The Hidden Engine of AI Robotics

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Agenda

- Who is STMicroelectronics?
- The Rise of AI Robotics
- Powering Intelligence at STMicroelectronics
- Where AI Meets Power: Three Key Areas of Interest
- Key Takeaways

Who is STMicroelectronics?

One of the world's largest integrated device manufacturing semiconductor companies

~49,000 employees
of which **~9,500** in R&D

$11.8 billion revenues
in 2025

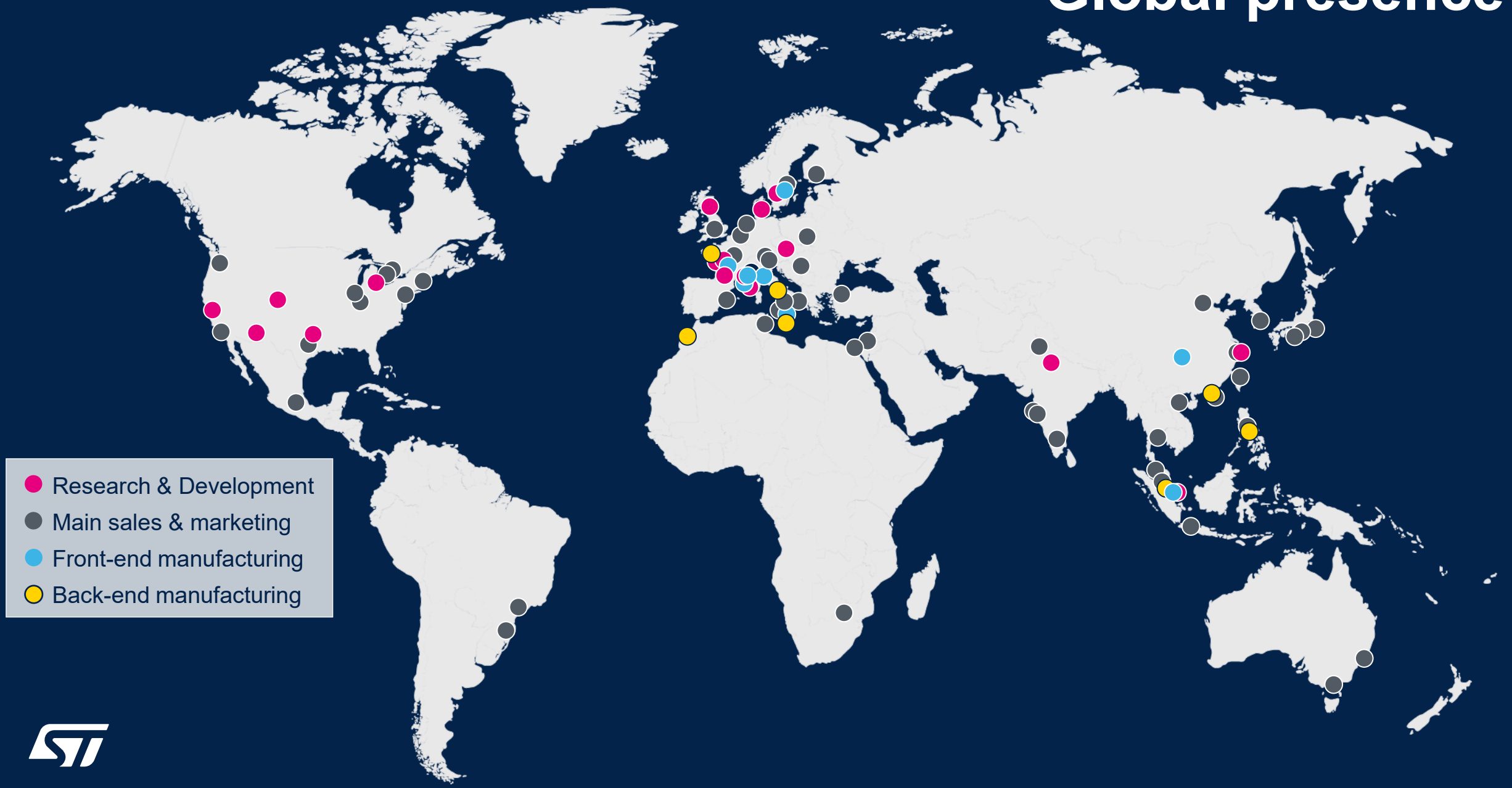
Over **80** sales & marketing offices serving over **200,000** customers across the globe

14 main manufacturing sites

Signatory of the United Nations Global Compact (UNGC)
Member of the Responsible Business Alliance (RBA)

As of December 31, 2025

Global presence



The Rise of AI Robotics
What are we really talking about?

