



Solution for Climate Crisis Sustainability



A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

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Sustainability Background

- This was first defined by the United Nations as far back as 1987, when it was becoming increasingly clear that action was **needed to avoid lasting damage to the environment, protect it for future generations and improve the welfare of people in developing countries.**
- **Sustainable Development Definition**
 - *“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.*
- **Sustainability describes a long-term objective to improve the lives of everyone, both now and into the future, both in developed and developing countries.**
- It drives innovation, and **provides the best protection against environmental systems, companies and economies** that would otherwise collapse at some point.



The Three Pillars of Sustainability – ESG

- **Environmental**

- Carbon emissions & Water management
- Energy efficiency & Waste management
- Responsible extraction and use of resources and raw materials

- **Social**

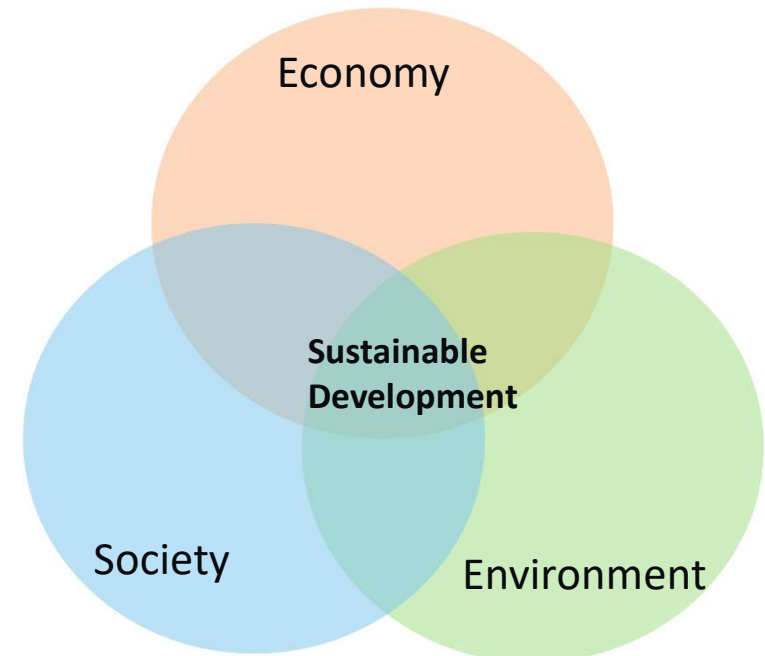
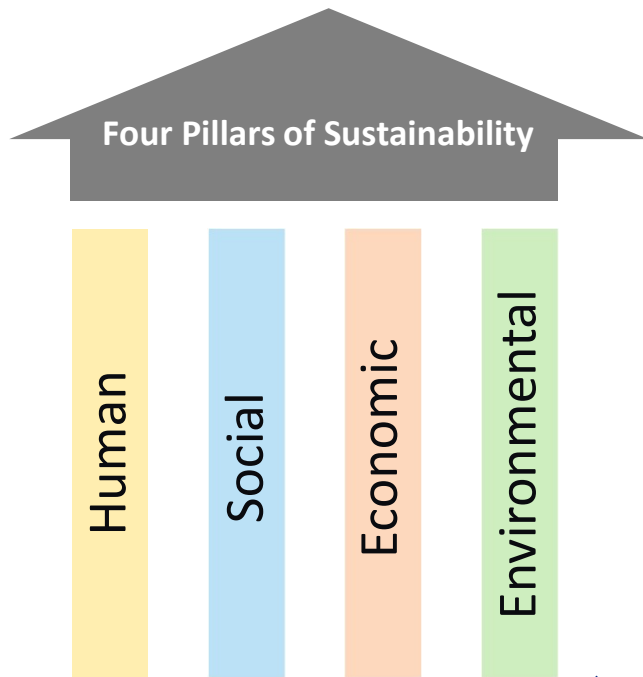
- How well a company treats its employees
- Employee wellbeing, health and safety
- Education, training, staff retention

- **Governance**

- How sustainable the company itself is
 - This company will stay in business long-term,
 - providing jobs, profitability for investment
 - Lower operating costs - It's policies on reusing and recycling
-
- High-level conversation about sustainability with the executive management in our clients
 - 'sustainability by design' conversation will be following with the decision makers in the engineering team

