Sustainability and IoT

Part 1
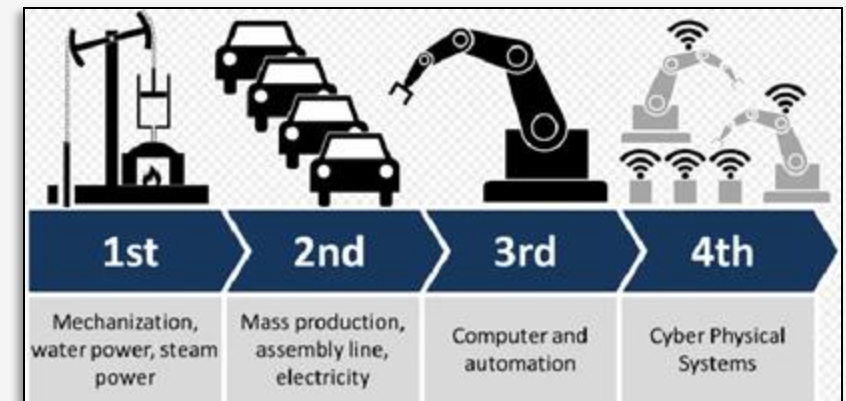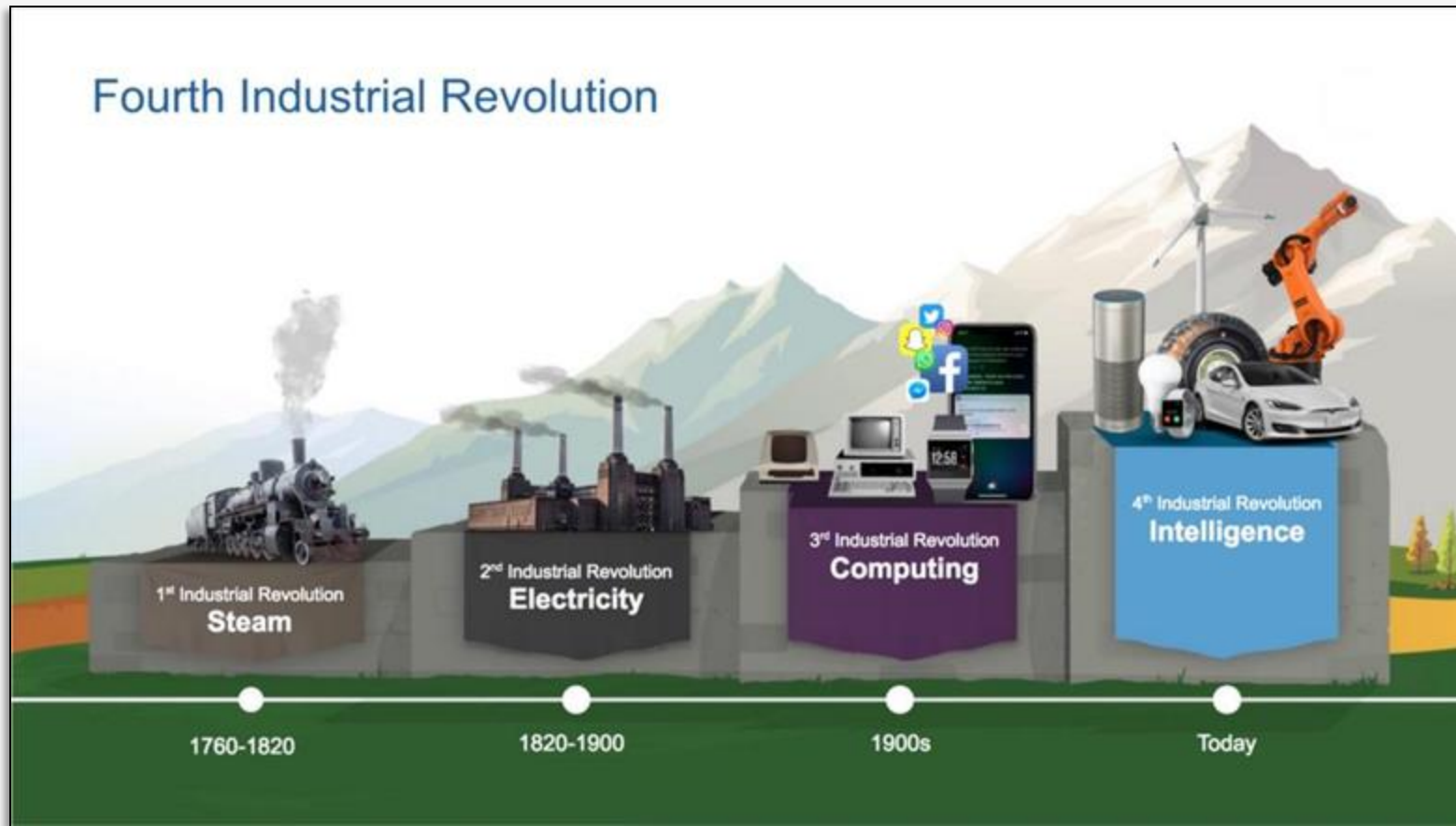
Smart–Edu4.0

Erasmus+ project

Sustainability

"Sustainable Development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs."

https://www.kindpng.com/imgv/ibbhwmo_sustainability-norron-sustainable-and-smart-cities-hd-png

the most common definition from the **UN Brundtland Commission, 1987**

3/32

Industry 4.0

Fourth Industrial Revolution

| 1st Industrial Revolution Steam | 2nd Industrial Revolution Electricity | 3rd Industrial Revolution Computing | 4th Industrial Revolution Intelligence |

1760-1820 | 1820-1900 | 1900s | Today

1st	2nd	3rd	4th
Mechanization, water power, steam power	Mass production, assembly line, electricity	Computer and automation	Cyber Physical Systems

Connecting the unconnected

Intelligent –> KNOW

https://highswartz.com/legal-insights/employment-law/just-hang-up-the-perils-of-pocket-dialing-and-accidental-calls/