Robotics

- **Sensors** → "eyes and skin"
- **Compute** → "brain"
- **Actuators (motors)** → "muscles"

Physical AI

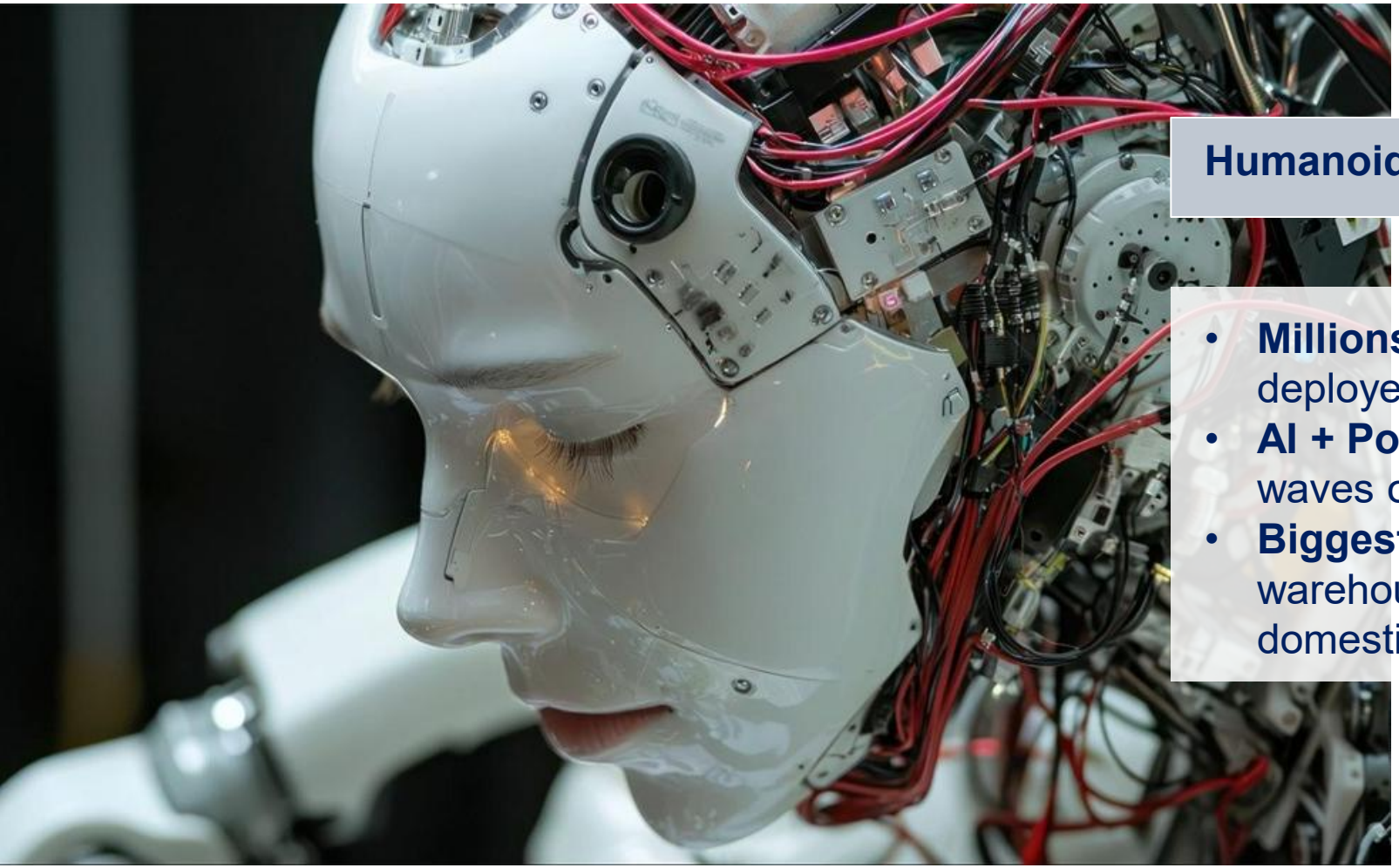
- **Runs on the edge** (on the robot itself)
- Must be **real-time**, **low-latency**, **battery-aware**
- Learns from the **physical world** (vibrations, torque, temperature…)

