

# WiGL's World Fair 2.0 (WWF 2.0)



**Create / Transmit / Store**

## **Electric Power Reimagined**

**For Immediate Public Release**

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*Version 2.0 – May 11, 2023*

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2. WiGL Network
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Energy Harvesting?
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## II. eENERGY

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# WWF 2.0 – Electrical Power Reimagined



**Transmit / Store**

## **touchless Wireless Power Transfer (tWPT) Networking**

### **3 Exciting 2023 Breakthroughs**



# tWPT Networking



**Wireless Electric Power  
Networks  
as a Mobile Service**

## Welcome to your future – wirelessly powering today



**Gets you wireless internet**



**Gets you wireless power**

## It's all about the network



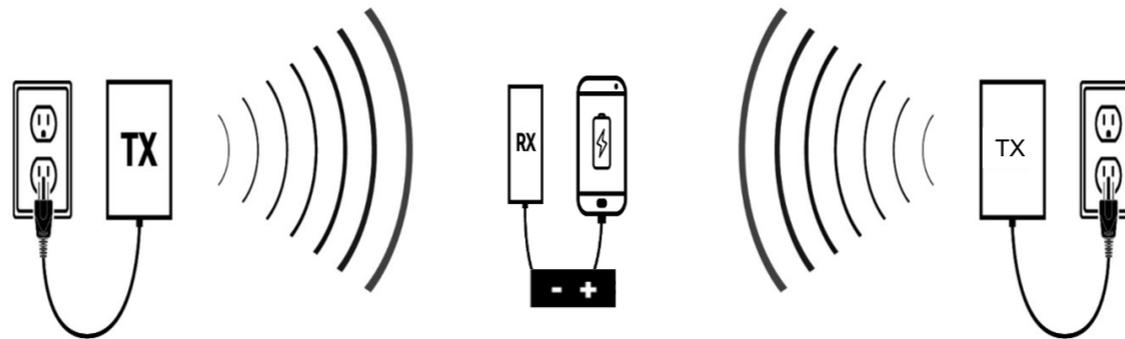
# Overview: What is tWPT?

## tWPT in Laymen's Terms:

Any form of sending and receiving electrical power without the device being recharged or powered touching the power source. The power source and/or transmission of the power can be AC / DC / RF / Laser / Light / etc.

tWPT is both power source and power transmission agnostic.

WiGL-enabled  
2023





# What comprises a WiGL network?

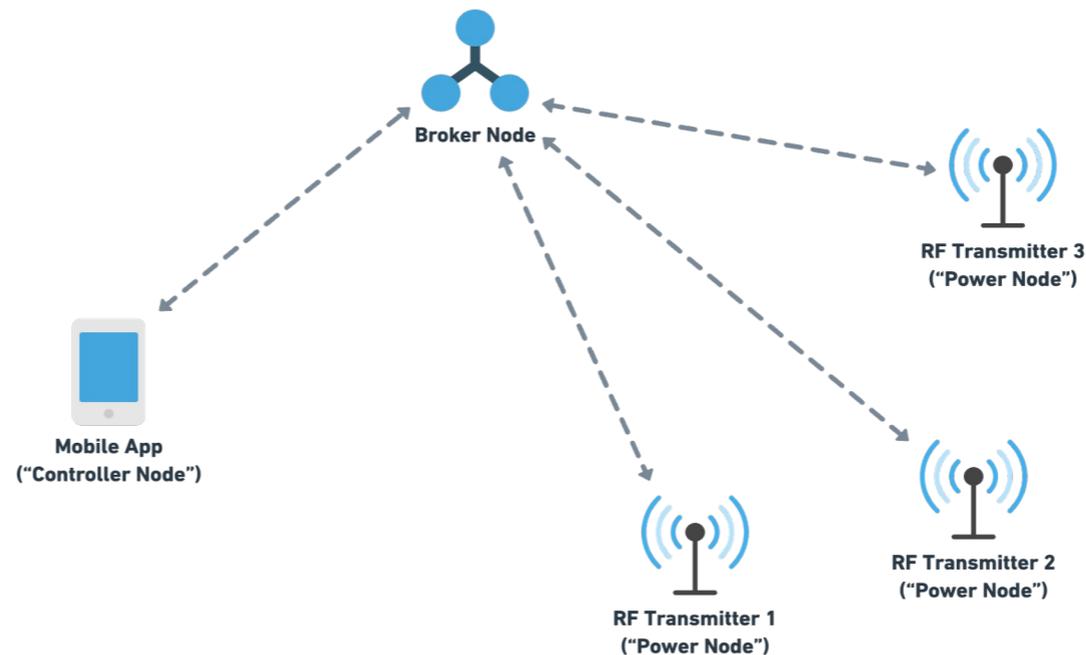
## What is a WiGL-enabled Network?