An intelligent device is any type of equipment, instrument, or machine that **has its own computing capability**.
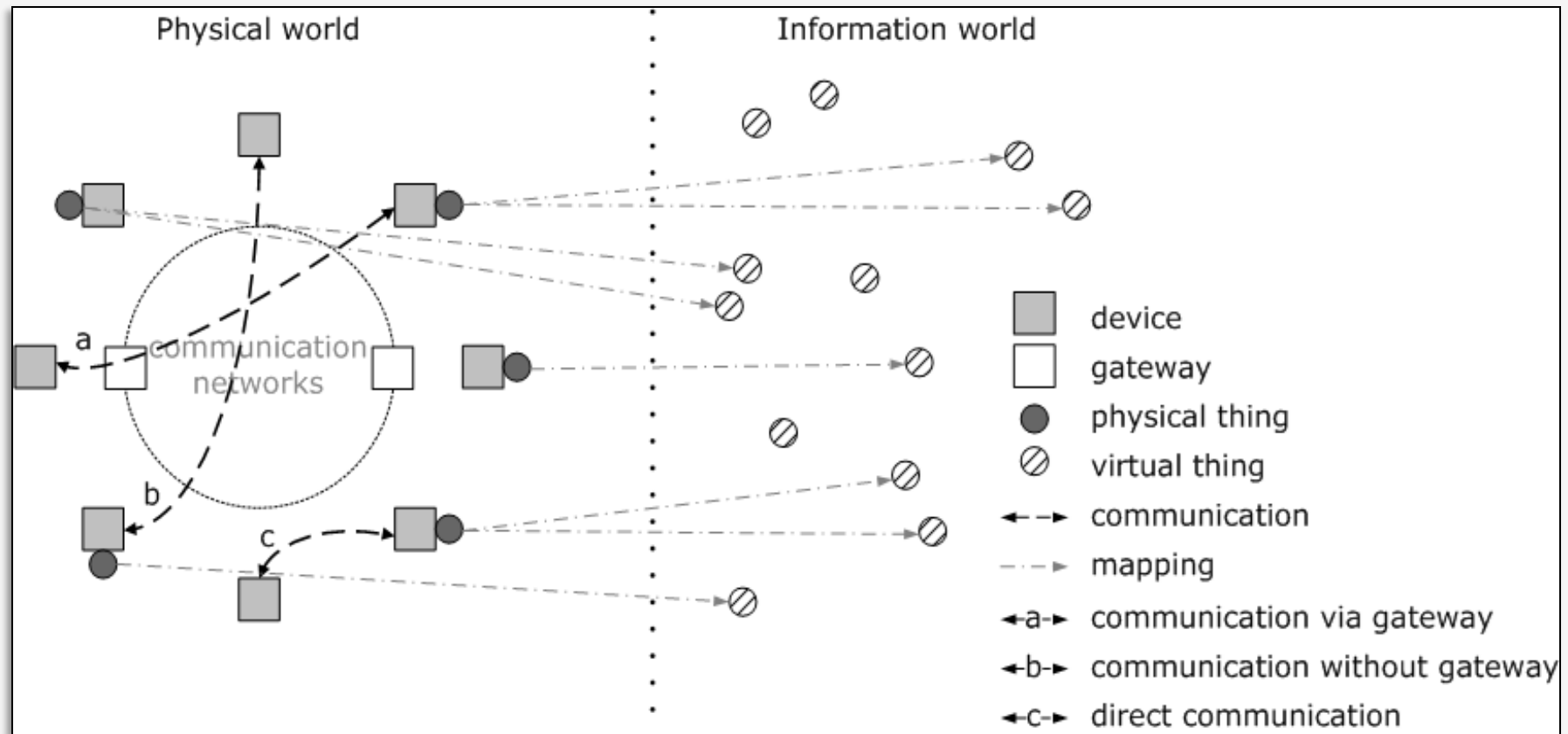
Smart –> SHARE

https://www.alamy.com/stock-photo-smartphone-and-home-electronic-devices-connected-to-cloud-server-note-133221650.html

A smart device is an electronic device, generally **connected to other devices** or networks via different protocols.

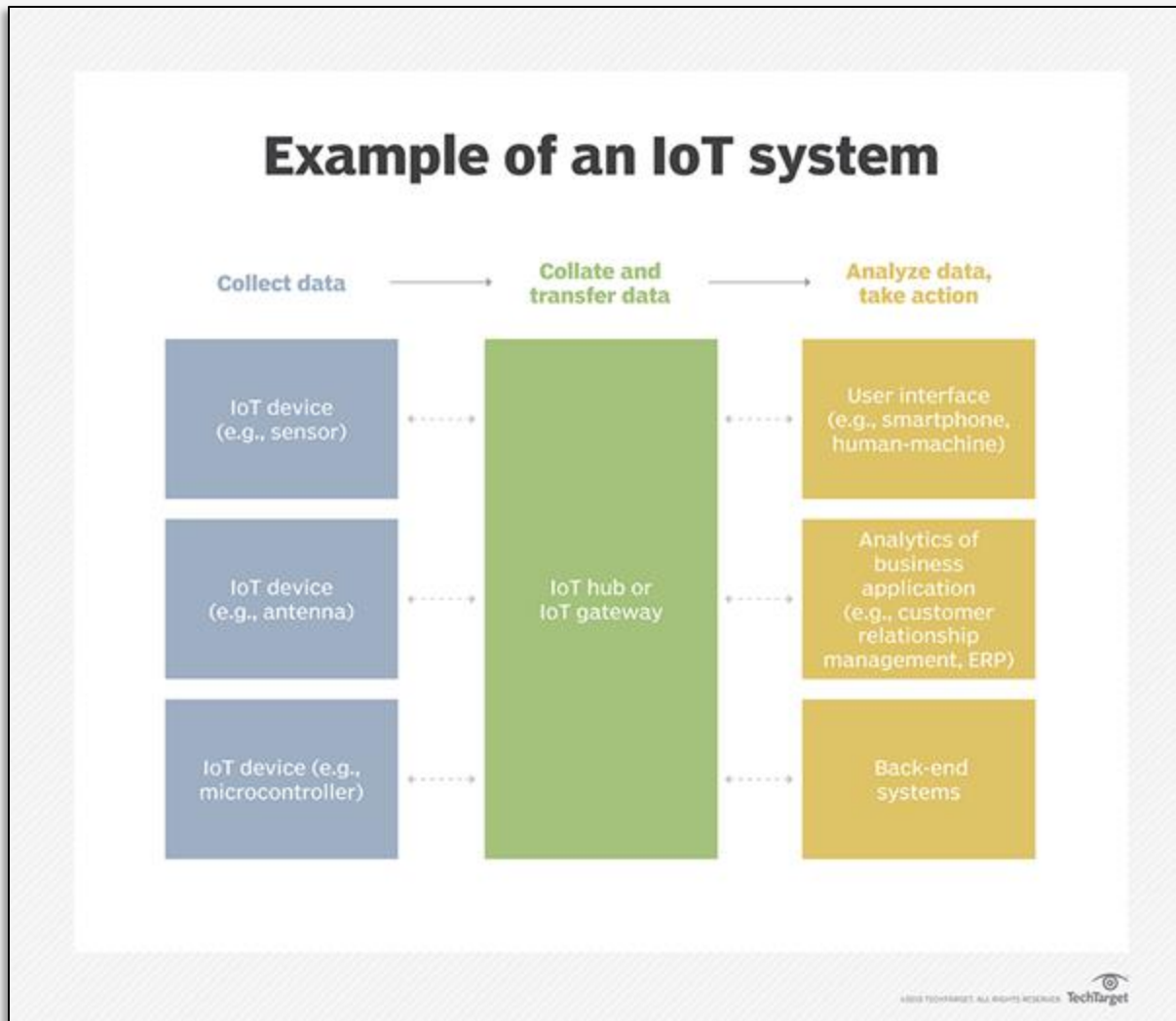Sergio Ariel Trabuchi, ITU Regional Standardization Forum for Americas, Washington D.C., United States, 2015