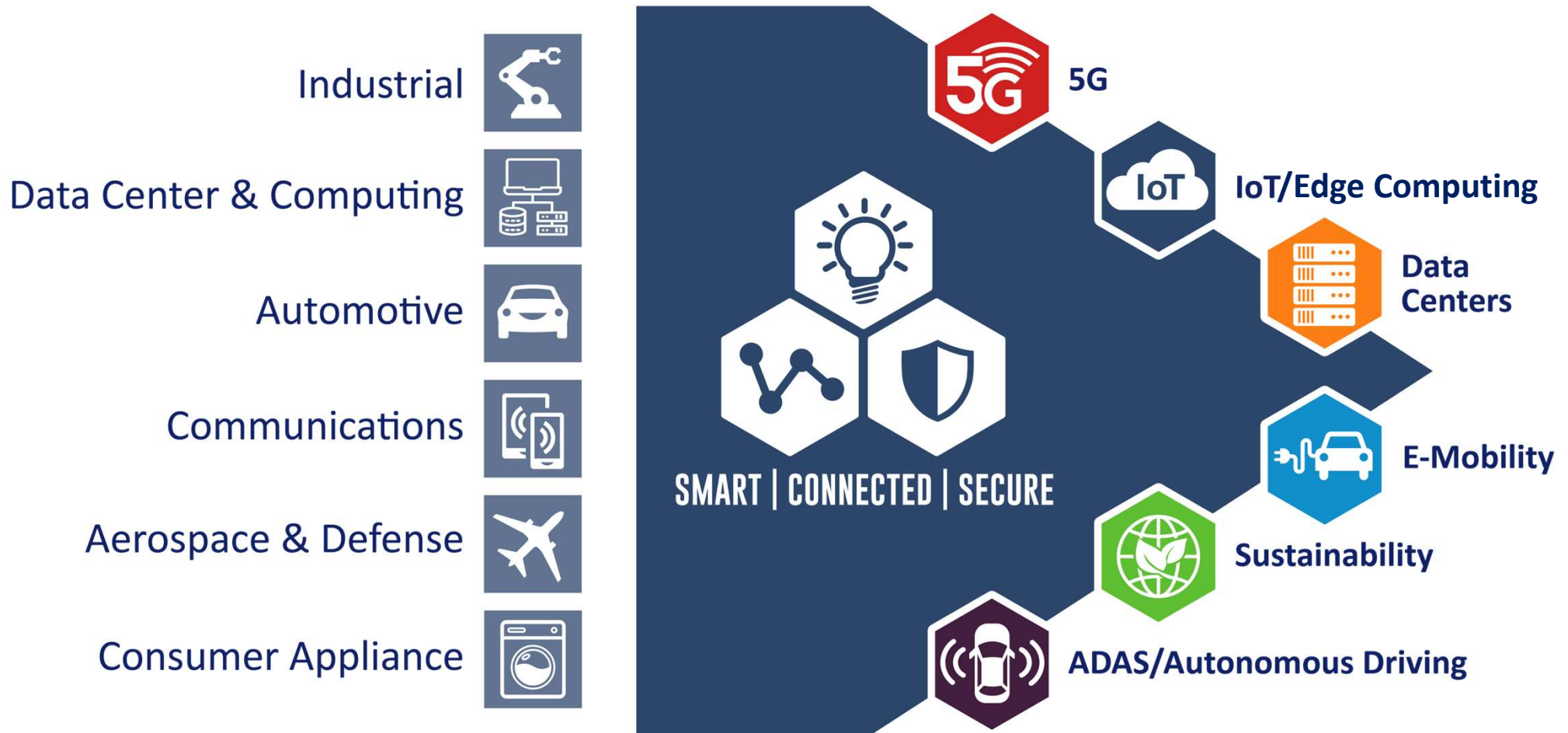


Microchip Can Help You Enable Sustainable Product Design



Eco-friendly design and production for sustainable product design

Megatrend Growth: Sustainability



How Microchip's sustainability story plays out

● Environmental

- Energy use & emissions
- Waste management and recycling
- Water conservation and management

● Social

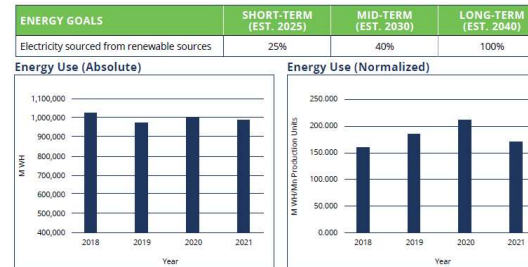
- Microchip Guiding Values / Company culture - diversity and inclusion
- Employee support, development, high retention

● Governance (Economic)

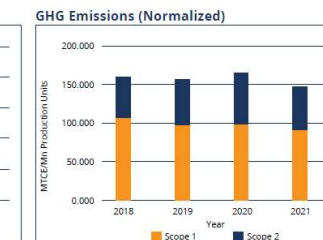
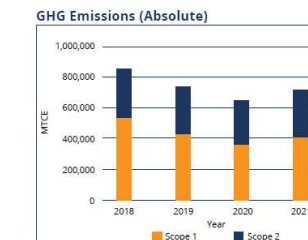
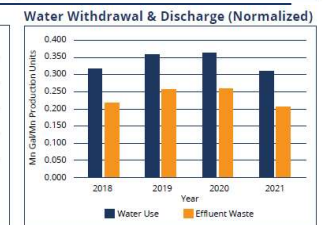
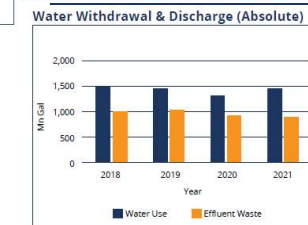
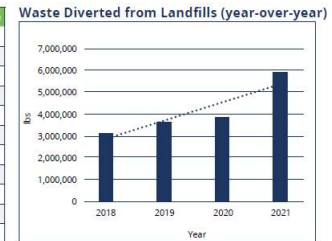
- Supply chain and responsible minerals sourcing
- Human rights / Business continuity – unbroken profitability
- Investor community demands strong sustainability statement

● It also matters to our clients

- By choosing to work with Microchip, Clients can be confident that our company, and its supply chain, will contribute to their own sustainability goals.



WASTE CATEGORY	2021 RECYCLED QUANTITY (LBS.)
Paper and Cardboard	1,384,074
Plastics	1,314,334
Metals	682,337
Electronic and Universal Waste	140,222
Precious Metal Scrap	823,755
Acid/Alkaline Solutions	1,215,122
Scrap Wood	214,548
Compost	3,174
Post-Consumer Fiber	53,796
Miscellaneous	24,594
Total	5,855,956



