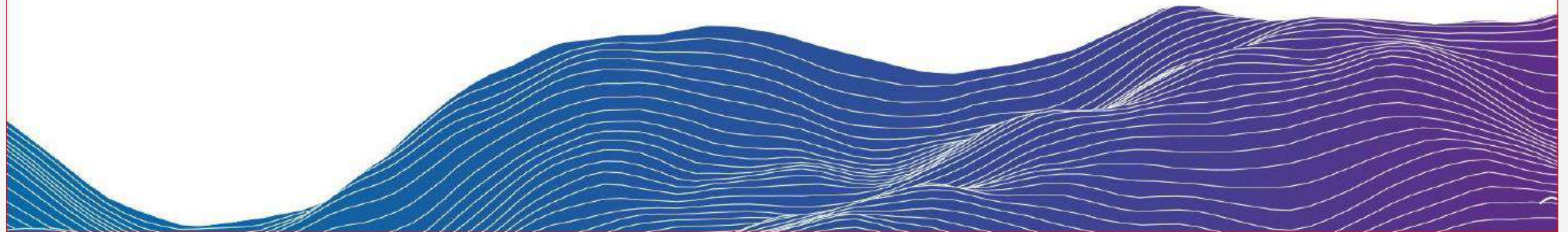
Critical data is kept at the data source which reduces vulnerability breaches or hacking.

Autonomy

Edge computing servers works autonomously even without any network and in critical environment.

Maintained cost

Whatever the data volume and complexity, the TCO is maintained.



Basic challenges of adopting sustainable edge cloud computing practices: the **complexity** of managing large-scale edge computing environments, the **limited availability** of renewable energy sources in remote areas.

Source: <https://motion-x.net/wp-content/uploads/2021/10/Atos-Edge-Computing-offering.pdf>

Sustainability - Agriculture and Food Technology

“Sustainability” and “Agriculture and Food Technology” are two areas that are increasingly interconnected.

Agriculture and food technology involve the use of technology to improve the efficiency and sustainability of agriculture and food production.

Important topics are:

1. Sustainable Agriculture Practices
2. Precision Agriculture
3. Sustainable Food Processing
4. Sustainable Packaging
5. Food Waste Reduction
6. Sustainable Supply Chain
7. Plant-Based Alternatives
8. Underutilized Ingredients



Source: <https://www.savills.co.uk/services/investment/agricultural-investment.aspx>



Sustainable Agriculture Practices

Discussing sustainable agriculture practices such as crop rotation, cover cropping, intercropping, conservation tillage, and integrated pest management that can improve soil health, reduce water usage, and minimize environmental impacts.

Agroforestry

Crops are intentionally intermingled with trees and shrubs.

There are three types of agroforestry currently being practiced:

- Forest farming where crops grow beneath the canopy of an existing forest.
- Alley cropping where crops are planted between rows of trees and shrubs.
- Silvopasture where livestock forage among trees and enjoy the shade and protection they provide.

Benefits: biodiversity, helps to filter runoff, and reduces stress on soil and livestock.



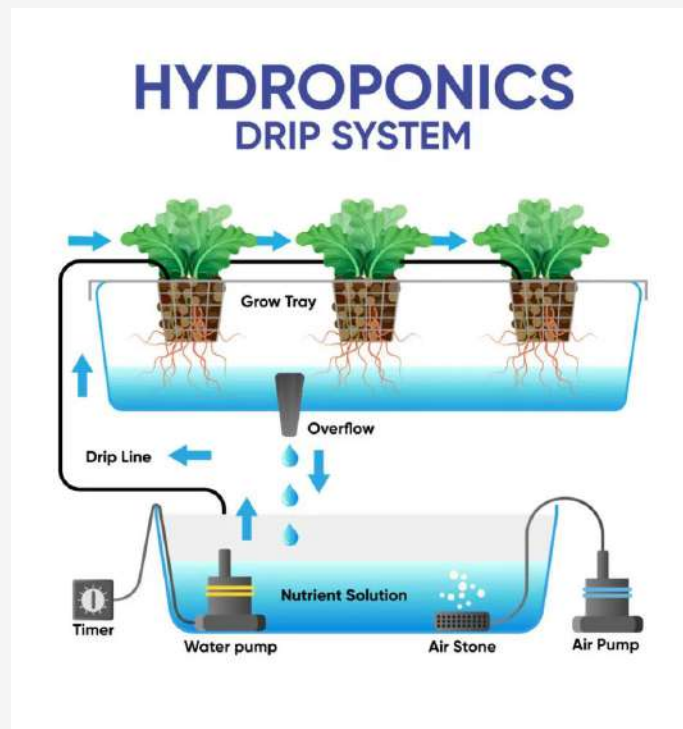
<https://www.state.gov/dipnote-u-s-department-of-state-official-blog/science-speaks-agroforestry/>