What is IoT (Internet of Things)

A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable ICTs.

https://www.linkedin.com/pulse/internet-things-iot-concept-reality-digitalforce-online/

Characteristics:
- Interconnectivity
- Things-related services
- Heterogeneity
- Dynamic changes
- Enormous scale

Source:: Recommendation ITU-T Y.2060

How IoT works

Technical overview of IoT

Source:: Recommendation ITU–T Y.2060

IoT Example

Example of an IoT system

Collect data → Collate and transfer data → Analyze data, take action

- IoT device (e.g., sensor)
- IoT device (e.g., antenna)
- IoT device (e.g., microcontroller)
- IoT hub or IoT gateway
- User interface (e.g., smartphone, human-machine)
- Analytics of business application (e.g., customer relationship management, ERP)
- Back-end systems

TechTarget

The IoT, is a system of

- interrelated computing devices,
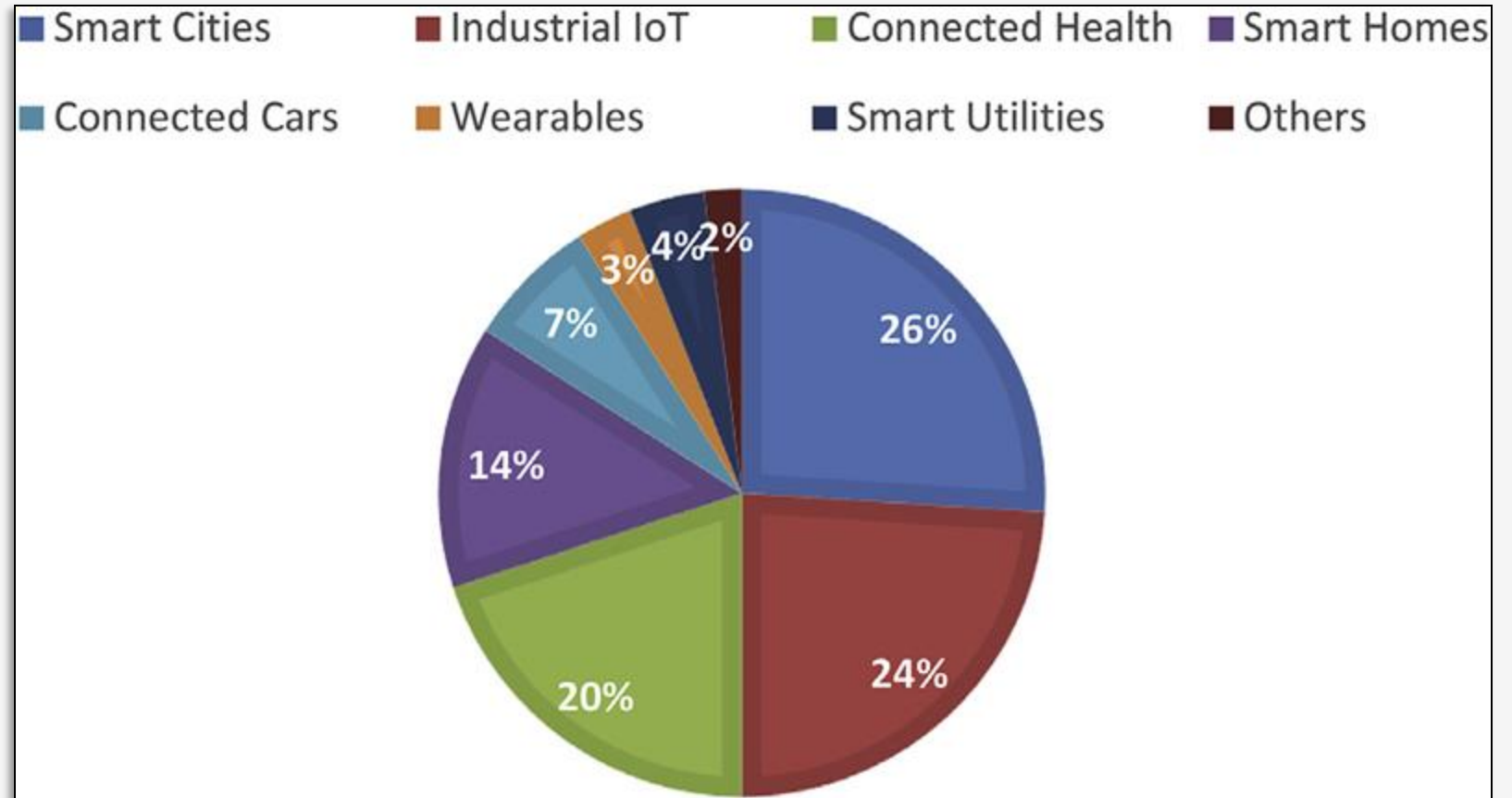- mechanical and digital machines,
- objects,
- animals
- people

that are provided with unique identifiers (UIDs) and the ability to transfer data over a network **without** requiring human-to-human or human-to-computer interaction.

Are the IoT Solutions available today?