Microchip's Definition of Sustainability

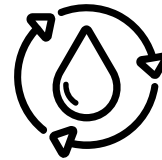
Target Applications



Any product or system designed to reduce consumption of resources



**Energy Generation,
Storage and Distribution**



**Efficient Use of
Energy and Water**



**Resource Monitoring
and Optimization**



**Waste Reduction
and Reuse**

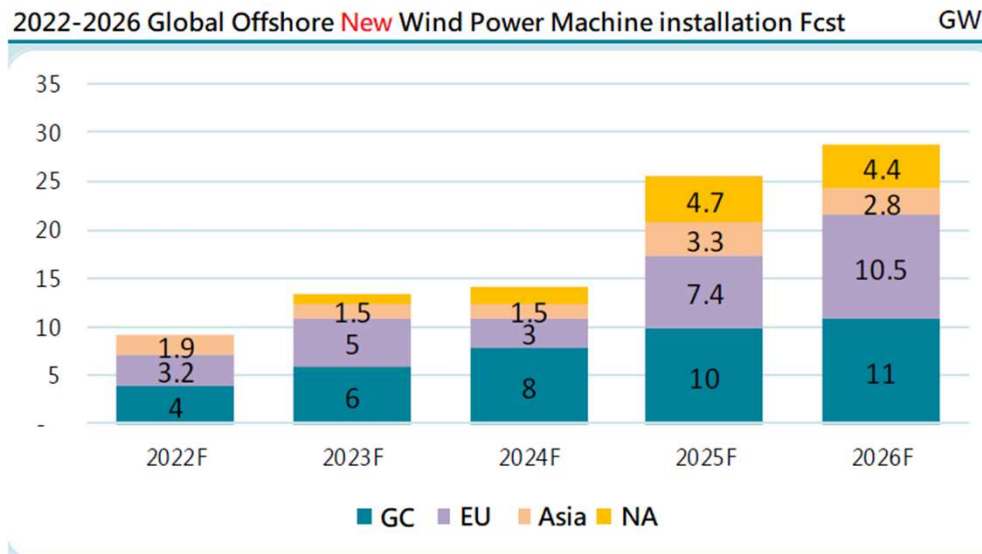
Market Trends



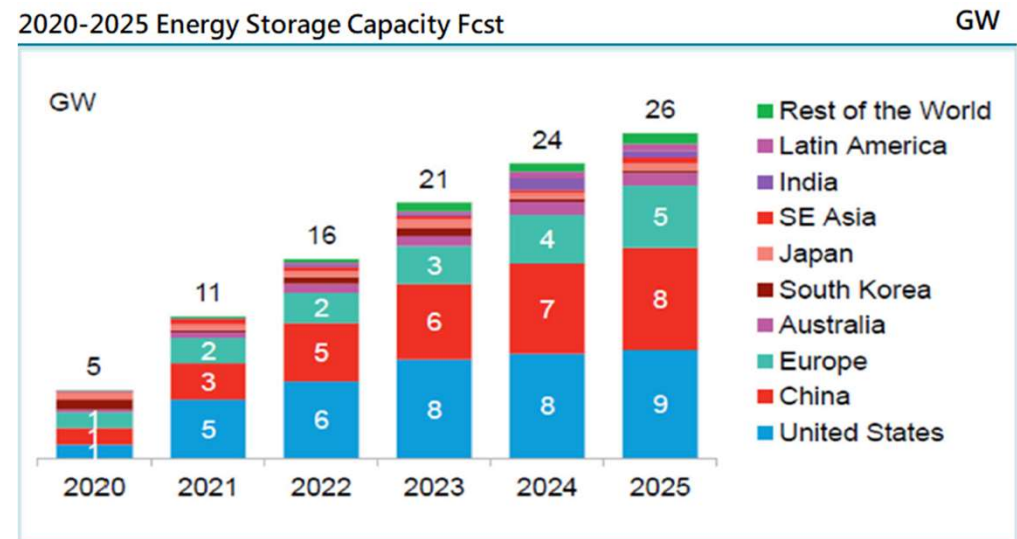
- Global green technology and sustainability market forecast to grow from \$35B to \$417B from 2021 to 2030, over 20% CAGR
- Governmental regulations increasing
- Overall societal change influencing purchasing behavior
- Disruptive force is an opportunity for differentiation and newer, smarter products
- Majority of these applications include embedded control for increased energy efficiency and smarter use of resources

Sustainability Business Opportunity

- Offshore Wind Power (56GW/2021 up to 146GW/2026 - WW, CAGR 5.7%)
- Energy Storage (24MW/2020 up to 590MW(**1000MW**)/2025-TW, 5GW/2020 up to 26GW/2025-WW, CAGR22.2%)
- ESS (Energy Storage System) : TaiPower 2022 bidding project – 22.3MW(Delta/5MW, AIDC/5MW, Tatung/4MW, Jin-Hwa/4MW, Power Diagnostic/3.2MW, Billion Elec/1.1MW). 2023 **60MW - Tatung**
- Smart Meter : TaiPower 2022 bidding project – 2.6Mu (Tatung/0.7Mu, Acbel/0.6Mu, CHEN/0.5Mu, Archmeter/0.5Mu, DAS/Itron/0.3Mu) **T/G 3Mu @ 2024 & 6Mu @ 2030.**



Data Source : GWEC 2022



Data Source : Bloomberg NEF(2021)

Microchip in Sustainability



Energy Generation, Storage and Distribution

- Solar Power Systems, Solar Inverters
- Wind Turbines
- Alternative Energy such as Biomass
- Hydrogen Fuel Cells
- Energy Storage Systems (Battery Charging, Battery Management Systems)
- Smart Grid Applications



Efficient Energy and Water Use

- Smart Agriculture (targeted irrigation & fertilization)
- High Efficiency Power Supplies/Inverters
- Higher Efficiency Motor Control
- LED Lighting
- Smart Dimmers, Actuators and Valves
- Heating, Ventilation and Air Conditioning
- ENERGY STAR® Appliances



Resource Monitoring and Optimization

- Smart Electric/Water/Gas Meters
- In-Home Energy Displays and Awareness Systems
- Motion Sensors
- Leak Detection
- Building Management (Light, Energy use)



Waste Reduction and Reuse

- Smart Waste Management
- Water Bottle Refilling Stations
- Smart Irrigation Systems
- Asset Tracking
- Public Restroom Dispensers (Soap, Paper, Water)
- Low Standby Power

1 - Energy Generation, Storage, Distribution



- Solar Power Systems, Solar Inverters
- Wind Turbines
- Energy Storage Systems
- Smart Grid Applications
- Hydrogen Fuel Cells
- Alternative Energy, Biomass

New Forms of Storage and Energy Distribution



House with Solar Panels and Inverter



Scalable Home Battery Storage



Home with Independent Energy System



Interoperable with Local Grid or Micro-Grid

dsPIC® DSCs
SiC
Communications



Solar Energy Conversion



dsPIC® DSC
Digital Power

SiC

Temperature Sensors

MCUs for
Housekeeping

Board
Power
(LDOs)

Serial EE

Solar Generation and Charging



Solar Controllers and Inverters

- Digital controllers for MPPT and DC/AC conversion
- DC and AC power monitoring
- Ethernet and Wi-Fi® connectivity
- Display drivers and user interface
- HV bias supplies and switching with Silicon Carbide