Source: <https://www.edengreen.com/blog-collection/sustainable-farming-practices>

Sustainable Agriculture Practices

Hydroponic Vertical Greenhouses

Hydroponic vertical greenhouses solve many of the challenges of traditional agriculture by removing soil from the equation altogether. Hydroponics is the practice of growing plants in water rather than soil.



<https://ponicslife.com/what-is-hydroponics-everything-you-need-to-know/>

Vertical Farming

Vertical farming is an innovative method of agriculture that involves growing crops in vertically stacked layers using advanced technologies such as hydroponics, aeroponics, and aquaponics.



<https://www.agritecture.com/blog/2021/5/3/the-most-innovative-vertical-farming-companies-of-the-decade>

Source: <https://www.edengreen.com/blog-collection/sustainable-farming-practices>



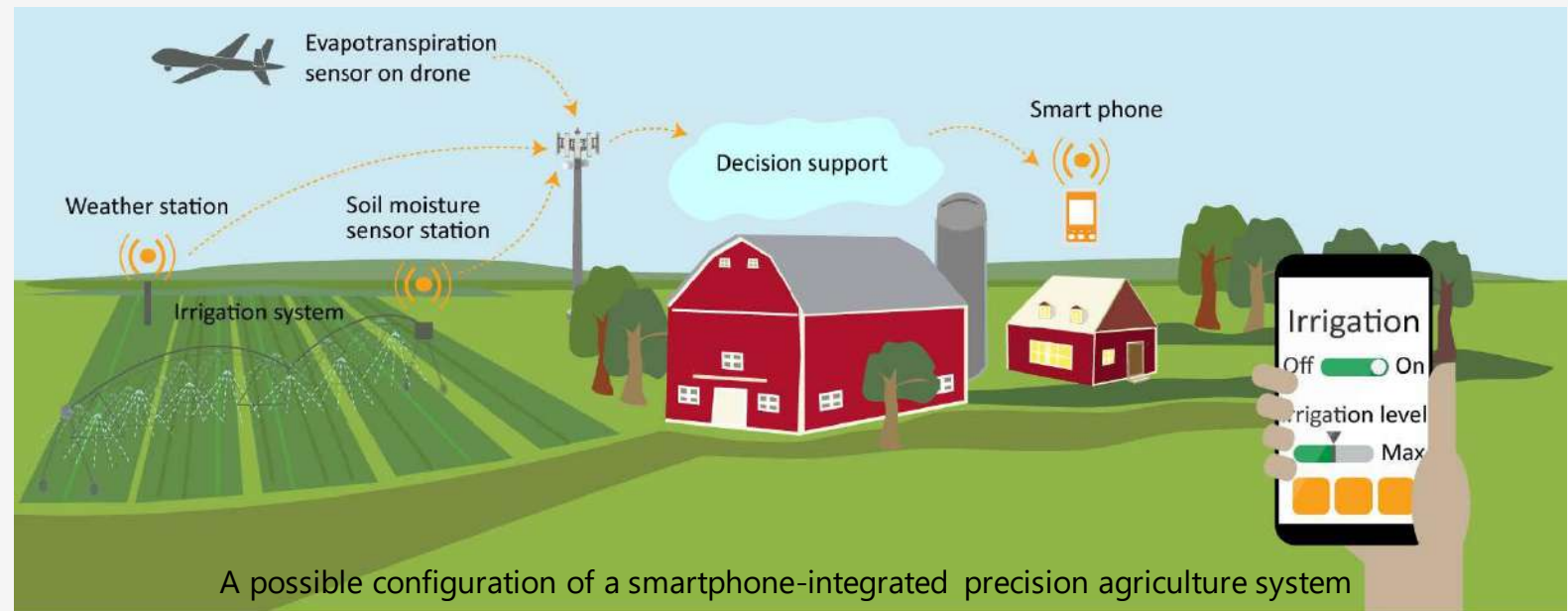
Precision Agriculture

Highlighting the role of technology in sustainable agriculture, such as precision agriculture techniques like drones, sensors, and satellite imagery that can improve crop yield, reduce waste, and optimize resource utilization.

Precision Agriculture