General market structure of IoT technologies

The main goal of IoT technologies is to simplify processes in different fields, to ensure a better efficiency of systems (technologies or specific processes) and finally to improve life quality.
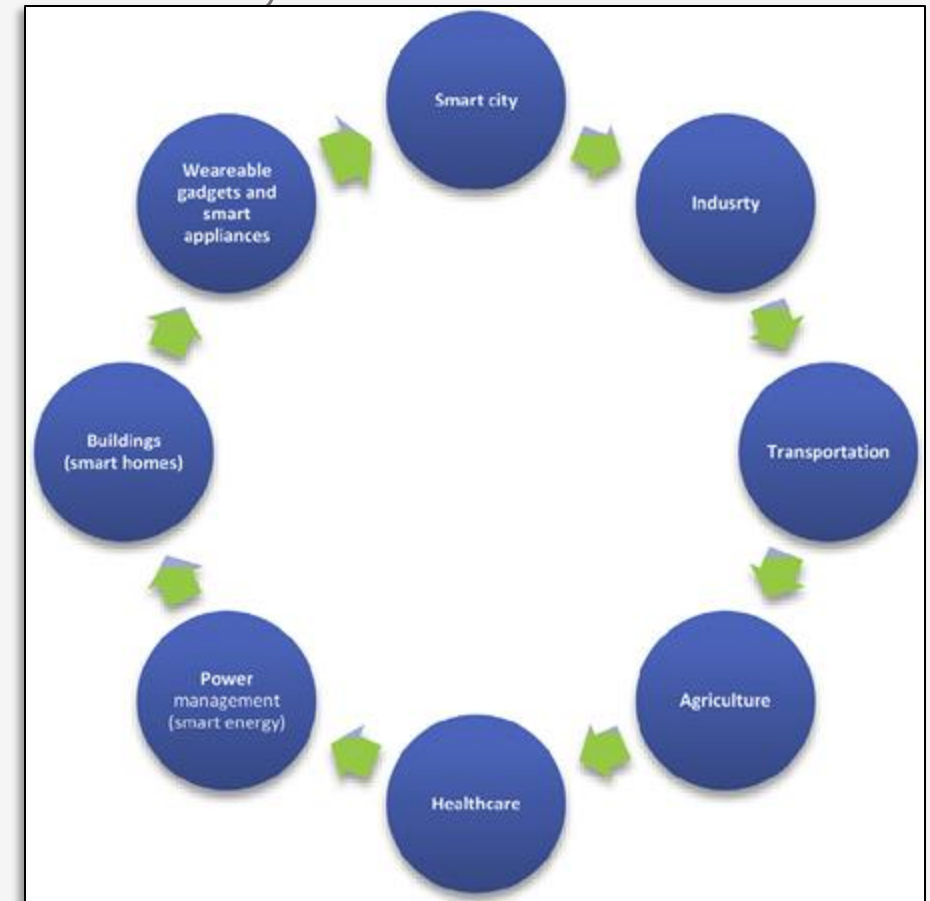

Legend:
- Smart Cities
- Industrial IoT
- Connected Health
- Smart Homes
- Connected Cars
- Wearables
- Smart Utilities
- Others

Pie chart values: 26%, 24%, 20%, 14%, 7%, 3%, 4%, 2%

Nizetic, S., Djilali, N., Papadopoulos, A., Rodrigues, J.J.P.C., 2019. Smart technologies for promotion of energy efficiency, utilization of sustainable resources and waste management. J. Clean. Prod. 231, 565e591. Osterrieder, P., Budde, L., Friedli, T., 2020. The smart factory

Key factors for developing IoT applications

The development of specific IoT application areas strongly depends from several key factors such as:

- general available advancements in electronic components

- available software solutions and user friendly surrounding

- solutions related to sensor technologies and data acquisition

- quality of network, i.e. network connectivity and infrastructure

- sufficient energy supply for production and operation of IoT devices
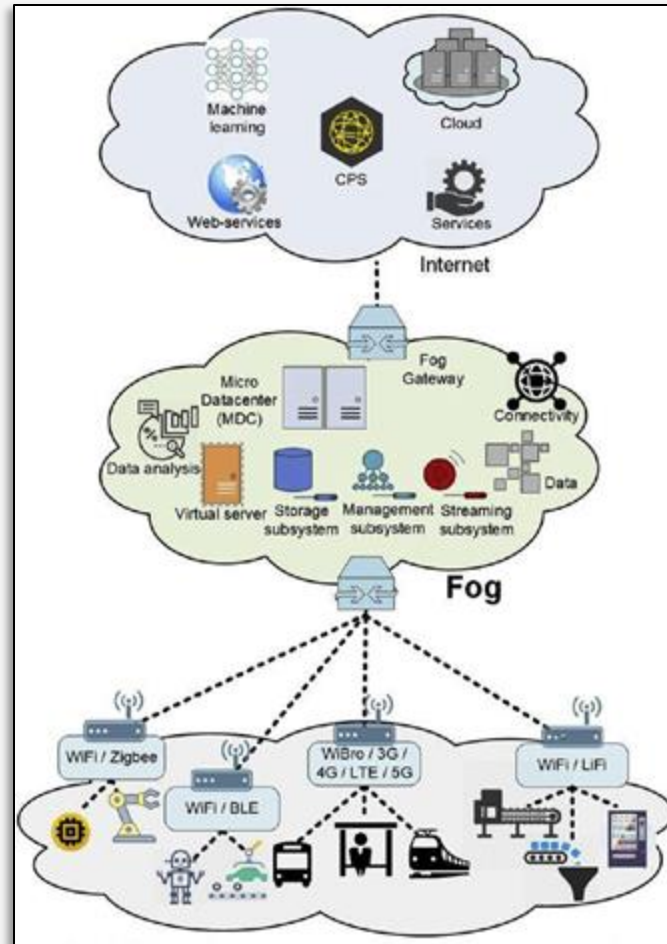

Sandro Nizetic, Petar Solic, Diego Lopez-de-Ipi-na Gonzalez-de-Artaza, Luigi Patrono (2020). Internet of Things (IoT): Opportunities, issues and challenges towards a smart and sustainable future, Journal of Cleaner Production 274 (2020) 122877.

Consumer and enterprise IoT applications

https://ednex.me/pdf/EdNex%20Proposal%20on%20AI%20IOT%20Autonomous%20Vehicle%20
ARVR%20Blockchain%20for%20Industry%204.0.pdf

https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT

IoT in industry

➤ The application of IoT technologies in industrial applications would allow for an increase in efficiency regarding the production process and would ensure more efficient communication and networking between operators and machines.

➤ It would allow for more competitive companies on the market with more efficient quality control with a minimization in losses.

