

O-Seal

Pioneering a new discipline of water infrastructure:

Autonomous in-pipe fracture sealing, making sure clean water gets to the crops that feed us all.



Solving Food Insecurity Through
Water Infrastructure

Our Team



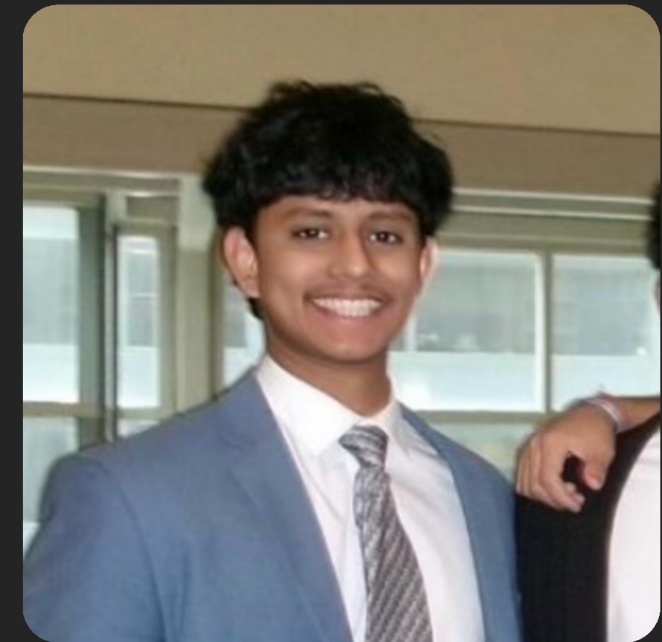
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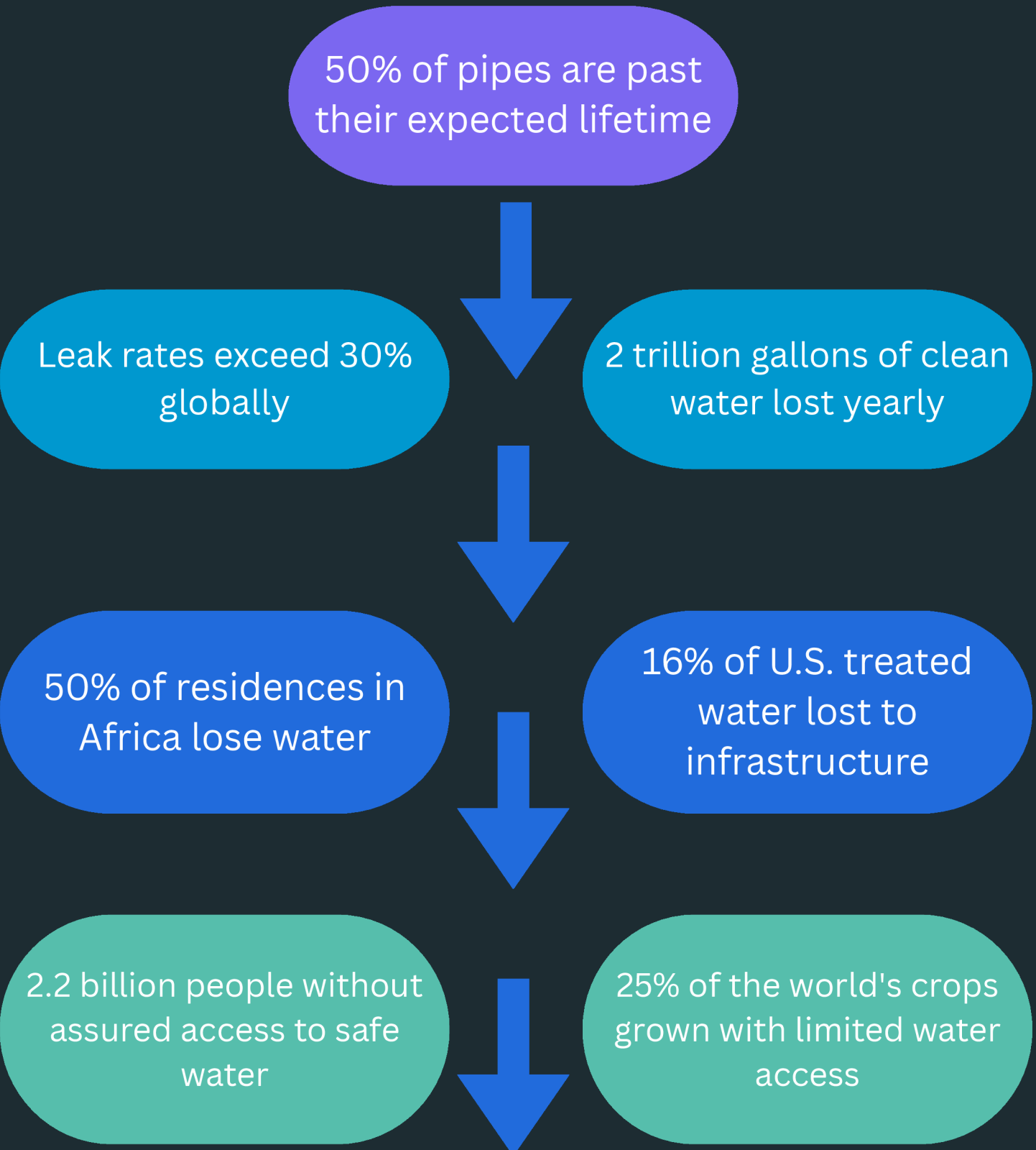
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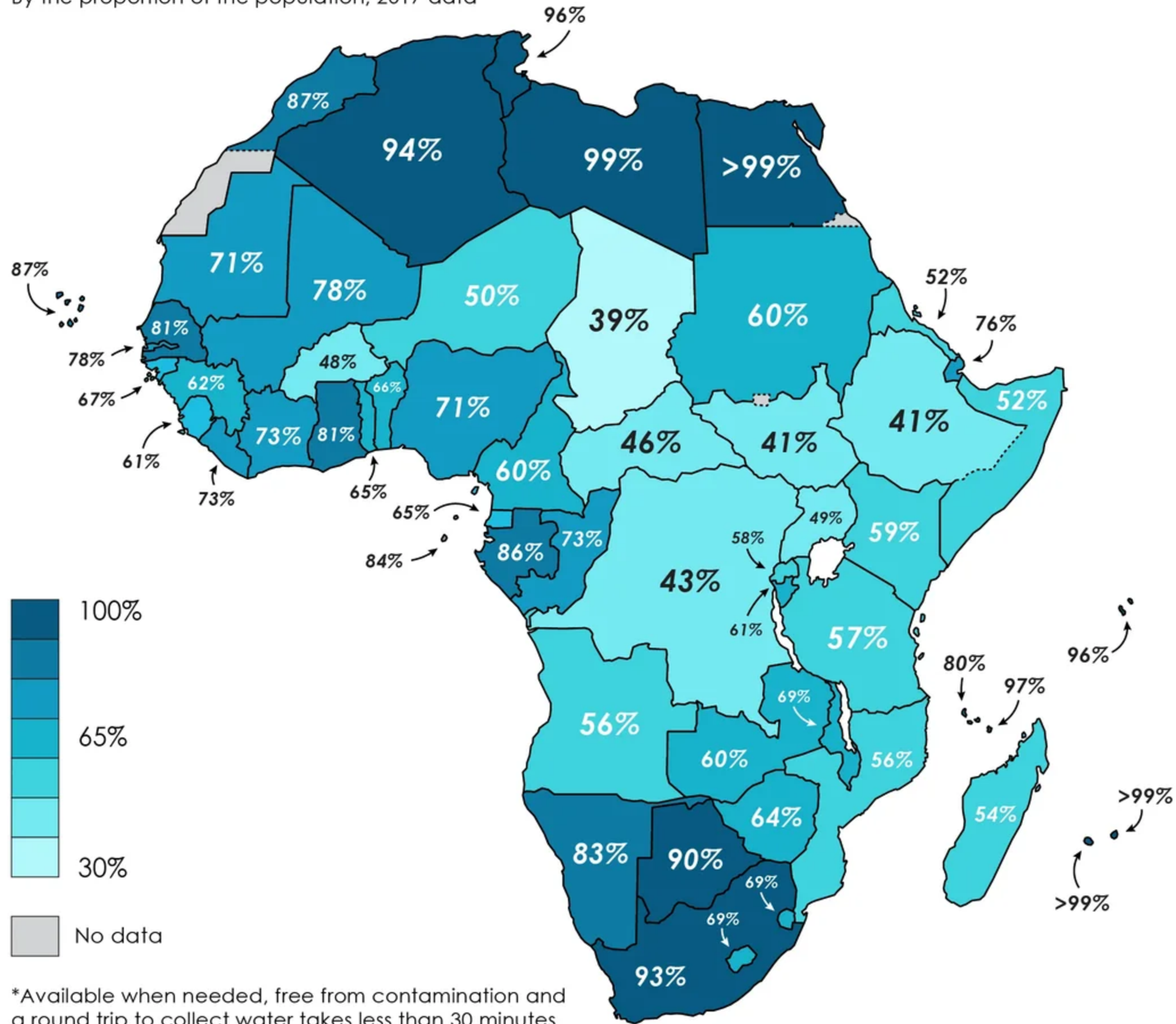
The Food Crisis Hidden Underground