can be defined as “the application of modern information technologies to provide, process and analyze multisource data of high spatial and temporal resolution for decision making and operations in the management of crop production”

It is referred to as “precision” because thanks to the state-of-the-art tools used, it is possible to perform the right intervention, in the right place, at the right time.



Source: GAO. | GAO-20-128SP

https://en.wikipedia.org/wiki/Precision_agriculture

Source: <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/precision-agriculture>
<https://www.mccormick.it/as/precision-farming/>



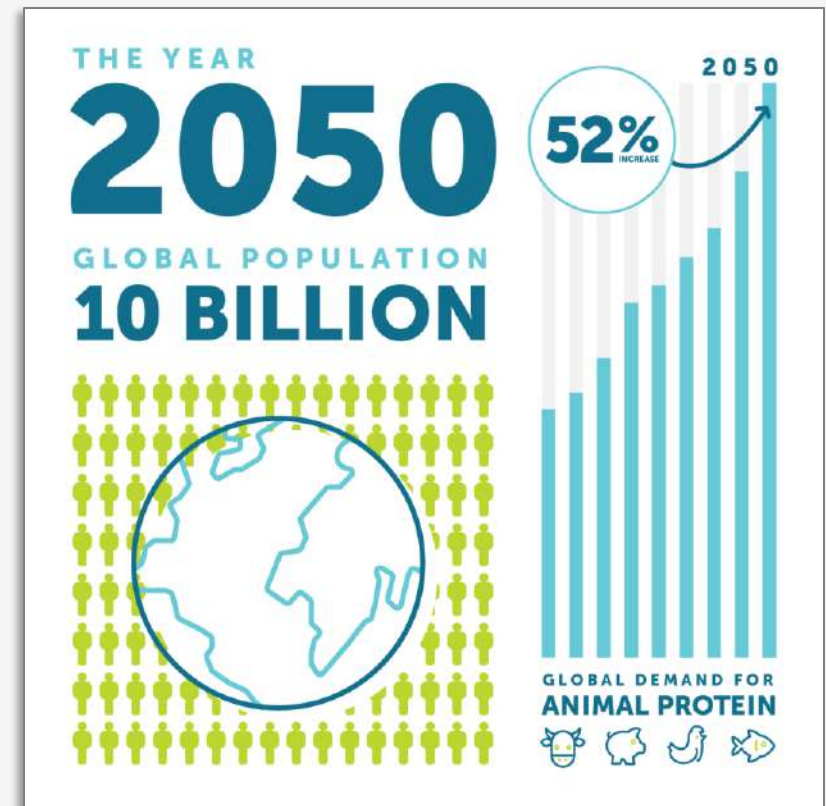
Sustainable Food Processing

Examining how sustainable food processing practices, such as energy-efficient technologies, use of renewable energy sources, and waste reduction techniques, can help reduce environmental impacts and enhance the sustainability of the food industry.

Global population about 10 billion by 2050 → food production will need to increase by at least 70%.

Challenge: finding innovative ways to minimize food production's environmental impact and support the planet's capacity to continue producing food far into the future.