Metering

- Billing-grade-accuracy smart metering solutions
- Efficient power supplies
- Ethernet, USB, CAN, Wi-Fi and Bluetooth®

Battery Management

- E-Fuse reference design
- DSP-based power converters
- Relay drivers for safety

Charging Station

- Efficient power switching
- User interface
- Communications

Electric Vehicle

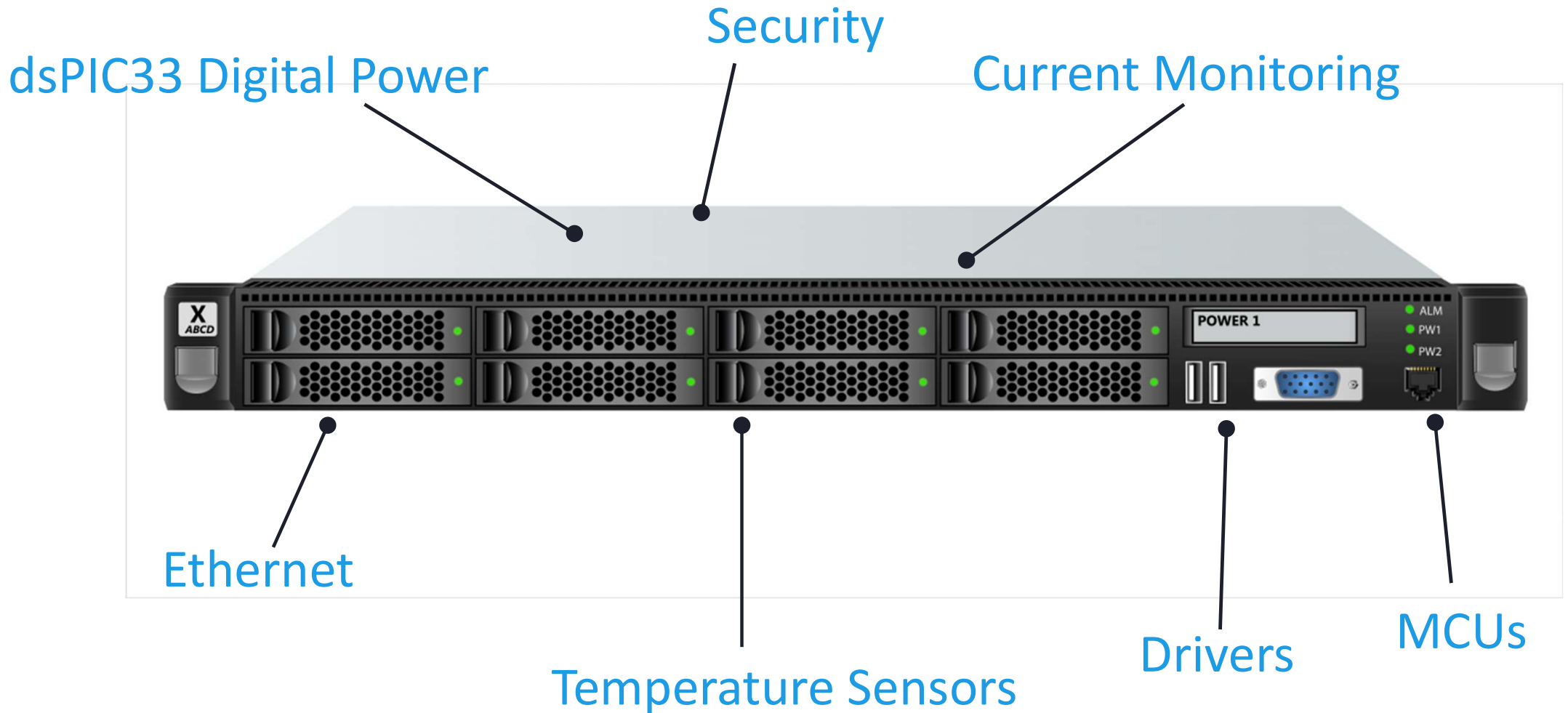
- Advanced motor control
- Efficient drivers and switching

2 - Efficient Energy and Water Use



- Smart Agriculture – Targeting Irrigation and Fertilization
- High Efficiency Power Supplies/Inverters
- Higher Efficiency Motor Control
- LED Lighting
- Smart Dimmers, Actuators and Valves
- Efficient Heating, Ventilation and Air Conditioning
- ENERGY STAR® Appliances

Server Power Supply – Increasing Energy Efficiency



LED Lighting

Power Conversion

Light Sensing

MCUs for Intelligence

Communications
(Weather, Coordination etc.)

Smart Agriculture



Smart Agriculture



Efficient Energy and Water Use

LED Lighting

- **LED Lights Are Great, Eco-friendly Options**
 - Compared to conventional incandescent or fluorescent lamps, it consumes significantly less power and emits much brighter light
 - The electricity bill is reduced by 50% and the LED lighting is twice as bright
 - LED lighting is about 4.5 times more efficient than three-wavelength fluorescent lamps
 - LED lights have a lifespan of about 50,000 hours (about 23 years when used for 6 hours a day)
- **Contributes to reducing the amount of carbon dioxide produced by low power use**



3 - Resource Monitoring and Optimization



- Smart Electric/Water/Gas Meters
- Energy Usage Displays and Awareness
- Motion Sensors
- Leak Detection
- Building Management (Light, Energy Use)

Smart Meters

Metering AFE

Board Power (LDOs)