**Laymen's Terms: Two (2) or more Tx's paired to send power to one (1) or more Rx.**

In the WiGL-enabled Network, there are 3 major node types:

1. The "Power Nodes" that physically switch the RF transmitters ON or OFF and generate RF waves.
2. The "Controller Nodes" that host the user application which interface with the WiGL Network and control the operation of the "Power Nodes".
3. The "Broker Node" that relays information between the "Controller Nodes" and the "Power Nodes"

The link between each of these node types is WiFi or WiFi-like RF.



A minor node type is dummy mode.  
Power on all the time. Two or more Tx's  
communicatively coupled.

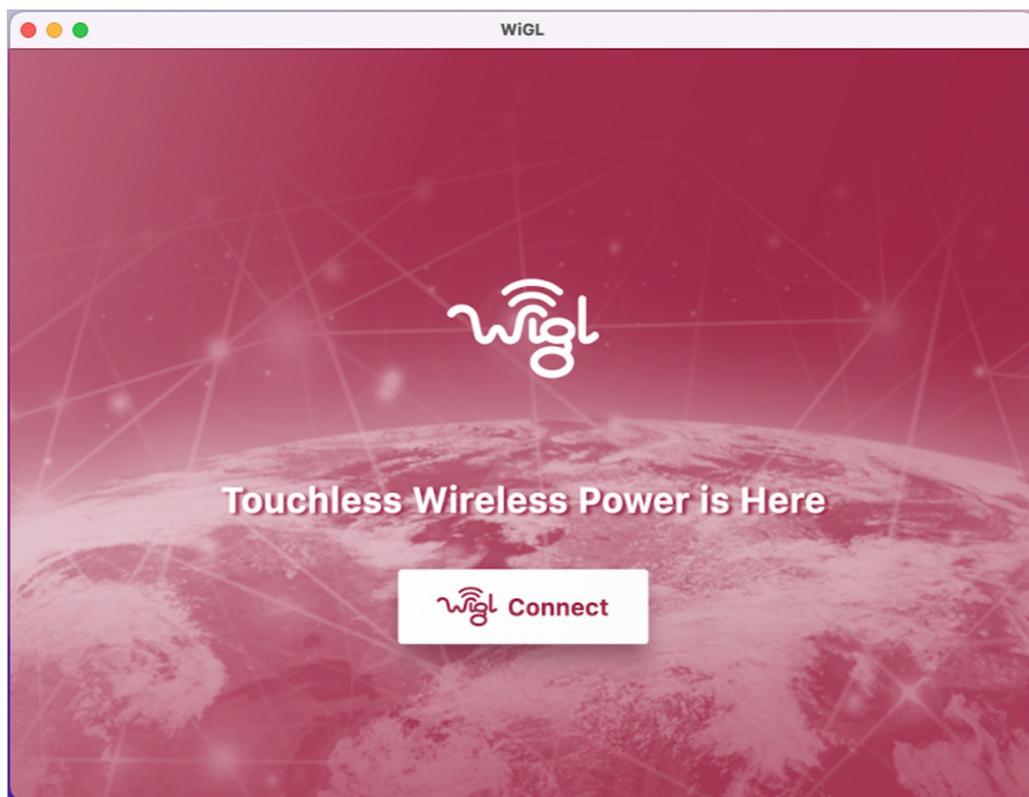


# How to operate the WiGL Network: Modes 1-3?

## Controlling the WiGL-enabled Network

The WiGL-enabled Network is controlled by an end user via the WiGL application running on a mobile phone, tablet, or laptop.

The application supports two modes: manual and automatic.