➤ A critical feature would be the development, design and integration of various useful sensors in the industrial applications

Aazam, M., Zeadally, S., Harras, K.A., 2018. Deploying fog computing in industrial internet of things and industry 4.0. IEEE Transactions on Industrial Informatics.PP (99):1-1. Abdou, M., Mohammed

IoT in smart city concept

IoT in smart city concept

Different challenges in Smart City concept

Bhagya, N.S., Murad, K., Kijun, H., 2018. Towards sustainable smart cities: a review of trends, architectures, components, and open challenges in smart cities. Sustainable Cities and Society 38, 697e713..
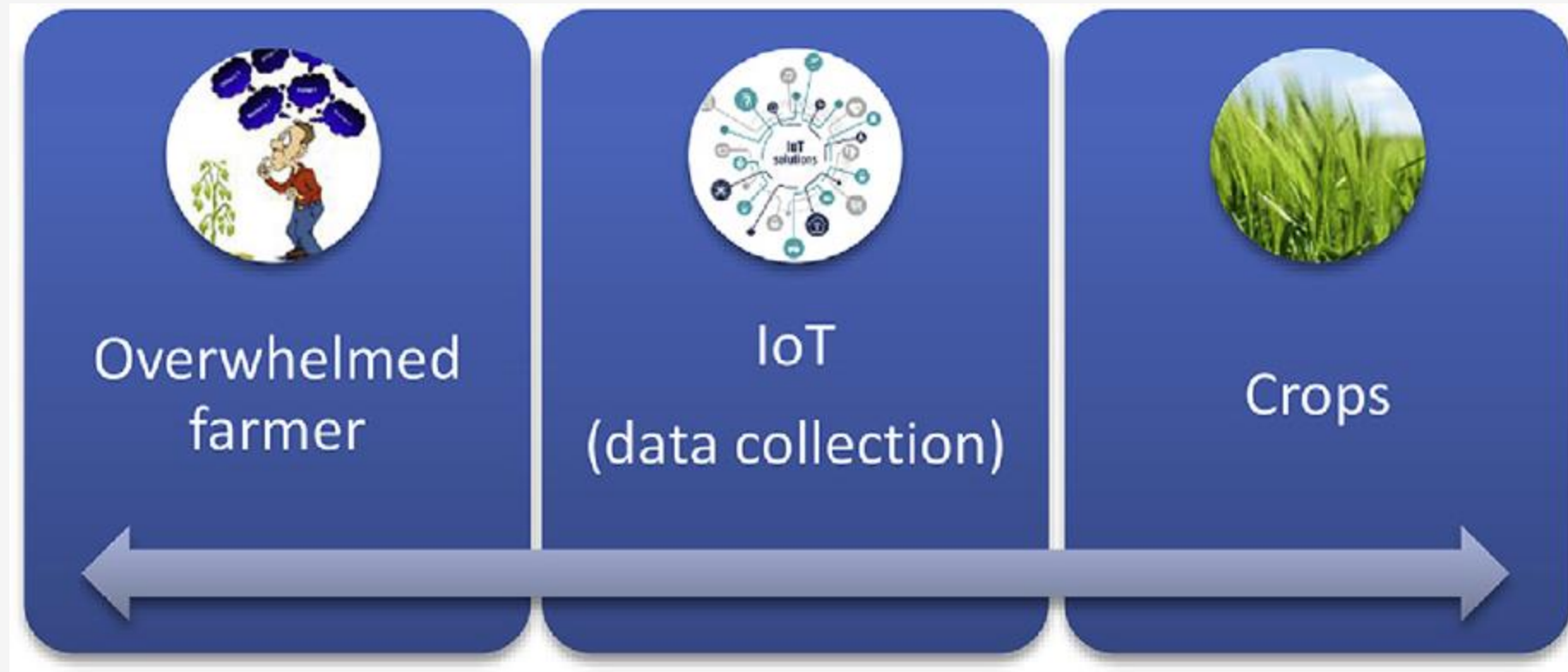
IoT in smart city concept

Various smart home

management systems

Present implementation

✓ different sensing technologies

✓ suitable network infrastructure

✓ education of population

✓ investigation of the sustainability

aspect

Zhou, B., Li,W.,Wing Chan, K., Cao, Y., Kuang, Y., Liu, X.,Wang, X., 2016. Smart home energy management systems: concept, configurations, and scheduling strategies. Renew. Sustain. Energy Rev. 61, 30e40.

IoT in agriculture

IoT in agricultural production from farmer's perspective

more precise seeding, fertility crop management, sensing and monitoring technologies, better education of farmers

Sensors and IoT

Sensors in even the holy cow!

In the world of IoT, even the cows will be connected and monitored. Sensors are implanted in the ears of cattle. This allows farmers to monitor cows' health and track their movements, ensuring a healthier, more plentiful supply of milk. On average, each cow generates about 200 MB of information per year.

IoT in waste management
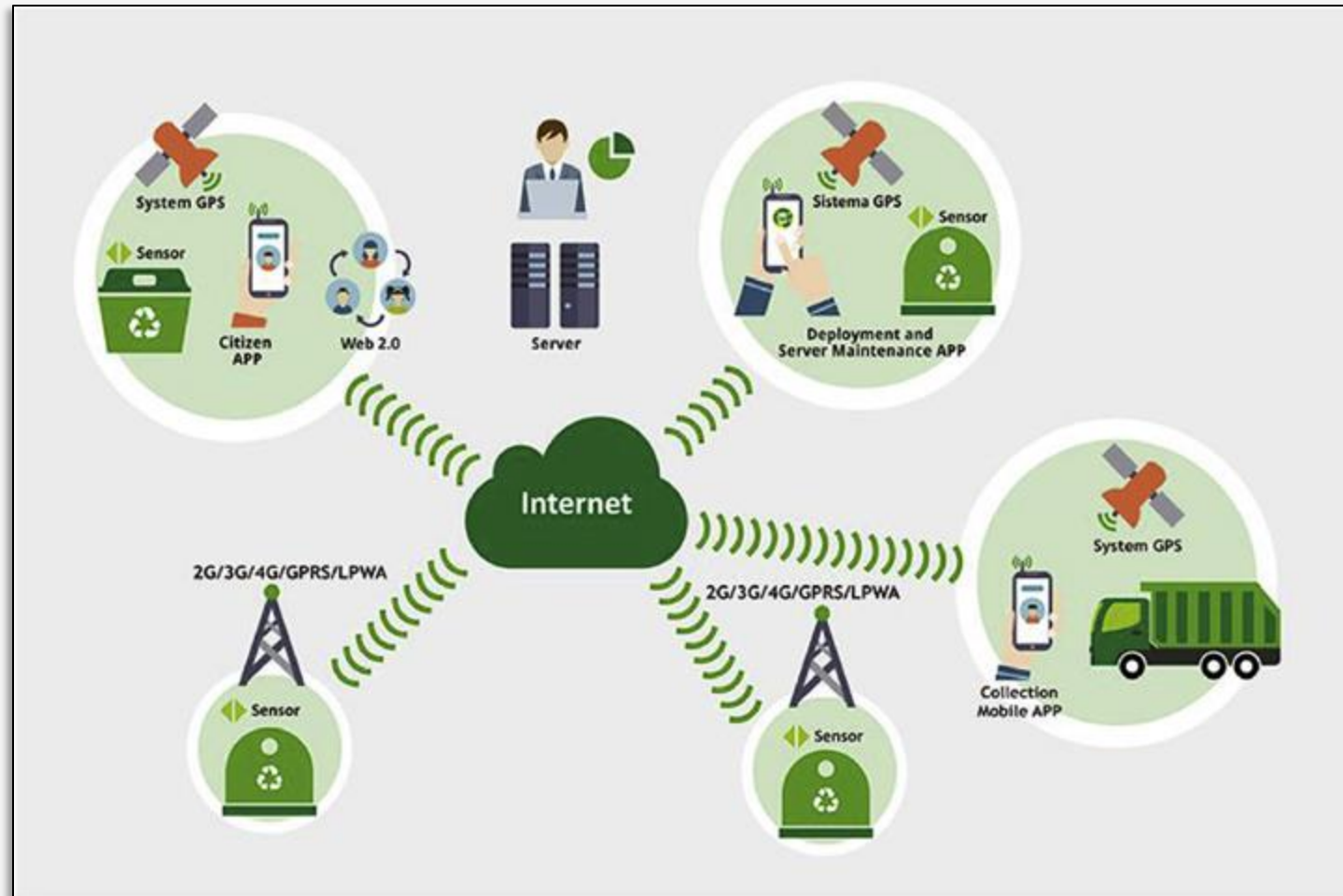
Innovative IoT based technological solutions are expected to be developed in upcoming years, especially from a smart city concept perspective and that could support smart waste management systems and a circular economy concept.