870 million people face food insecurity.
The cause is hiding underground.



Access to at least basic drinking water services in Africa*

By the proportion of the population, 2017 data



*Available when needed, free from contamination and a round trip to collect water takes less than 30 minutes

Source: WHO, World Bank for Central African Republic and Eritrea

O-Seal: The Overview



1

25% of the world's crops depend on water systems that lose over 2 trillion gallons yearly to pipe fractures - directly threatening global food supplies. O-Seal is a torus-shaped inflatable device that enters pipes of inner diameter 5-30 inches, detects cracks, and creates a watertight seal, keeping that water in the system and on the field.



An O-Seal prototype in testing, inflating in a pipe and sealing up a crack.

2

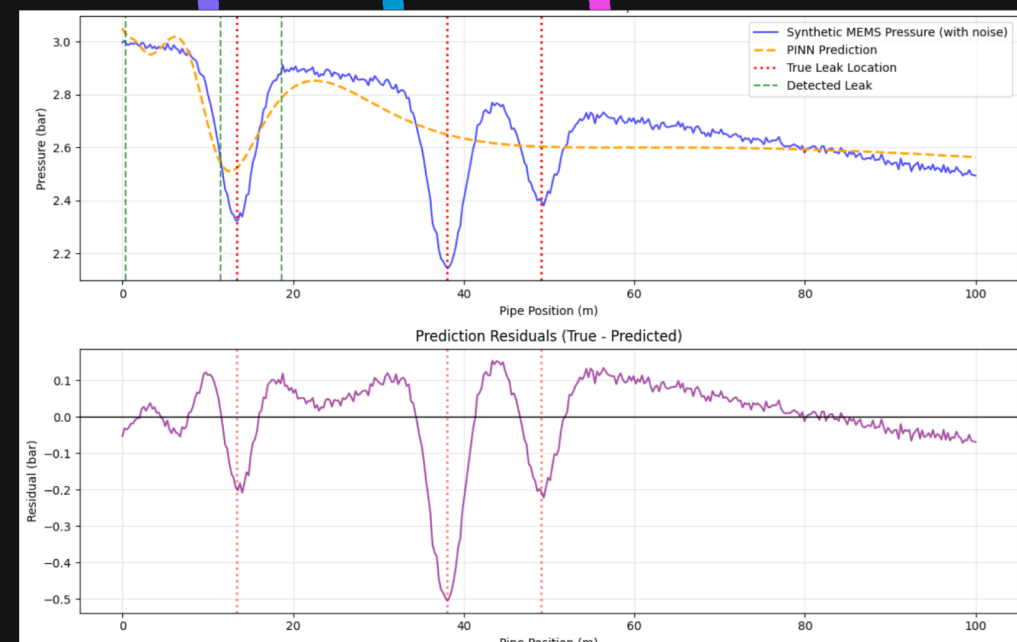
O-Seal flows with the water until its sensors detect a pressure drop. The outer ring then inflates against the pipe wall, sealing any cracks, while water continues flowing freely through the open center of the torus. This means zero supply interruption while the leak is actively contained.