MPU/MCU

Display, User
Interface

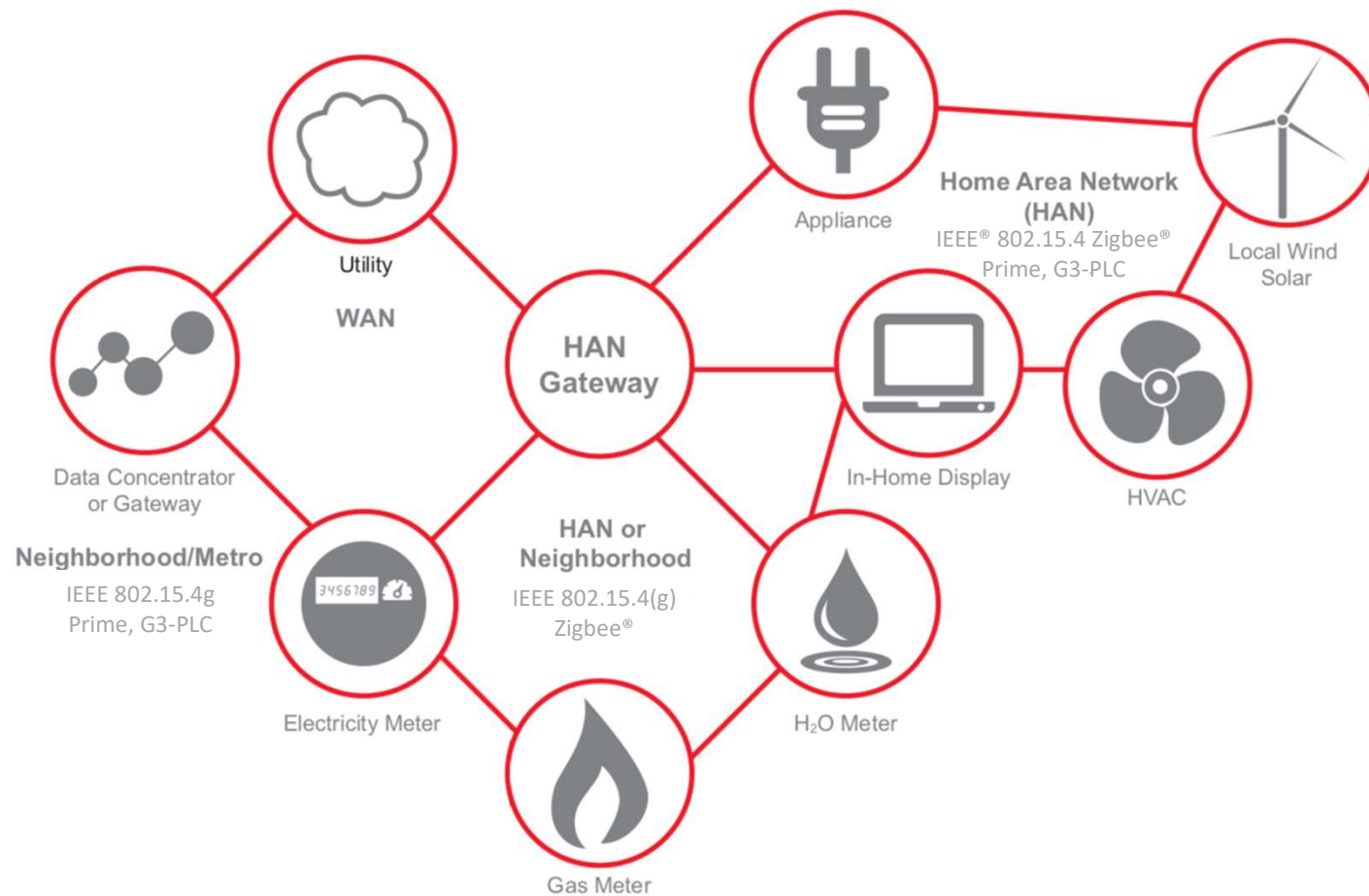
Security

Serial EE



Resource Monitoring, Awareness, Optimization

System-Level Communication and Intelligence



4 - Water Reduction and Reuse



- Smart Waste Management
- Water Bottle Refilling Stations
- Smart Irrigation Systems
- Asset Tracking
- Restroom Dispensers (Soap, Paper, Water)
- Low Standby Power