https://europepmc.org/article/pmc/pmc7368922

IoT in healthcare

An increase in the service quality of healthcare systems could be utilized through IoT support (mainly collection of patient health data) and finally with the improvement of patient safety and care since it could also lead to an increase in patient life expectancy.

There is an enormous potential in smart medical devices for different purposes that can be utilized for the monitoring of various vital and valuable human functions such as heart rate, skin temperature, movement monitoring, etc.
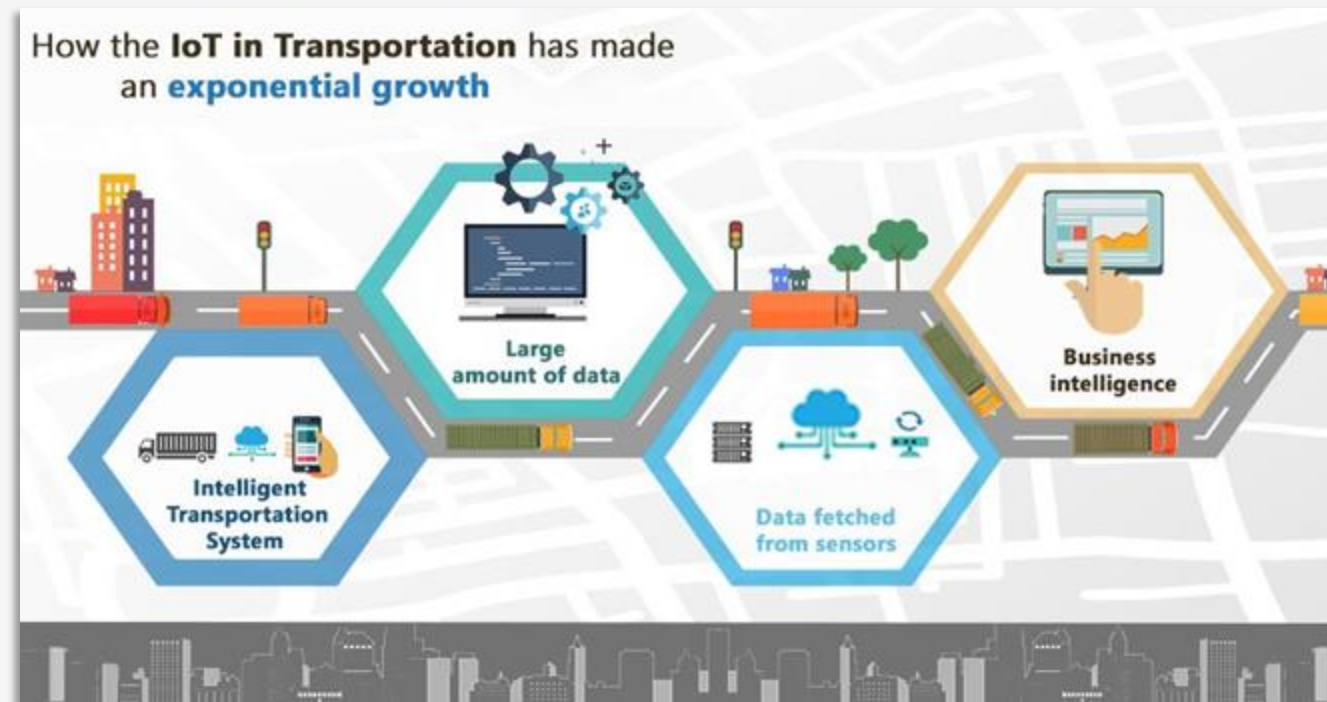
Support of IoT in:

remote health monitoring, monitoring a patient's general health condition and nutrition status, rehabilitation after a serious disease, ensure proper cyber safety due to potential attacks, smart hospital information system.

https://sbr-technologies.com/advantages-of-iot-in-healthcare/

IoT in transportation

Transportation modes will be significantly changed in upcoming decades.

In general, there is a demand for more environmentally suitable transportation options that are already being gradually developed with an expected penetration on the market. A necessary development of transportation infrastructure is needed for specific vehicle technologies to ensure desirable vehicle autonomy.

How the **IoT in Transportation** has made an **exponential growth**

Intelligent Transportation System

Large amount of data

Data fetched from sensors

Business intelligence

The most significant IoT application area is in the case of **the smart car (vehicles) concept**. The smart car concept considers the utilization and optimization of different internal functions in the car that are supported by IoT technologies. The application of IoT would upgrade driver experience and increase in comfort and safety.

https://www.iotcentral.io/blog/how-the-iot-in-transportation-has-made-an-exponential-growth

IoT in transportation – Google Traffic

One of the most well-known examples of IoT in transportation is Google Traffic, which uses real-time data from various sources to provide users with accurate traffic information.

Google Traffic uses a combination of data from GPS devices, cell phone signals, and other sources to determine traffic conditions in real-time.