A simulation showing how an O-Seal expands and stops cracks, allowing water to flow through.

3

Prototype seals 100% of leakage within 14 seconds and holds position against flow — demonstrated in bench testing. Can release, reposition, and reinflate autonomously.

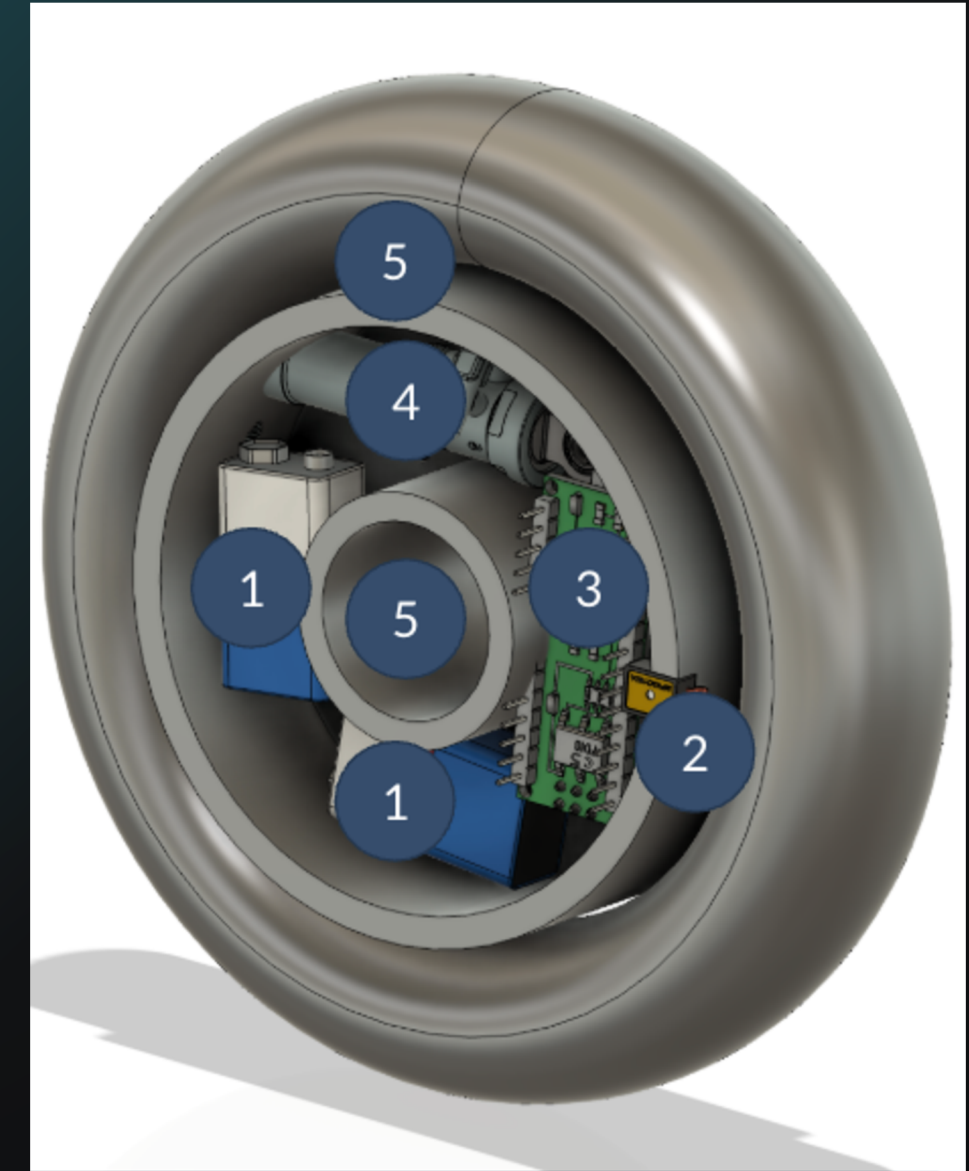


Water contamination and loss is one of the main causes behind mass crop death.

Our computation system, a Physics Informed Neural Network, is extremely accurate at detecting cracks.

The Functionality I

1. O-Seal is powered by a **500mAh Li-Po battery**. Full power budget: deep sleep ($14\mu\text{A} \times 99.7\%$ duty) + active pressure polling ($130\text{mA} \times 100\text{ms}$ every 60s) + acoustic heartbeat ($30\text{mA} \times 50\text{ms}$ per hour) = 0.23mA average draw – 89-day calculated lifespan, rated at 45 days, against a 30-day retrieval window.
2. It can track external water pressure using **pressure sensors**.
3. Pressure information feeds into the central computer, which determines whether there is a significant pressure loss using a **Physics Informed Neural Network (PINN)**, pre-trained on **physics-based fluid dynamics simulations** (Navier-Stokes equations) as a universal baseline, then refined using **real-time pressure readings** collected by the device itself during deployment, requiring **no existing digital infrastructure** at the installation site. The PINN distinguishes crack-induced drops from normal events such as valve closures and demand surges by analysing their spatial pressure gradient and waveform propagation speed: each event type produces a distinct, identifiable signature.