Reduce Waste

Public Restroom Paper Dispenser

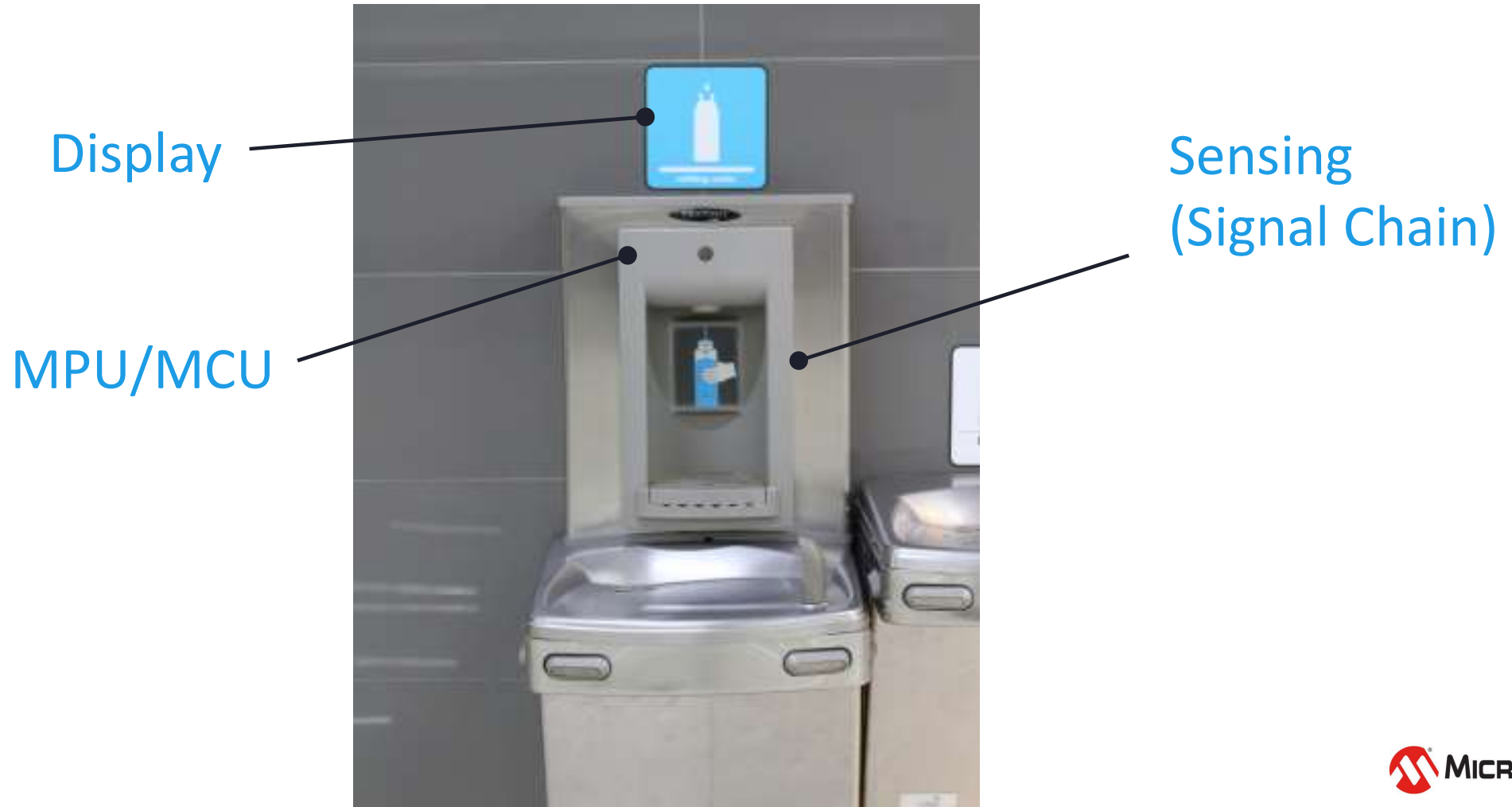
Low-Power MCUs,
Motor Control



Sensing
(Signal Chain)

Reduce Waste, Encourage Reuse

Public Water Refill Station



Reduce Waste, Encourage Reuse

Residential Trash and Recycling Station

Low-Power
MCUs,
Motor Control



Sensing
(Signal Chain)

Reduce Waste

Industrial Trash Compactor



Power Drive

Motor Control

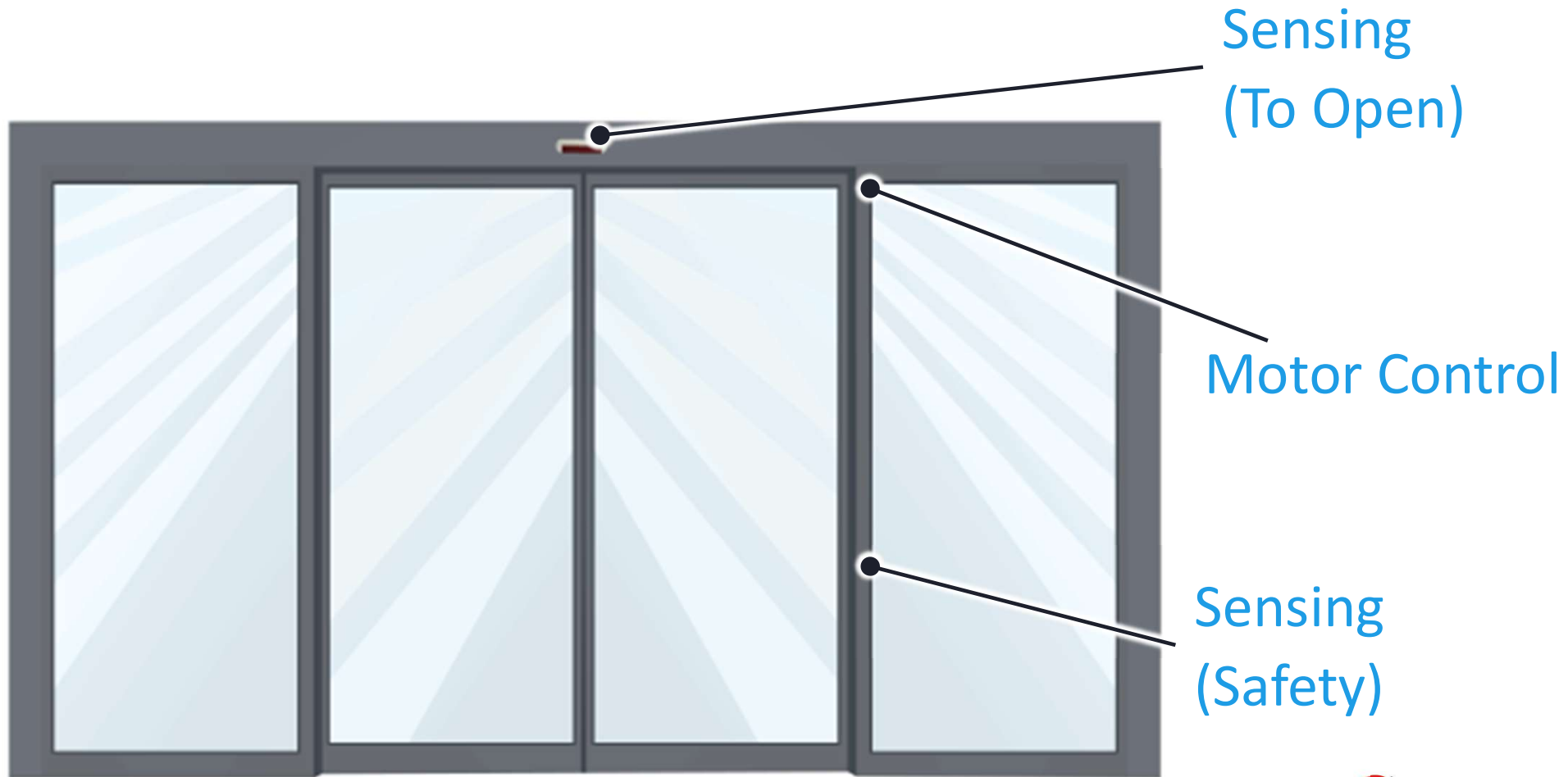
MCU for
General Control

Sensing
(Safety)