Power Electronics

- Turns a **battery voltage** into what **motors**, **sensors** and **MCUs** need
- Efficiency = autonomy, size, weight, safety
- Made of transistors (Si, **SiC**, **GaN**), drivers, controllers, sensors

A robot = Robotics (body) + Physical AI (brain) + Power Electronics (heart)

The Rise of AI Robotics
A market taking off



Humanoid robots: ~$3B (2025) → **~$38B (2035)**[1]

- **Millions** of industrial & service robots already deployed.
- **AI + Power Electronics** are driving the next waves of robotics
- **Biggest opportunities:** manufacturing, warehouses & logistics, healthcare, agriculture, domestic assistance, defense.

Two revolutions converging → AI + Power Electronics = Powered AI

[1] Goldman Sachs Research, *Humanoid robots: The AI accelerant*, 2024.

Powering Intelligence at STMicroelectronics

Robotics & Electric Vehicles share the same Power challenge

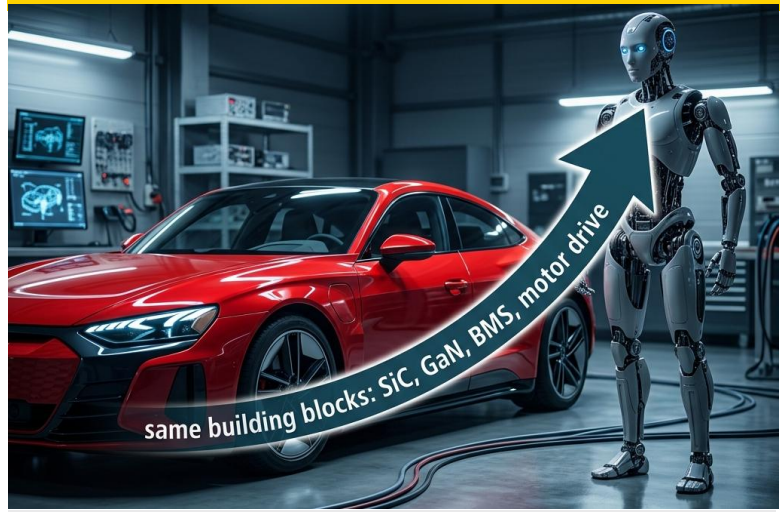
Data centers: Unlimited plug, limited grid

- **945 TWh/year** by **2030**[2]
- **~ 50 GWh** to train a single LLM
- **Always tied to the grid**

Robots: No plug, only a battery

- Just **1–2 kWh** on board
- **Walk, lift, perceive and think** for hours
- Every watt lost = less autonomy
- **No wall socket**