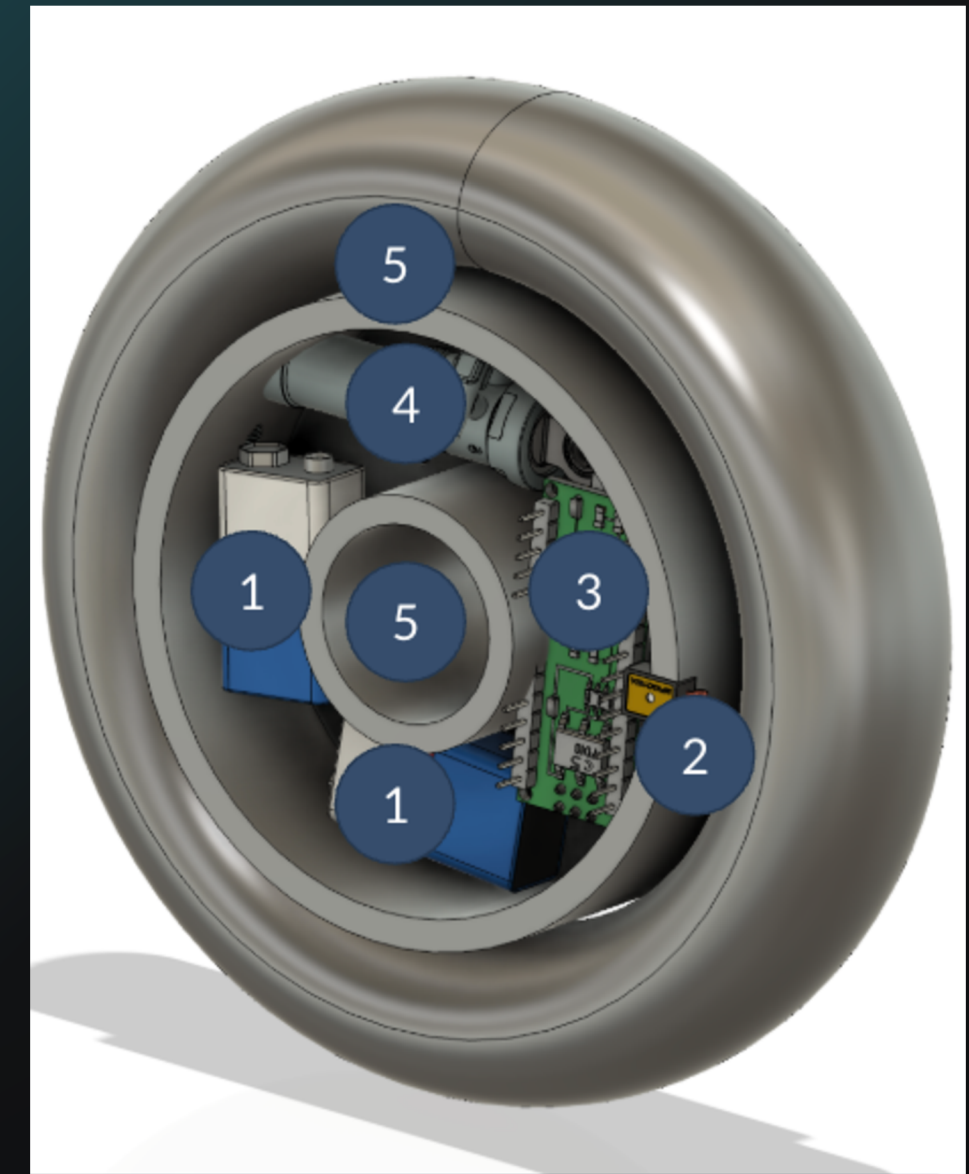


The Functionality II

4. If a significant pressure drop is detected, the O-Seal expands its **outer flexible ring** within **milliseconds** by using a **miniature powerful air compressor unit**, as well as a single-use CO₂ cartridge backup, which fires only on compressor failure. Units that CO₂-inflate are flagged for priority retrieval and refitted with a \$2 replacement cartridge before redeployment.

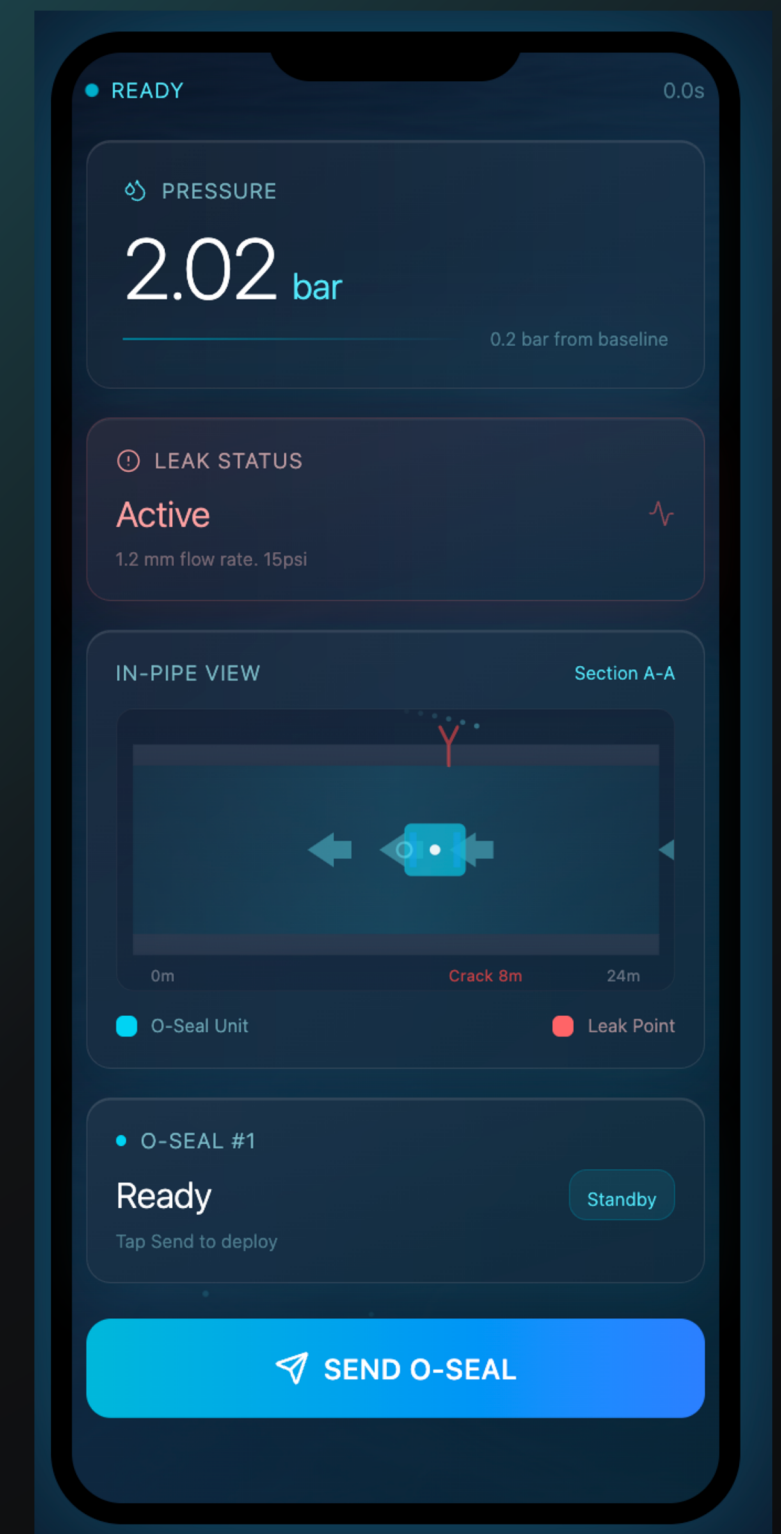
5. O-Seal is designed for **straight-run and gradual-curve pipes (5–30" diameter)**. T-junctions and sharp elbows are outside current scope. The **companion app** uses **pressure mapping** to identify crack systems and directs deployment. Water flows through designated regions to ensure continual access while mitigating loss.