Reduce Waste

Preserve Heat and Cooling With Smart Doors



Common Design Challenges



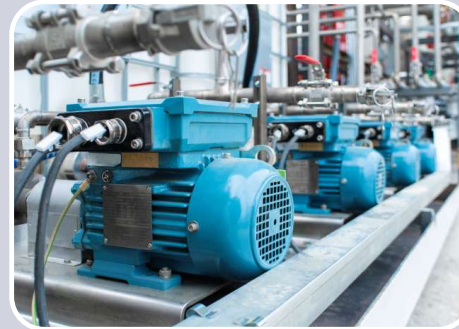
Consume Less Power

- Devices with sleep modes
- Timed wake-up
- Smart use of power-hungry peripherals or components



Convert Power More Efficiently

- Digital control reduces power losses and heat
- Adaptive control
- Lower power bills
- Improve system efficiency
- Faster charging times
- Reduce size and weight



Spin Motors with Less Energy

- New motor types with higher efficiency
- Advanced control algorithms
- Real-time control



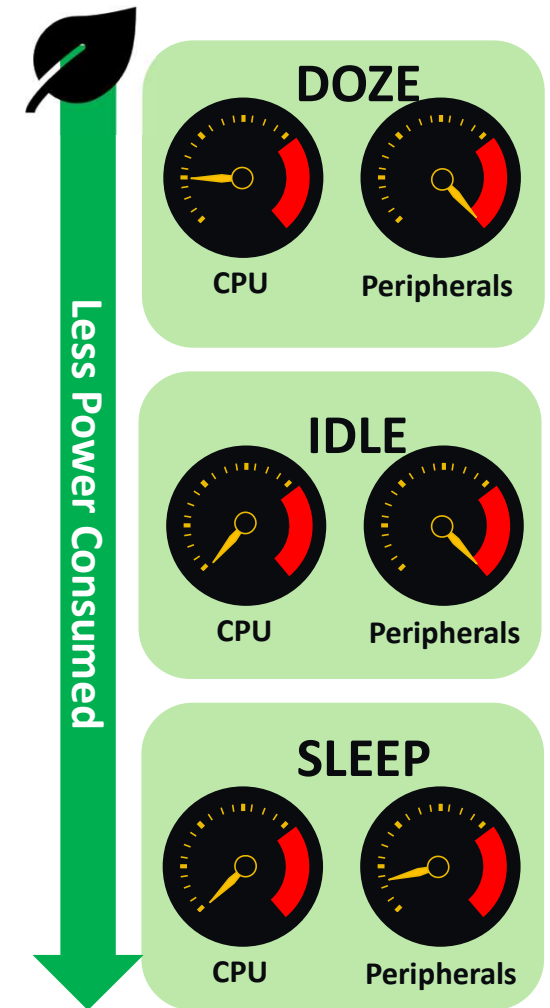
Make Smarter Decisions

- Connect to the Internet or a central processor
- Increase a device's environmental intelligence
- Smarter use of resources through coordination and sensing

Consume Less Power

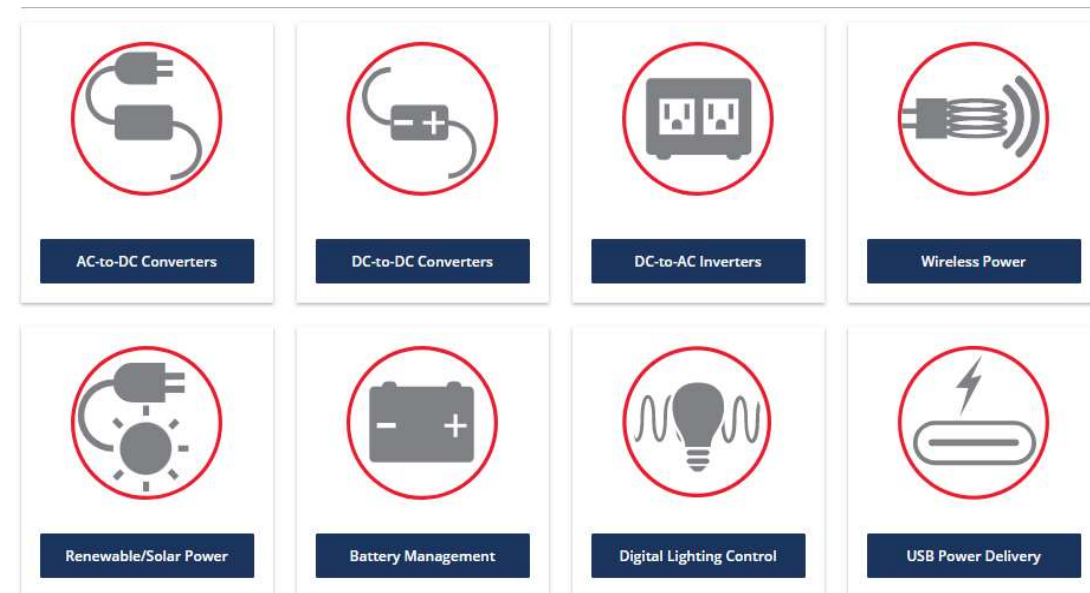
Get More Sleep

- Devices in sleep mode consume less power
- Flexible power-down options as well as special peripheral control to optimize power consumption
 - Technologies such as MCUs with XLP, Ethernet Wake on LAN and power down link detection
 - Peripheral Module Disable (PMD) and Analog Peripheral Manager (APM) gate power to analog peripherals such as ADCs for any programmed duty cycle
- Counters and Real-Time-Clock circuitry enable low-power timed wake up