The data collected by Google Traffic is analyzed using machine learning algorithms to identify patterns and predict traffic congestion. This information is then used to generate real-time traffic updates and route recommendations for users, helping them avoid traffic congestion and arrive at their destinations more quickly.
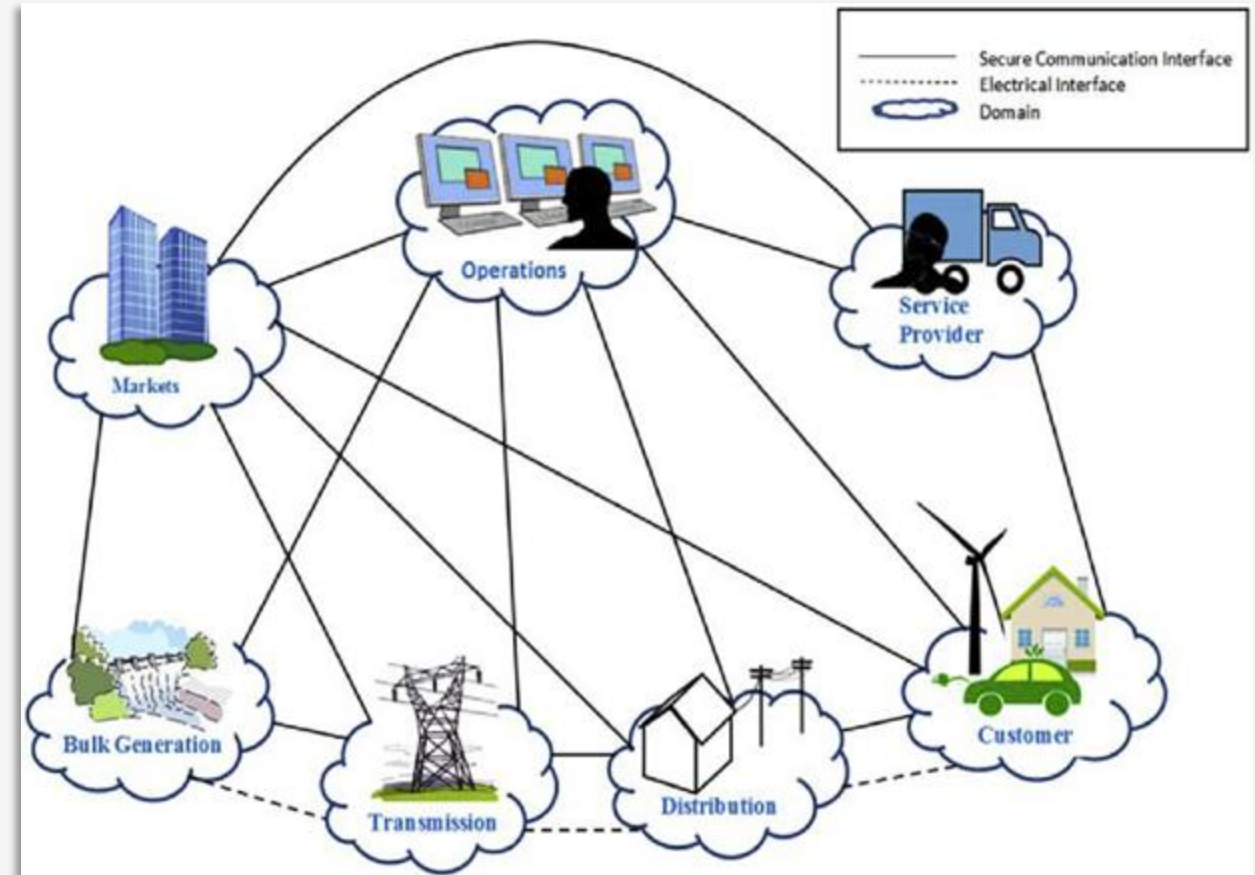

https://messiniaradio.gr/blog/2015/11/19/google-maps-me-traffic-information-ke-stin-ellada/
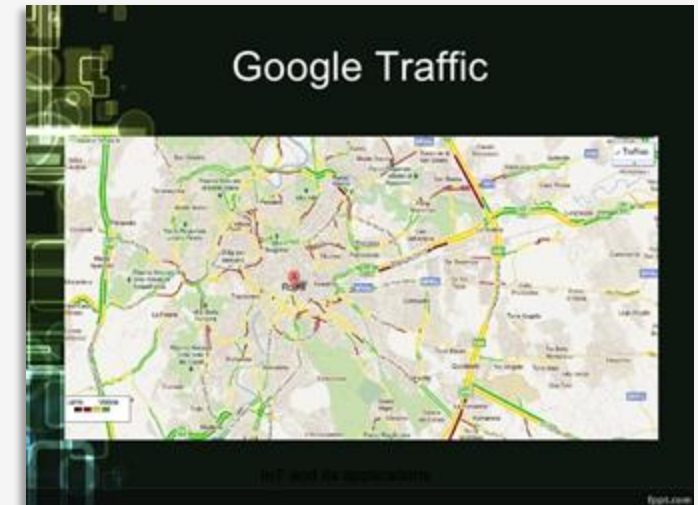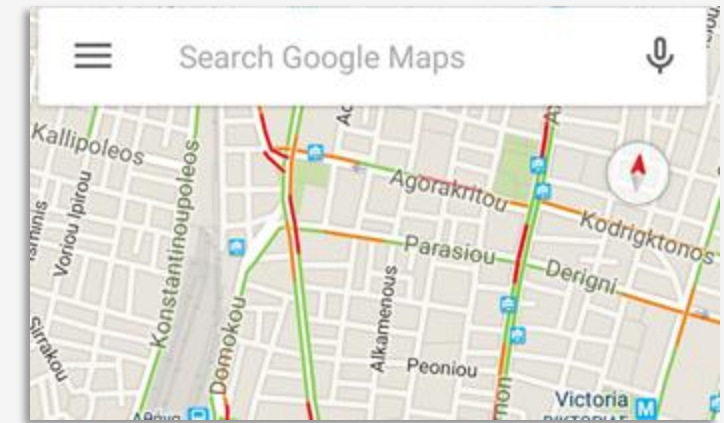
IoT in smart grids and power management

IoT products and technologies in smart power management is expected to enable

- accurate forecasting and
- different load strategies

in the case of renewable generation.

https://europepmc.org/article/pmc/pmc7368922

Tuballa, M.L., Lochinvar Abundo, M., 2016. A review of the development of Smart Grid technologies. Renew. Sustain. Energy Rev. 59, 710e725.

IoT technologies in sustainable energy and environment

https://europepmc.org/article/pmc/pmc7368922

Energy–Efficient Infrastructure Management in the IoT era

Megatrends are provoking a rise in **Energy Demand**

URBANIZATION
+2.5B people in cities by 2050

Source: United Nations, DESA

DIGITIZATION
50B connected things by 2020

Source: Cisco

INDUSTRIALIZATION
+50% Energy consumption by 2050

Source: IEA
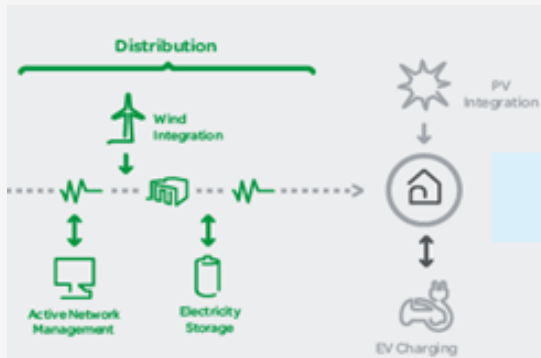
Source: Schneider Electric

Our World will be...