Units deflate on either app command or autonomously before approaching known valve locations. All water-contact materials follow NSF/ANSI 61 standards for water system components. The ESP32-S3 communicates through the pipe wall via low-frequency acoustic pulses through the piezo transducers. Reliable through-wall transmission across pipe materials (PVC, cast iron, and concrete) is a named Phase 2 development milestone; initial bench validation is currently underway.

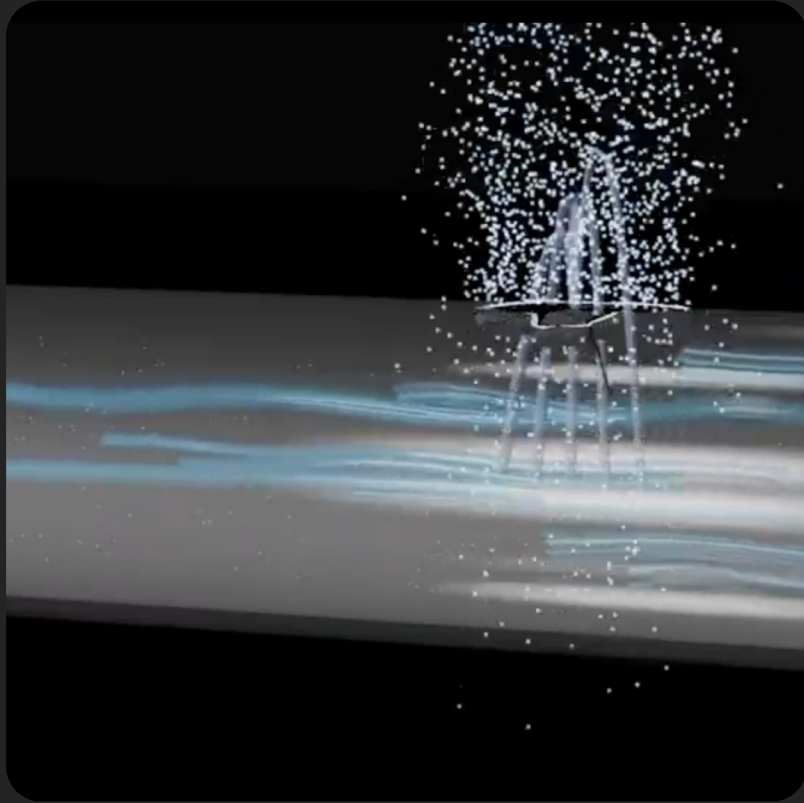


The Functionality III

- O-Seal comes with a **partner app**, which can communicate with **all of the active O-Seals** in a given water provider's constituent region.
- The app has in-built tutorials in a **variety of languages** to teach pipeline managers how to interact with their O-Seals **remotely**. It operates **offline-first** with **automatic data sync** when connectivity is available. **No continuous internet** is required, making it **accessible to cooperative operators** in low-connectivity rural areas.
- Given local data on pressure losses and standard parameters for water levels, it can also recommend **deployment schedules and locations**, and even **coordinate with other O-Seals** to seal **large cracks or crack systems**.
- Simply select your procedure, place the O-Seals into the pipeline, let the water carry them away, and watch as the **cracks seal!**