Same challenge as the electric vehicle

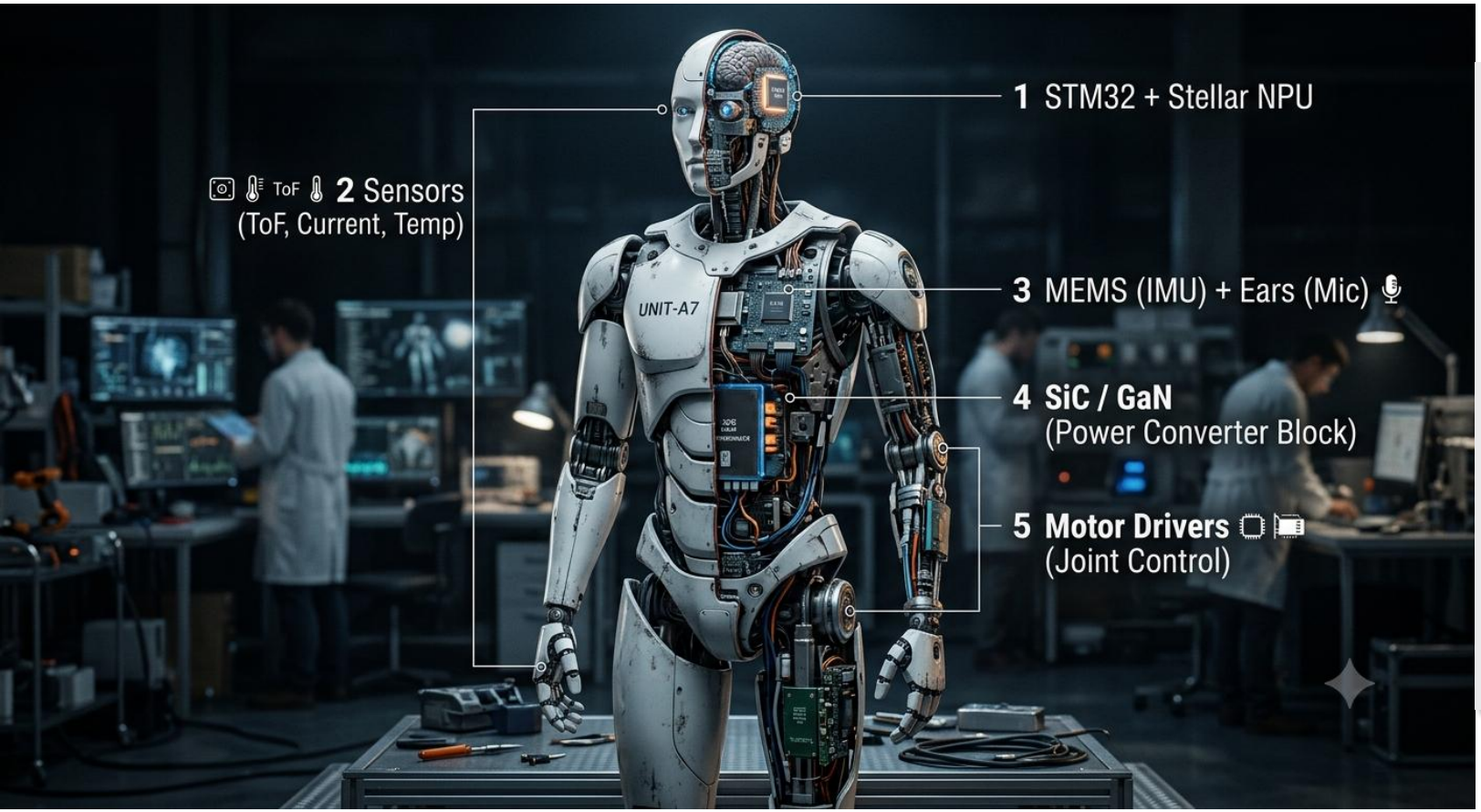


- **High-voltage battery** → efficient **inverter** → **motor**
- **SiC / GaN** converters, smart **BMS, motor drives**
- **Automotive-grade** know-how → **DNA** of **AI** robotics

AI relies on better power electronics, in the cloud AND in the robot.

[2] International Energy Agency (IEA), *Energy and AI* (2025).

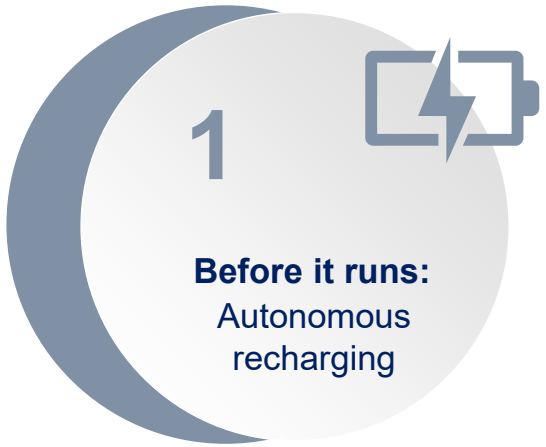
Powering Intelligence at STMicroelectronics
A full silicon track



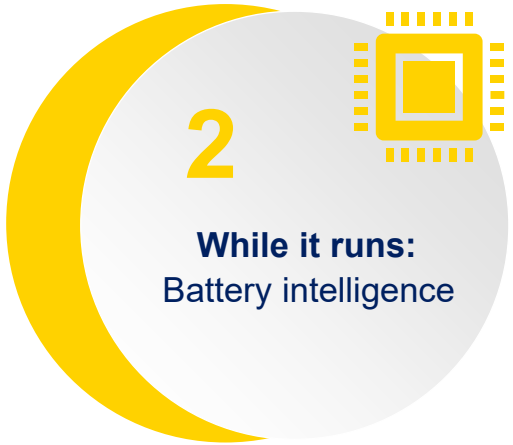
- **Compute** → STM32 / Stellar + NPU, real-time AI
- **Perception** → vision & physical sensors
- **Motion** → MEMS for balance, movement, interaction
- **Power** → SiC / GaN, efficient energy conversion
- **Actuation** → motor drivers, smart power ICs