MORE ELECTRIC

Demand for electricity driven by sustainability, intelligent devices, and evolution of key energy consumers

MORE CONNECTED

Internet of Things will connect at least 50bn devices by 2020

MORE DISTRIBUTED

- Provide local energy to facilities, around positive energy and micro grids, to empower users
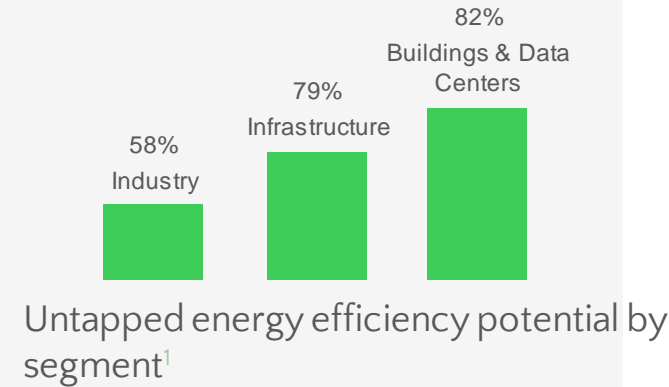- Falling prices of renewable energy

MORE EFFICIENT

- 2/3 of energy efficiency potential remains untapped[1]
- Buildings, industry & infrastructure end-users and datacenters all look to improve performance, efficiency and environmental footprint

58% Industry
79% Infrastructure
82% Buildings & Data Centers

Untapped energy efficiency potential by segment[1]

1: World Energy Outlook 2012, OECD / IEA, Internal analysis

Source: Schneider Electric

Smart Grid & Smart City IoT Solutions

Smart Grid Operator

"IT/OT integration from field to control center to enterprise"

Smart Generator

"Producing power efficiently"

Energy Services Provider

"Bridging supply & demand"

Renewable Operator

"Making renewables dispatchable"

Smart Buildings & Homes

Smart Energy

Smart Water

Smart Mobility

Smart Public Services

Smart Data Center

Smart Integration

Source: Schneider Electric

Industry IoT Solutions

From **design** to **maintenance** – **Sustainability & Efficiency** of the operations

Energy and Sustainability

Improve the sustainability of the operations and reduce the energy bill.

Process Management

Strive for zero waste while increasing the flexibility.

Source: Schneider Electric

Building & Homes IoT Solutions

From grid to floor space: **safety, comfort, reliability, efficiency and sustainability**

Buildings:

Smart Electrical
Distribution Panels

Building Management
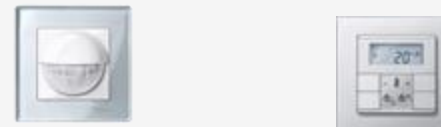System

Energy & Power
Management

Power Meters

Homes:

Connected Home System

Home Automation

Lighting & Temperature
Control

Data Center IoT Solutions

From rack to cyber space: **optimization of performance, speed and cost**

HV/MV & MV / LV Transformers

MV and LV Switchboards & Switchgears
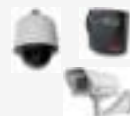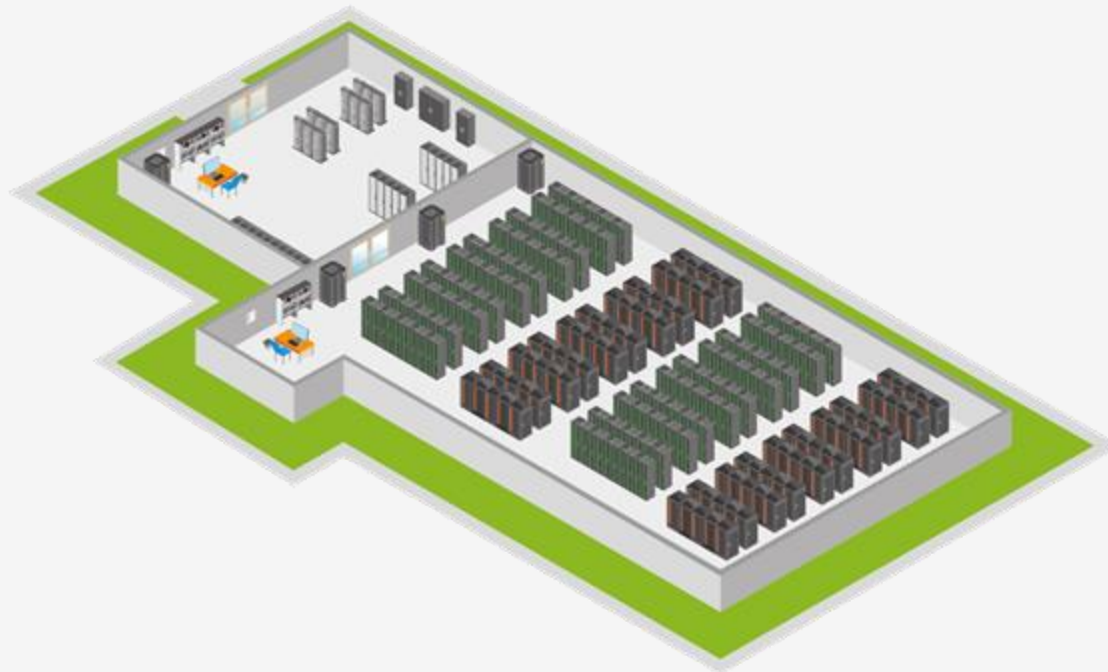
Modular UPS

Sensors & Meters

Busway

Row Modular UPS & PDU

Lighting Control

Access Control, CCTV

Network connectivity & Cable management

Floors, Rack systems

Flexible Air Containment

Room / Row / Rack precision cooling

Indirect Free Cooling

Chillers

Cooling VSD & Control

Source: Schneider Electric

Transforming data from IoT

Transforming data from IoT into **actionable information** will require the **right people**

Field Services	Energy & Sustainability Services

Sustainability and IoT create connected technologies that ......

https://www.alamy.com/stock-photo-robots-are-working-on-a-body-framework-on-wednesday-29-february-2012-53160427.html

RESHAPE INDUSTRIES

https://becpas.com/

TRANSFORM CITIES

https://www.mother.ly/birth/c-section/its-science-chewing-gum-after-a-c-section-can-help-you-leave-the-hospital-sooner/

ENRICH LIVES

Any questions?

Thank you ☺