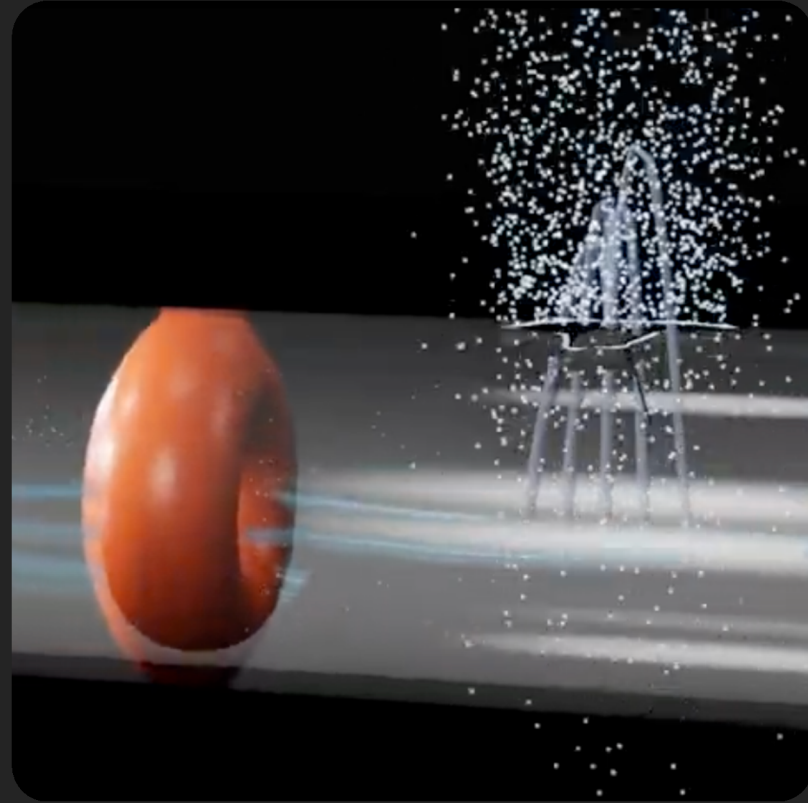


The Process



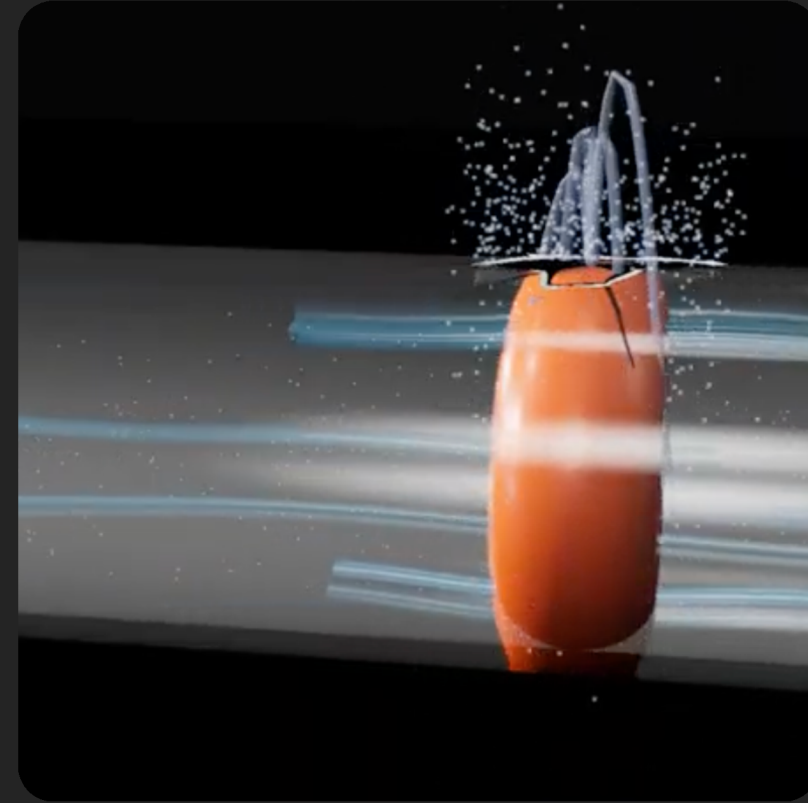
Stage I

A leak occurs. Users report lack of water or decrease in water pressure.



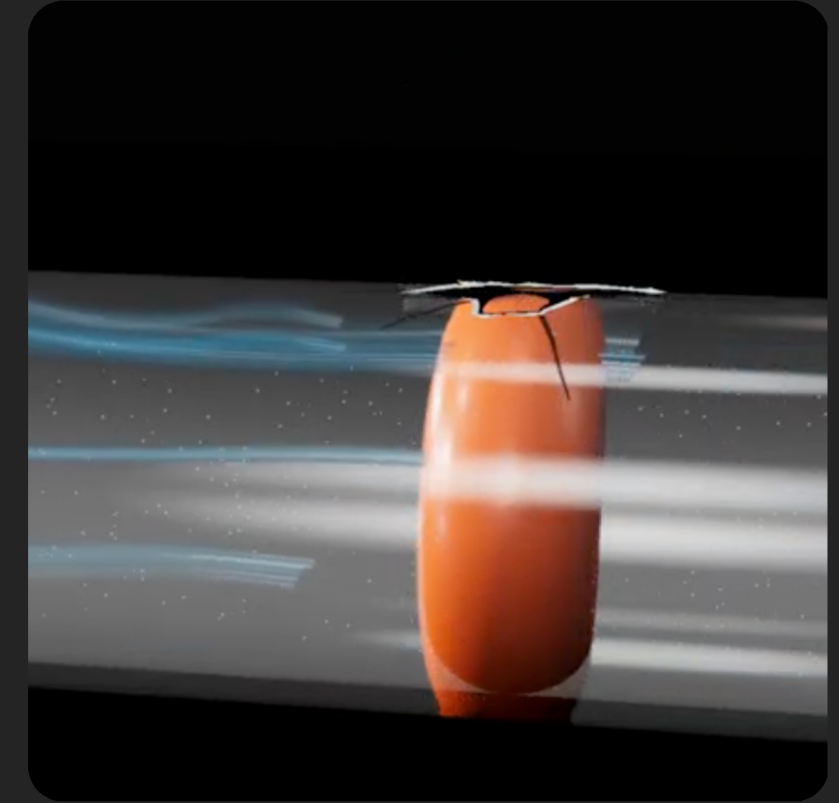
Stage II

An O-Seal is deployed, ready to inflate to the full diameter of the pipe.



Stage III

It uses its sensors to detect the crack and inflate, stemming the loss of water.



Stage IV

The O-Seal has inflated and is only allowing water to pass through its center.

The Numbers

Startup capital (patent fees, distribution setup, etc) - \$25,000 seed grant (WaterAid, UNICEF, USAID) covers patent filing and initial tooling. First production run of 250 units (~\$53K first-run manufacturing cost) will be funded through pre-committed NGO pilot purchase orders, with units delivered on a net-30 basis.