Where AI Meets Power: Three Key Areas of Interest

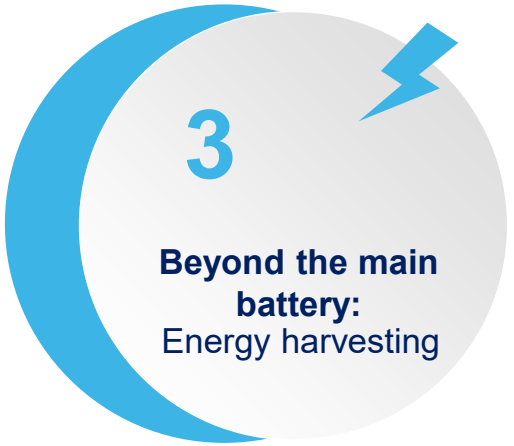
Let's make this concrete. In a robot, AI and power electronics collaborate at three critical moments: before, during, and after the robot uses its energy.



How does the robot get its energy back without a human plugging it in?



How does the robot get the most out of every joule it carries?



Can the robot generate a bit of its own energy from motion and vibration?

AI decides **when, where, and how** the machine manages its own energy.

Where AI Meets Power: Three Key Areas of Interest

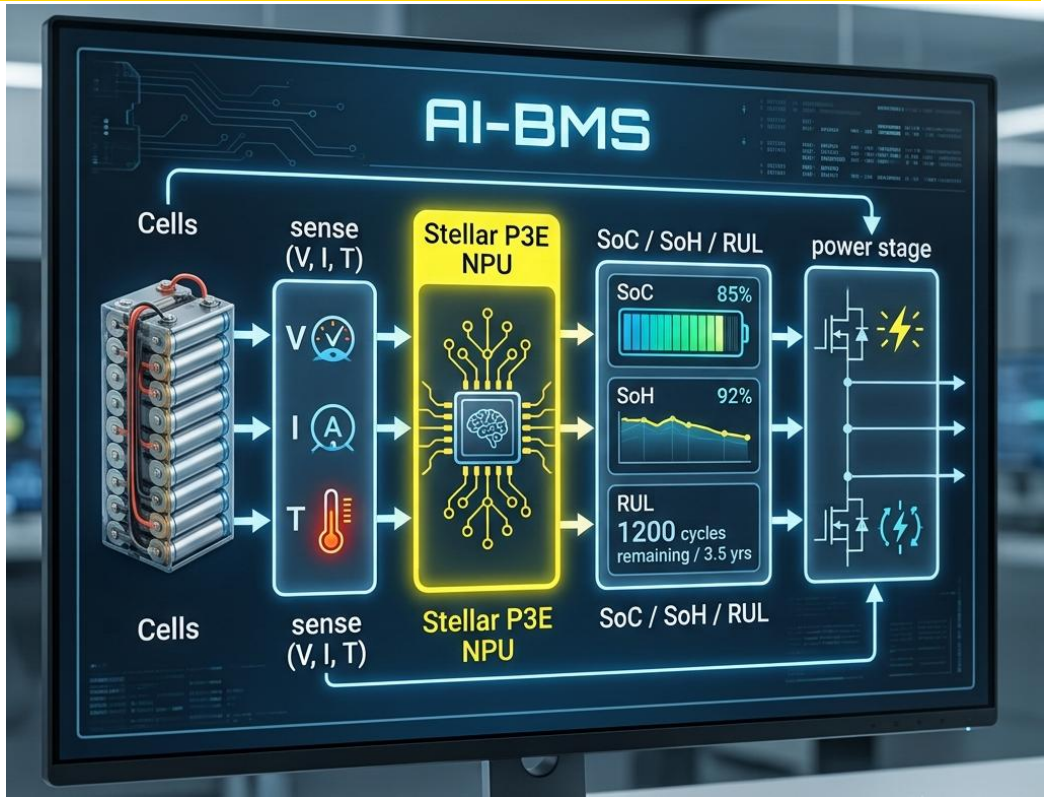
Autonomous Recharging

- **The constraint** → 1–2 kWh humanoid = ~2–4 hours autonomy
- **The solution** → WPT (Wireless Power Transfer) floor tiles + docking stations
- **The intelligence** → AI decides when, where, and how to charge

