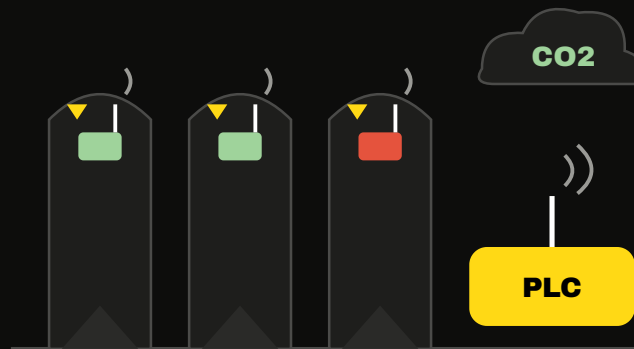


AGRICULTURE

Know the grain is fine. Without climbing every silo.

Solar radio nodes read the CO2 of every silo and a PLC sends it to the cloud.

[Read the interactive case study online ›](#)


Schematic illustration

30 min

between two readings of each silo

1

solar radio node per silo, with no wiring between silos

600 ppm

of CO2: above this, the grain starts to change

0

trips to look inside a silo when the readings are normal

THE CHALLENGE

Grain that spoils where nobody looks.

Every year, a large amount of stored grain is lost to fungi and insects. Research in wheat growing areas shows that CO2 is an effective indicator of grain quality. The customer had dozens of silos spread over large areas and checked them by eye, which meant driving to each one. A change inside a silo could go unseen until part or all of the grain was lost, or lost its value.

01

Measure the CO2

CO2 as the key indicator of the state of the grain, with other sensors on the same nodes.

02

No wires between silos

One radio node per silo, powered by a solar panel.

03

A reading every 30 minutes

The nodes read and send to a master, which talks to a PLC connected to the cloud.

04

Change it without new hardware

Python and bash scripts that are easy to change: reading times, sensors, signals to actuators.



CO2 tells the story of the grain

Ambient air has 350 to 400 ppm. A stable grain mass has 400 to 600 ppm. From 600 to 1,500 ppm, mould is starting. From 1,500 to 4,000 ppm and beyond, there is severe mould or an insect infestation.

HOW IT WORKS

Three jobs: read the grain, keep the nodes alive, watch the farm.

Job 1 · Read the grain

The CO2 band says what is happening inside.

Each node reads the CO2 of its silo and sends it. The PLC compares the value with the bands of the case: stable grain, mould starting, severe mould or insects. A rise above the stable band is the sign to act before the grain is lost.

- 400 to 600 ppm: stable grain
- 600 to 1,500 ppm: mould starting
- Above 1,500 ppm: severe mould or insects

Job 2 · Keep the nodes alive

Wake, read, send, sleep. The sun does the rest.

The slave nodes wake every 30 minutes, read their sensors, send to the master and sleep. A solar panel keeps each battery charged, and the node can tell in advance when its battery is running low. The master hands the data to the PLC, which sends it to the cloud. Change the weather, then lose the cloud link.

- 48 readings per silo and day
- Solar power, no battery changes
- A warning before a battery runs out

Job 3 · Watch the farm

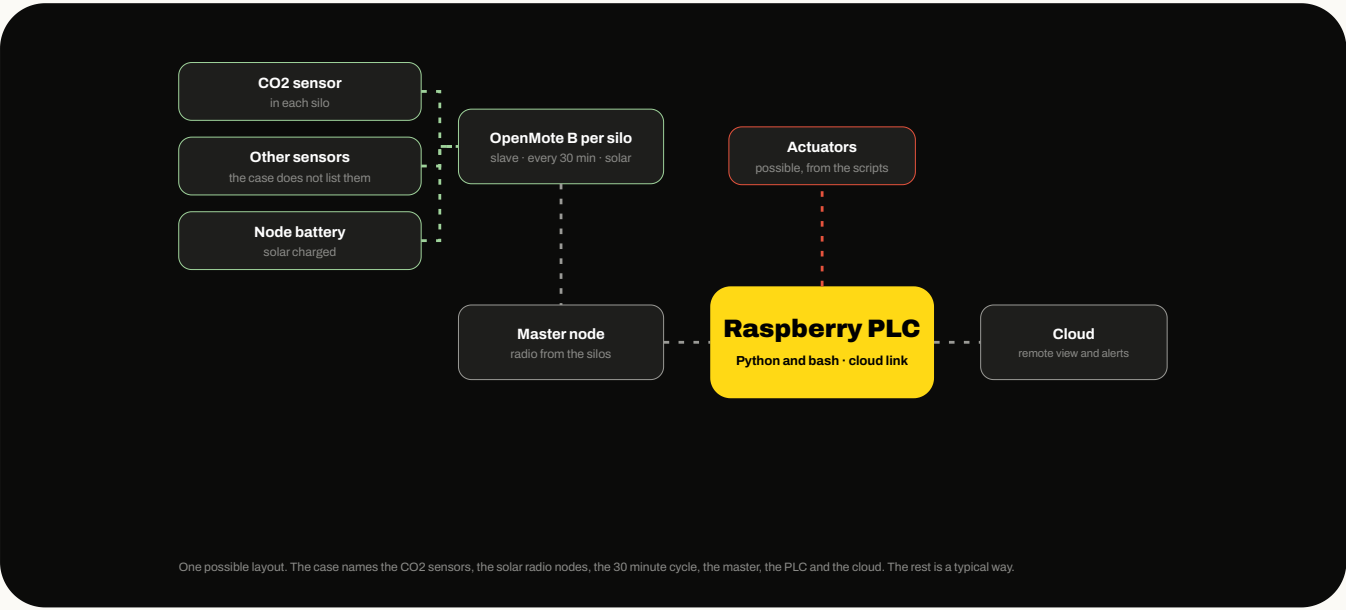
Only the silo that changes needs a visit.