ESP32-S3 MCU board - \$15
Pressure sensors (3) - \$30
Li-Po battery + BMS - \$12
Solenoid valve - \$18
CO2 cartridge system - \$10
Piezo acoustic transducers - \$12
Custom PCB fabrication - \$25
3D printed chassis - \$20
Silicone and membrane - \$30
Fasteners, seals, wiring - \$10
Misc electronics - \$18

- **Total unit cost - \$200**
Retail price - \$300

33%

Profit Margin

\$100

Per-Unit Profit

3.5 Million

More Irrigated Acres

of Farmland*

*(projected at full global municipal deployment, per WHO & EPA loss data)
Equivalent to sustaining approximately 3.5 million acres of irrigated cropland annually (USDA avg. 1.5 acre-ft/acre)

O-Seal's Impact

O-Seal Can:

Bring clean water to billions

By ensuring that external silt and mud is unable to enter the water, and that pipe cracks **do not incur shortages**, we stand able to **ensure clean water** for whole ecosystems.

Ensure crop survival in harsh summers

By making **water access dependable through harsh summers**, O-Seal is able to nurture crops at their most **crucial** time, **preventing scarcity and increasing yield**.

Save millions of lives

By **providing clean water** to people worldwide, O-Seal is able to **reduce water-related diseases** and save up to **3.5 million people yearly** (WHO, 2023).

Ethical Considerations

When to Deploy

O-Seal deploys only when local water authorities authorize it.

If residents report limited access, authorities assess pressure data and determine whether deployment is warranted.

Control over scheduling never leaves local hands.

Number to Deploy

The partner app recommends deployment quantities based on crack severity and local data, but authorities make the final call.

Budget, available units, and infrastructure priority all remain the authority's determination. We never automate quantity decisions without human approval.

When Something Goes Wrong

Each unit self-monitors and alerts the app and nearby units to any irregularities. Units are rated for 30 days minimum with a 45-day expected lifespan.

Retrieval uses two methods: mesh collection gates retrofittable in 1–2 hours, or existing pigging access ports. The app flags any unaccounted unit within 48 hours via heartbeat signal. Units that miss collection are fully recyclable.

Disposability

O-Seal is a short-term intervention designed to bridge the gap before full pipe repair is possible.

Emergency shutdowns and excavations can cost tens of thousands: an impossible burden for underserved communities.

All components are disposable and fully recyclable through standard e-waste and silicone programs.

Competitors



Eddyfi Technologies provides advanced **in-pipe inspection tools** that **detect** leaks and damage but **cannot repair** them.

It is also **extremely expensive** and **unrealistic** for **impoverished communities**.



Echologics (a Mueller Water Products subsidiary) uses acoustic sensing to locate leaks but **cannot seal them** - still requiring **separate excavation** and **days of downtime**. O-Seal **detects and seals** in a **single autonomous deployment** at a fraction of the combined **inspection + repair cost**.

O-Seal's Advantages

1

Autonomous detect-and-seal in one deployment.

2

No excavation and limited downtime.