- **SiC / GaN**: High-efficiency, high-frequency power conversion.
- **STM32 + Stellar**: Intelligent resonant converter & AI charging control.
- **BMS + sensors**: Real-time battery protection and monitoring

Where AI Meets Power: Three Key Areas of Interest

Battery Intelligence

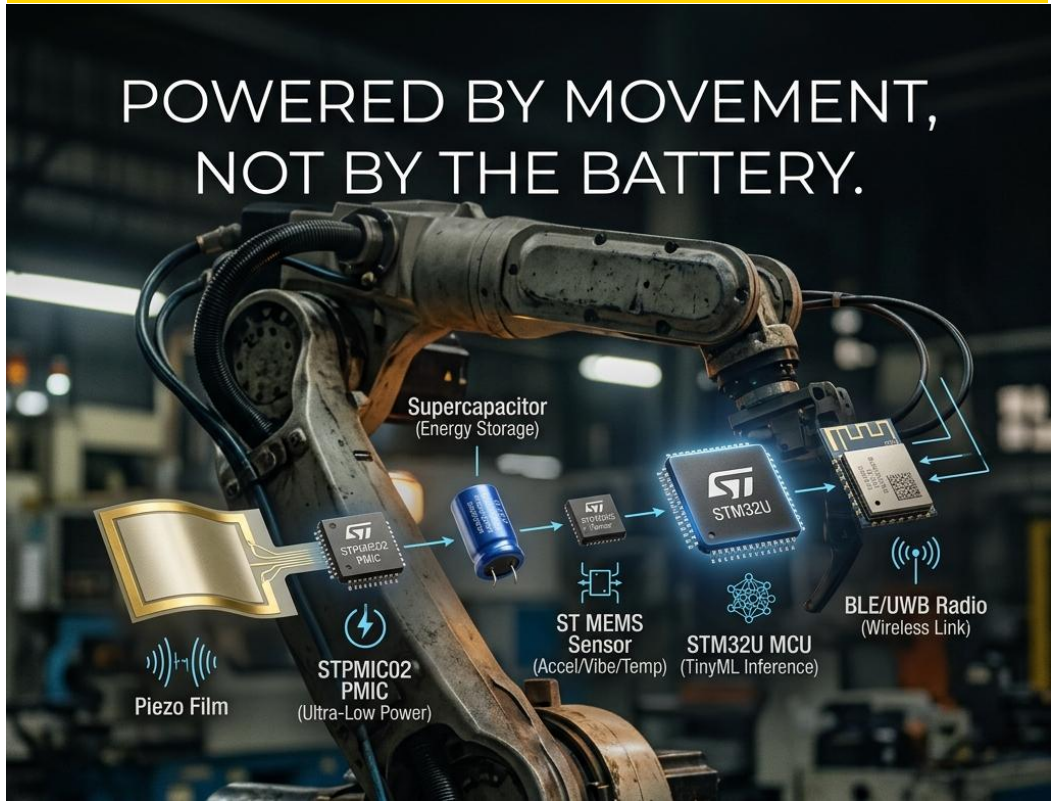


- **The challenge** → Classical BMS wastes 10–20% of usable energy
- **The solution** → AI learns cell ageing for better SoC / SoH / lifetime
- **The benefit** → +15–20% range, safer charging, longer battery life
- **The trend** → Li-ion (2-3h) → solid-state (8–12h)

- **BMS ICs** → cell monitoring + active balancing
- **Stellar P3E** → on-chip AI (no external compute)
- **Sensors** → current + temperature telemetry