With every silo on one screen, the farmer sees at once which one is moving out of the stable band, and drives there only when it is needed. Follow a week on the farm.

- All silos on one screen
- Warnings by band, per silo
- Fewer trips, earlier action

How do you monitor CO2 in many grain silos with a PLC?

Each silo has an OpenMote B radio node with a CO2 sensor and other sensors, powered by a solar panel. Every 30 minutes the slave nodes send their readings by radio to a master node, which passes them to a PLC connected to the cloud. Scripts in Python and bash process the data, show it remotely and can drive actuators. In the original layout the radio works at 868 MHz.



— Sensors and nodes — Outputs — Radio and cloud

Signals

Signal	Between	Type	Purpose
CO2 of the grain	Sensor → node of the silo	Sensor on the node	Key indicator of grain quality
Other values	Other sensors → node	Sensor on the node	The case says "not only CO2"
Readings every 30 min	Slave nodes → master node	Radio, unlicensed band	No wiring between silos
All readings	Master node → PLC	Local link	Processing in Python and bash
Remote view and alerts	PLC → cloud	Internet	Check the silos without driving to them
Battery state	Node → master (typical way)	Radio	Warn before a battery runs out

Solar radio nodes and a Linux PLC.



CURRENT OPTION

RASPBERRY PLC CPU-Gateway FLEX

The case names a PLC connected to the cloud, programmed with Python and bash scripts, and does not publish the model.

Role in this design	Receives the master node, runs the scripts, sends the data and the alerts
Compute	Raspberry Pi 4, quad core 64-bit, 1.5 GHz, 2, 4 or 8 GB RAM
Ports	1 x Gigabit and 1 x 10/100 Ethernet, Wi-Fi, Bluetooth LE, 2 x USB 2.0, 2 x USB 3.0, 2 x RS-485
Expansion	One optional board: CAN, LoRa or 4G (LTE-M/NB-IoT or LTE Cat 4)
Software	Debian 64-bit preinstalled; runs Python, Node-RED and C/C++

If the same PLC must also drive fans or other actuators at the site, the [RASPBERRY PLC 21 FLEX](#) adds 13 inputs and 8 outputs. Where there is no wired internet, the 4G board gives the cloud link.

[See the CPU-Gateway FLEX ›](#)


OpenMote B (image from the original case)

One OpenMote B per silo, in slave mode, with its sensors and a solar panel.

Sensors	CO2 and others; the case does not list them
Cycle	Read and send every 30 minutes
Radio	Unlicensed band; 868 MHz in the original layout
Power	Solar panel, no battery changes
Expansion	Free ports for more sensors or actuators

OpenMote B is no longer in the Industrial Shields catalogue. The pattern still applies: low-power radio nodes, one master and a Linux PLC.

[Ask about the nodes ›](#)

One number that means something

CO2 bands tell stable grain, mould starting and severe damage apart, as the research in the case shows.

No cables across the farm

Radio between silos and solar power on each node, so a silo far away costs no trench.

Slow is enough

Grain changes over hours and days, so a reading every 30 minutes is enough and keeps the nodes in low power.

SIMILAR PROJECT?

Tell us about your silos. An engineer will answer.

Tell us how many silos or stores you have, how far apart they are, what you want to measure and where the data must go. We will tell you which nodes, which radio and which controller fit.

READ IT ONLINE

industrialshields.com/case-study-grain-silo-co2-monitoring-wireless-sensors

EMAIL

info@industrialshields.com

PHONE

[\(+34\) 938 760 191](tel:+34938760191)