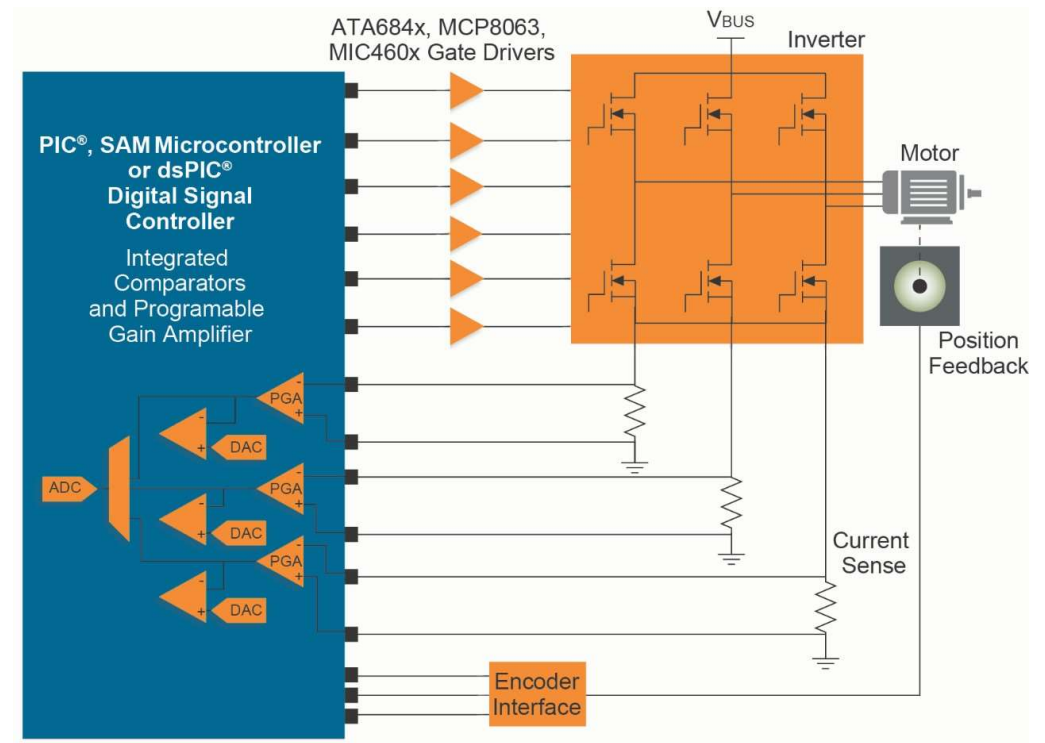
Convert Power More Efficiently

- Digital power control reduces power supply losses and reduces heat
- High-efficiency switching AC-DC power supplies for network servers that reduce AC power requirements and lower power bills
- High efficiency DC-DC power supplies for battery-powered equipment reduces charging needs



Spin Motors With Less Energy

- BLDC and PMSM motors typically have higher efficiency compared to older single-speed ACIM motors
- Variable-speed drive control saves power vs. ACIM
- Digital motor control improves efficiency through advanced algorithms such as Field-Oriented Control (FOC)
- A little bit of increased efficiency across a lot of motors can make a huge global impact



Make Smarter Decisions

Connect It

- **Linking to the Internet increases a device's environmental intelligence**
- **Use cases:**
 - Wireless mesh connected power meters eliminate “truck rolls”
 - Irrigation controllers that monitor the weather online via Wi-Fi®
 - Solar panels that wirelessly connect to one another to coordinate optimal sunlight tracking
 - Ethernet that enables sleeping PCs, turns off non-used ports or reduces TX power based on distance



What Products Enable These Solutions?

Deliver Higher Efficiency, More Reliable, More Flexible Solutions

Microcontrollers

Digital Power Conversion
Efficient Motor Control
Intelligent Decision Making
User Interface
Housekeeping

SiC

Proven Ruggedness
HV Bias Supplies and Switching
Low-Risk Supply Chain Model

Signal Chain

ADC, Op Amp, Clocks/Timing, Gate Driver, Sensors for Light, Temperature and Water

Communication

Ethernet
Wi-Fi®
CAN, LIN, USB
Zigbee®

Security

Secure Boot and Authentication
Hardware Encryption
Secure Key Storage

Power

LDO
Battery Management
Current Monitoring
Power Monitoring

Reference Designs to Simplify Development



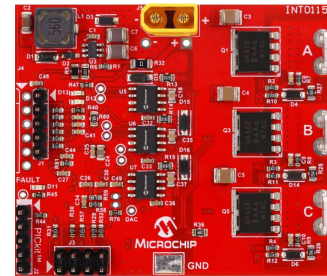
Residential Solar Breaker

Protects solar microinverter from fluctuations in grid voltages by relay disconnect; including energy tracking, power monitor and temperature control



Low-Voltage Fan

Efficient motor control and reduced energy use in ceiling, desktop or pedestal fans, supports trend to replace AICMs with higher efficiency BLDC motors; supports trend away from using ACIM to higher efficiency BLDC motors



E-Scooter Motor Control

Develop smaller, more efficient motor control with regenerative braking capability for e-scooters to meet the increased demand for fuel-efficient vehicles



Smart Power Strip

Power monitor with LCD display to monitor four device loads for current, voltage, power and frequency measurements



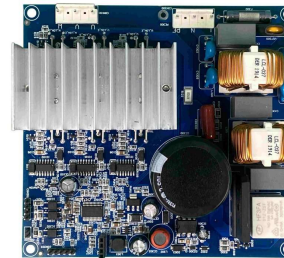
Grid-Connected Solar Microinverter

Full digital control of power conversion with high efficiency in 230Vac systems; ensures maximum power point tracking for PV panel voltages between 20V to 45V DC; grid failure detection



Air Conditioner

Solution for window A/C or outdoor unit of split A/C; including power stages for high-power PFC (220V, 1.8 KW), condenser fan (120W), and compressor (1.34 KW) motor control; higher Seasonal Energy Efficiency Ratings (SEER)



Refrigerator Compressor

High energy efficiency and highly reliable compressor start-up for BLDC or PMSM motor; Field-Oriented Control (FOC) enables variable speed drive; on-the-fly start up, stall detection with auto-recovery



150 kVA 3-Phase SiC Power Stack

Silicon Carbide (SiC) stack solutions drive performance, cost efficiencies and higher levels of power fidelity; includes power modules, bus bar, cooling, gate drivers and capacitors

Summary

- **Empowering your innovation for a more sustainable future**
 - Energy generation, storage and distribution
 - Efficient use of energy and water
 - Resource monitoring and optimization
 - Waste reduction and reuse
- **Large portfolio of products**
- **Reference designs**
- **Solving common design challenges to**
 - Consume less power
 - Convert power more efficiently
 - Spin motors with less energy
 - Make smarter decisions to use resources wisely



Environmental Stewardship



NET ZERO BY
2040