Where AI Meets Power: Three Key Areas of Interest

Energy Harvesting

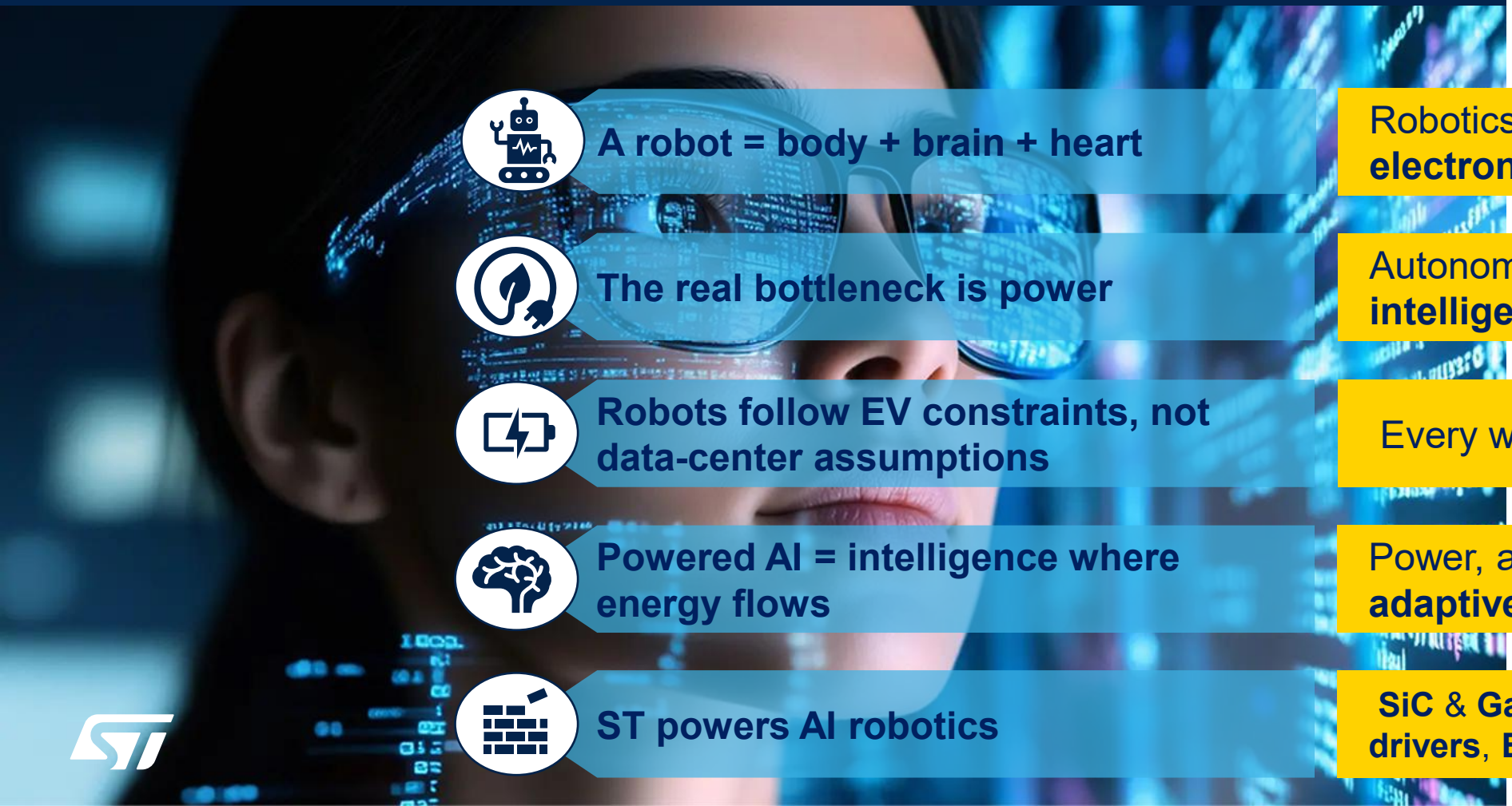


- **The idea** → Robots harvest micro-energy from vibration, motion, heat, light
- **Where** → joints, bearings, feet (piezo films → microwatts)
- **What it powers** → always-on sensing + TinyML inference
- **Why it matters** → distributed, self-powered, maintenance-free intelligence
- **Bigger picture** → smart systems in robotics, EVs, and industrial IoT

- **Ultra-low-power STM32 (U-series)** → TinyML on microwatts
- **Energy harvesting PMICs + AFE** (Analog Front-end) → capture, rectify, store energy
- **MEMS sensors** → motion, vibration, audio sensing

Conclusion

Key Takeaways



A robot = body + brain + heart	Robotics, physical AI, **power electronics**
The real bottleneck is power	Autonomy fails on **energy**, not **intelligence**
Robots follow EV constraints, not data-center assumptions	Every watt matters, **no wall plug**
Powered AI = intelligence where energy flows	Power, actuation, sensing become **adaptive** systems
ST powers AI robotics	**SiC** & **GaN**, **STM32** + **Stellar** (NPU), **drivers**, **BMS**, **sensors**, **MEMS**

Our technology starts with You

Find out more at www.st.com