Encouraging sustainable food processing and manufacturing is one of the primary objectives of the EU's new Farm to Fork strategy, a hallmark initiative of the new European Green Deal.



https://twitter.com/gsa_seafood/status/1116684915909828608?lang=zh-Hant

Source: https://certification.bureauveritas.com/magazine/4-ways-make-food-processing-more-sustainable#_ftn1
<https://www.fao.org/news/story/en/item/35571/icode/>

Sustainable Supply Chain

Highlighting the importance of sustainable supply chains in the food industry, including responsible sourcing of raw materials, reducing carbon footprint, and minimizing waste and emissions throughout the supply chain.

A sustainable supply chain in the food industry refers to the responsible sourcing of raw materials, reducing carbon footprint, and minimizing waste and emissions throughout the entire supply chain.

Importance of sustainable supply chains in the food industry:

- 1.Meeting consumer demand: by providing products that are ethically and sustainably produced.
- 2.Reducing environmental impact: help to minimize the environment impact.
- 3.Ensuring the future of food production: help to ensure the long-term viability of food production.

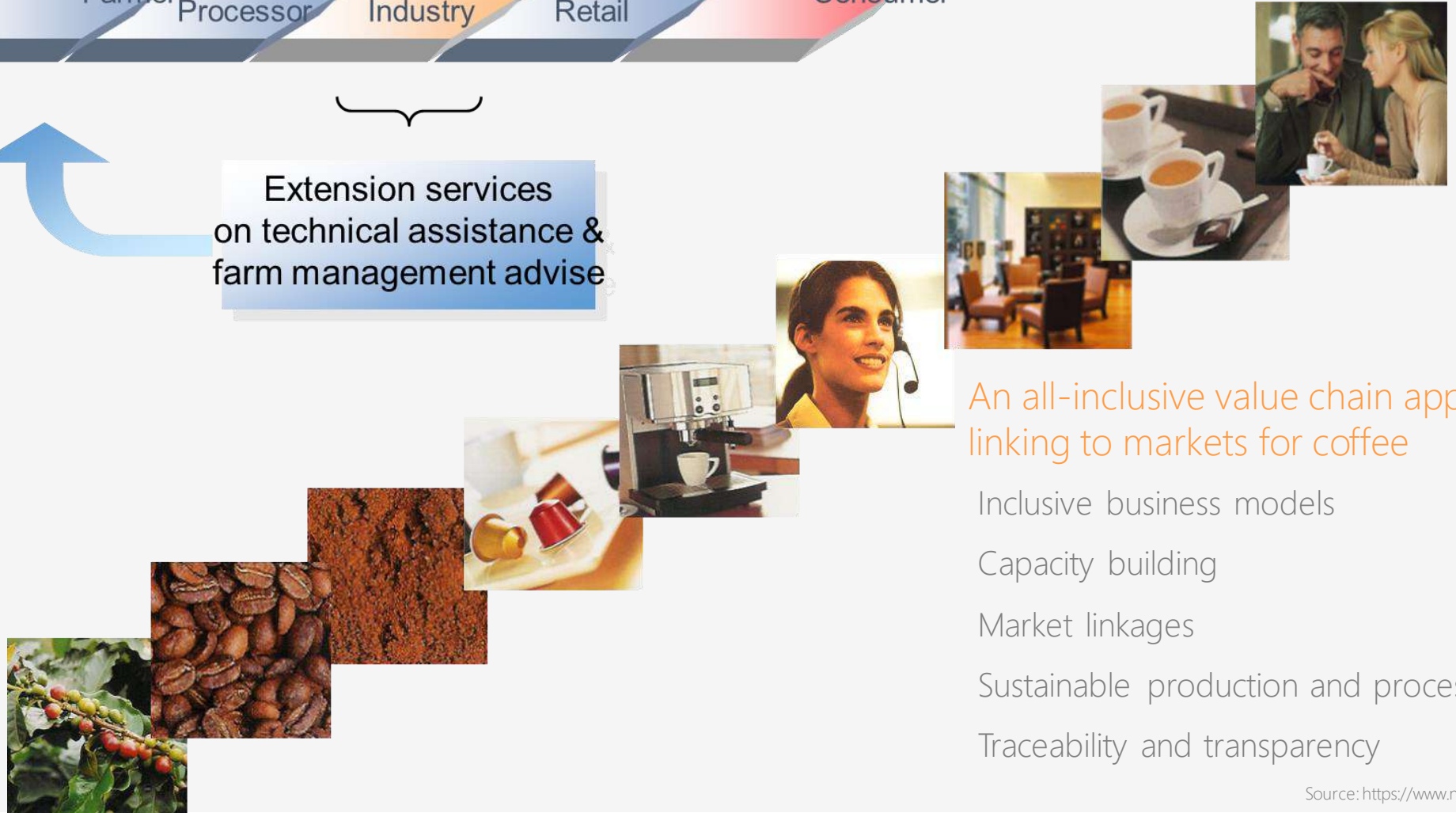


Source: <https://www.legalzoom.com/articles/creating-a-sustainable-supply-chain-management-plan>

Example of a sustainable chain approach linking to markets



Extension services
on technical assistance &
farm management advise



An all-inclusive value chain approach linking to markets for coffee

Inclusive business models

Capacity building

Market linkages

Sustainable production and processing

Traceability and transparency

Source: <https://www.nestle.com/>

Plant-based alternatives

Plant-based alternatives refer to products that are made from plant-based ingredients as a substitute for animal-based products. Here are some key points on plant-based alternatives in agriculture and food technology:

1. Health Benefits: lower in saturated fats and higher in fiber and nutrients.
2. Environmental Benefits: less land, water, and other resources to produce.
3. Ethical Concerns: can be a more ethical choice for consumers
4. Innovation: developed using innovative techniques
5. Market Growth: plant-based alternative market is growing rapidly.
6. Nutritional Concerns: can be lower in certain nutrients such as protein, iron, and vitamin B12.



Source: <https://kellswwholemeal.ie/are-plant-based-alternatives-healthier-than-meat/>

Underutilized Ingredients

Underutilized ingredients refer to food items that are often overlooked or discarded, despite being nutritious and flavorful. These ingredients can include plant-based foods such as fruits, vegetables, and grains, as well as animal-based foods such as offal and bone broth.



Key points on underutilized ingredients.

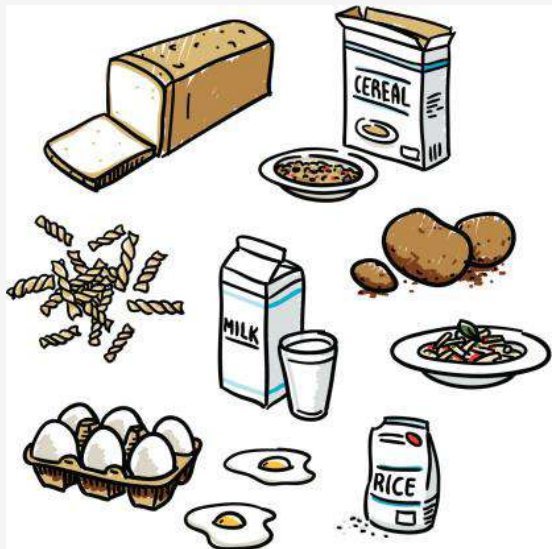
- Nutritional Value: including vitamins, minerals, and antioxidants.
- Economic Value: source of income for farmers and producers.
- Sustainability: can be a more sustainable choice.
- Culinary Potential: new and exciting flavors and textures to food products.
- Cultural Significance: representing traditional foods and flavors.



Source: <https://www.globalseafood.org/advocate/underutilized-marine-organisms-as-potential-aquaculture-feed-ingredients/>
<https://www.foodnavigator.com/Article/2021/07/21/Underutilised-crops-and-emerging-technologies-set-to-shape-next-generation-of-plant-based-products>

SDGs related to ...

The adoption of sustainable agriculture and food technology practices is essential for achieving the United Nations Sustainable Development Goals (SDGs) related to food security, poverty reduction, climate action, and environmental protection.



<https://www.istockphoto.com/vector/basic-food-sketches-gm479329209-16991051>



Source: <https://www.mdpi.com/2071-1050/10/3/815/>

Any questions?

Thank you 😊



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