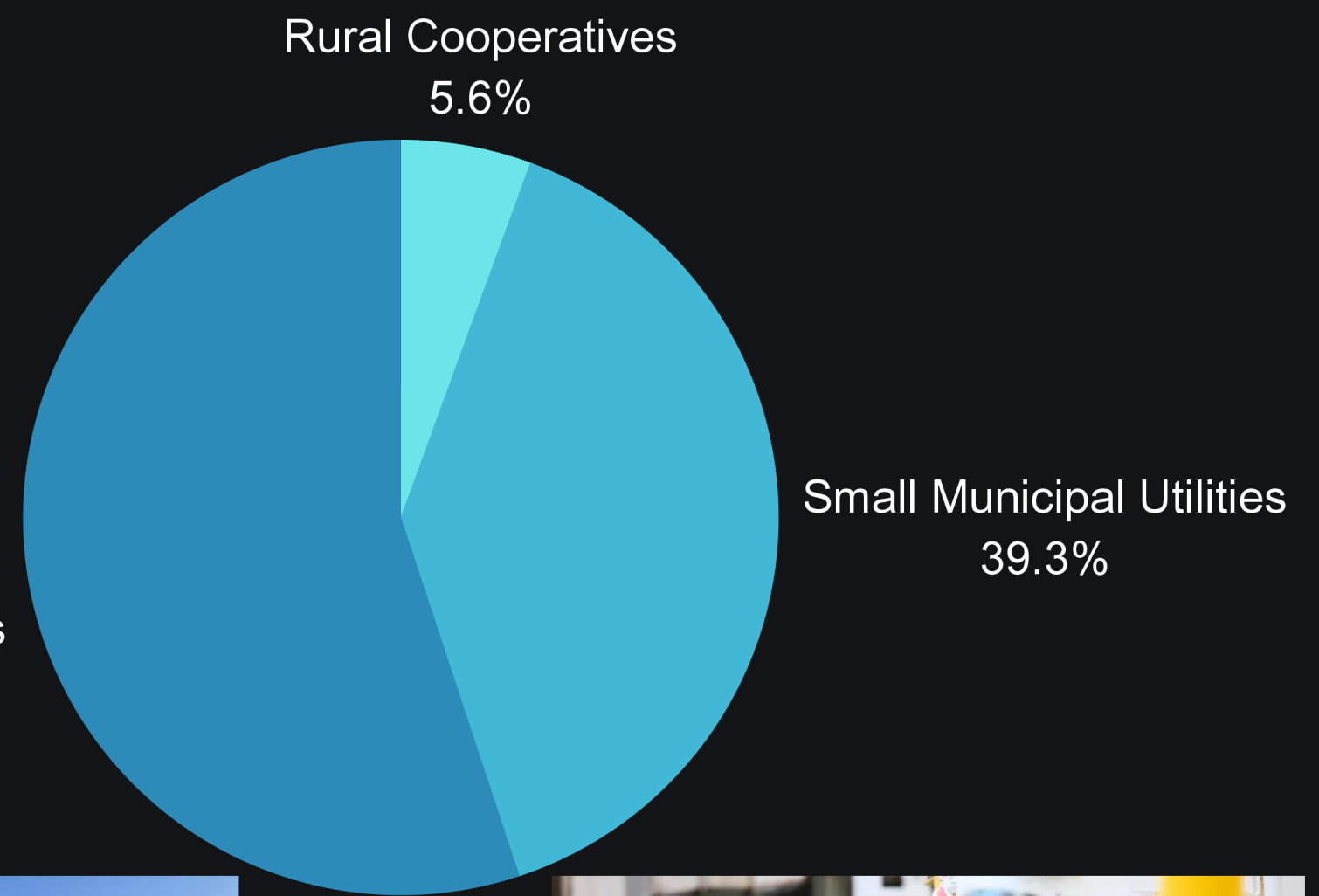
3

Affordably priced at \$300

4

Works in almost any pipe, anywhere

Target Markets



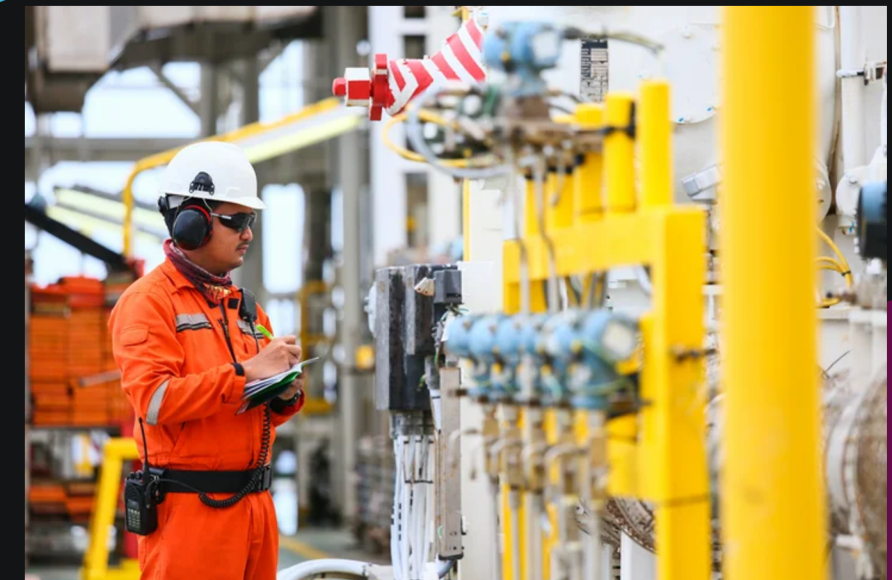
Rural Cooperatives in Sub-Saharan Africa

Size: 186,000 systems
Possible Revenue: \$17 million



Small Municipal Utilities

Size: 5,000 cities
Possible Revenue: \$120 million



Industrial Pipeline Operators

Size: 50,000 facilities
Possible Revenue: \$168 million

Marketing Strategy

NGO Partnership & African Pilot Program

- Publish paper, patent design and reach out to and partner with 3-5 rural water cooperatives in Sub-Saharan Africa through NGOs like **WaterAid** and **UNICEF**.
- Offer **subsidized pilot deployments** to generate impact data and local testimonials. Outreach to WaterAid and UNICEF's **WASH division** is being targeted. Estimated NGO-channel **customer acquisition cost: ~\$2000/customer**. At a typical pilot deployment of 25–50 units per cooperative, the CAC represents **\$40–80/unit** — offset by subsidized pricing covered by grant funding in Phase 1.

NGO Bulk Procurement & Regional Expansion

- Leverage success with NGOs to secure **bulk orders from international development organizations** for larger-scale deployments.
- Establish **local distribution** through African water **equipment suppliers** and demonstrate ROI.

Regional Expansion and Diversification

- Expand to South Asia, Latin America, and small **municipal utilities** with proven **pilot success**.
- Target industrial pipeline operators via direct outreach to facilities **managers** and **operations directors** at **refineries, food processing plants**, and large municipal water authorities.
- Primary channel: **AWWA (American Water Works Association) Annual Conference** and **regional pipeline equipment distributors**. **Volume pricing** at 50+ unit orders.
- **Estimated industrial CAC: ~\$3,500/customer**. At a typical industrial order of 50–100 units, the \$3,500 CAC represents a **\$35–70/unit acquisition premium** — fully recovered within a single deployment contract.

Future Growth

O-Seal's long-term goal is simple: **equitable water access for every person on the planet.**

1

Pilot **data** unlocks enterprise contracts with major water providers. In parallel, we develop a reusable v2 (replaceable CO₂ cartridge, rechargeable battery, re-sealable membrane; **\$15K R&D + \$30K tooling**, targeting Year 2–3, priced \$400–500). Year 1 targets **NGO and rural cooperative systems**, which operate outside municipal regulation; **NSF/ANSI 61 certification and utility review** (a 12–18 month process) begin in Year 1 to **open municipal sales** from Year 2. **Projected: Year 1: 250 units / \$75K (in-house); Year 2: 1,500 / \$450K (contract manufacturing at 500 units enables volume pricing); Year 3: 5,000 / \$1.5M; Year 4: 15,000 / \$6M (v2 launch).**

2

Once established with major providers, pursue congressional mandates requiring O-Seal readiness in water processing facilities - precedent exists in EPA mandates for lead service line replacement under the **Safe Drinking Water Act**. We have already initiated outreach to public officials and are actively expanding those conversations.

3

Partner with governmental agencies, including Public Works departments, the **Department of Agriculture**, and their international equivalents, to standardize O-Seal deployment as a **global water conservation tool**.

Conclusion

What is O-Seal?

- O-Seal addresses food insecurity at its root: failing water infrastructure. It is a torus-shaped device that autonomously detects and seals pipe fractures, ensuring the irrigation water that hundreds of millions of people depend on actually reaches crops and communities.

What is O-Seal's target market?

- O-Seal is primarily focused on three markets: rural sub-Saharan African water cooperatives, small municipal utilities, and industrial pipeline operators.

How is O-Seal profitable?

- O-Seal's components can be produced en masse for \$200, which allows us to sell each O-seal for \$300 at a 33% profit margin, with the option for cheaper units for large purchasing orders.

What are the future plans for O-Seal?

- We are developing a reusable v2 (replaceable CO₂ cartridge, rechargeable battery, re-sealable membrane - \$15K R&D, targeting Year 2) priced at \$400–500 for enterprise contracts, with full commercial launch in Year 4. Longer term, we are pursuing government standardization through Public Works and Agriculture departments worldwide.