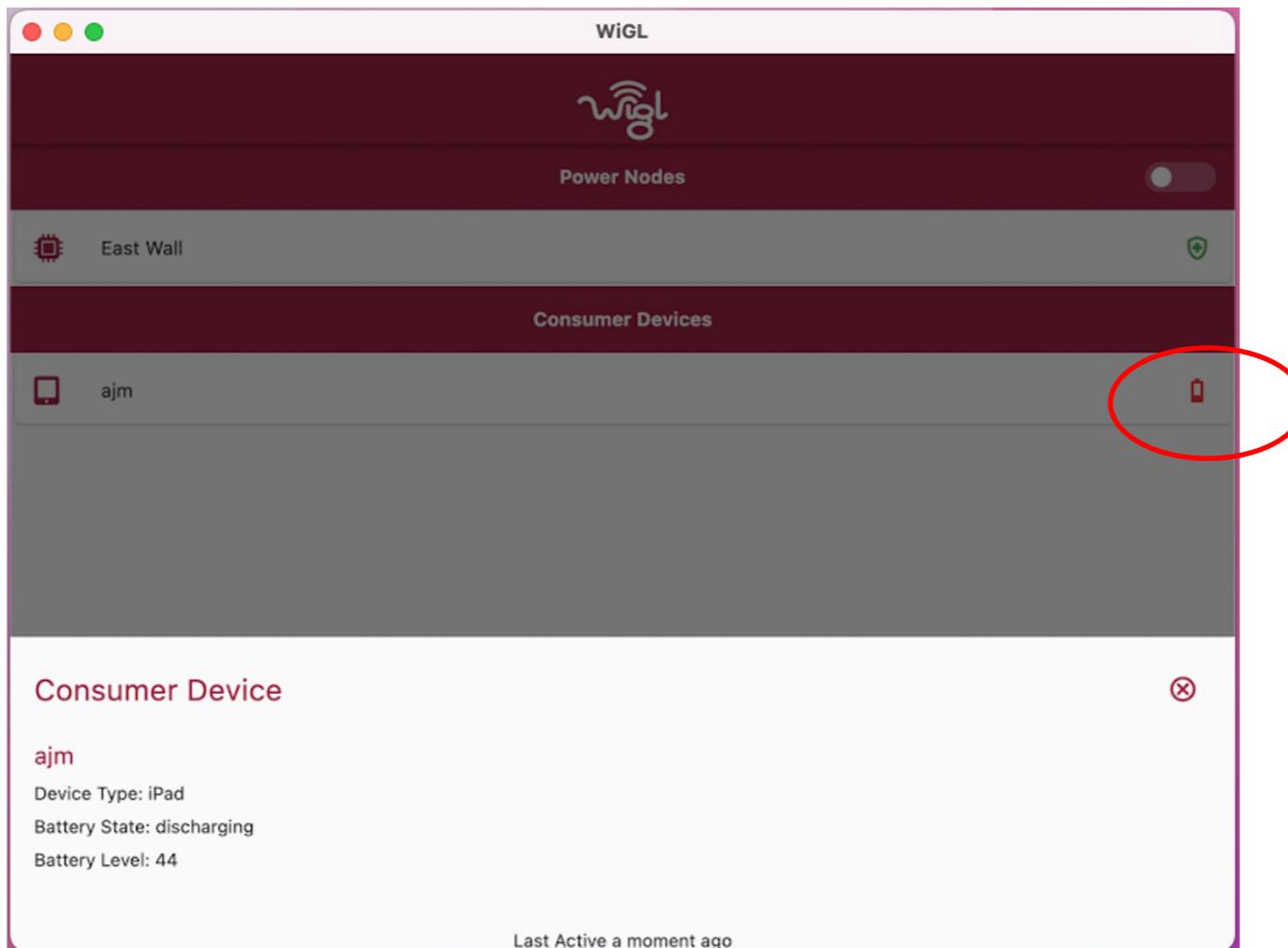




# Consumer Device Battery Level: Modes 1-3

## Device Charge Level

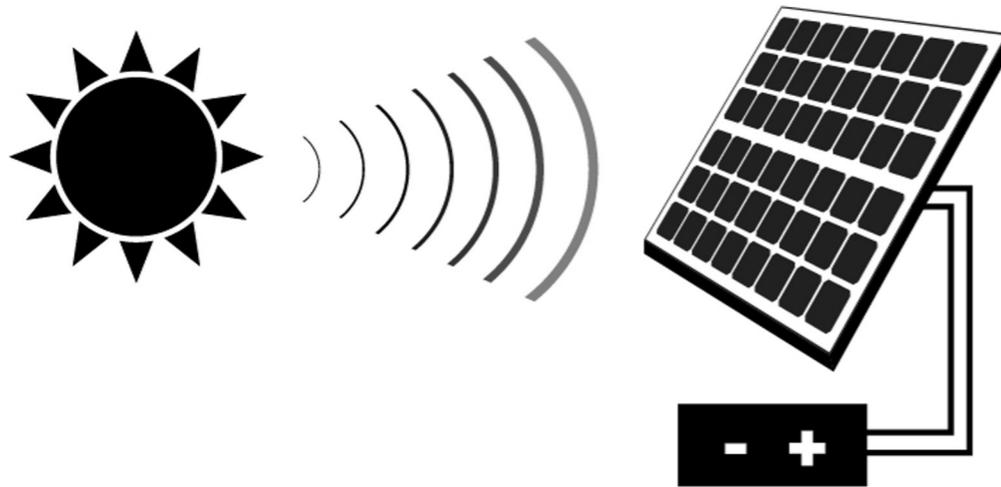
The WiGL app will also read the charge/discharge level of the device the application is installed on (Controller Node).





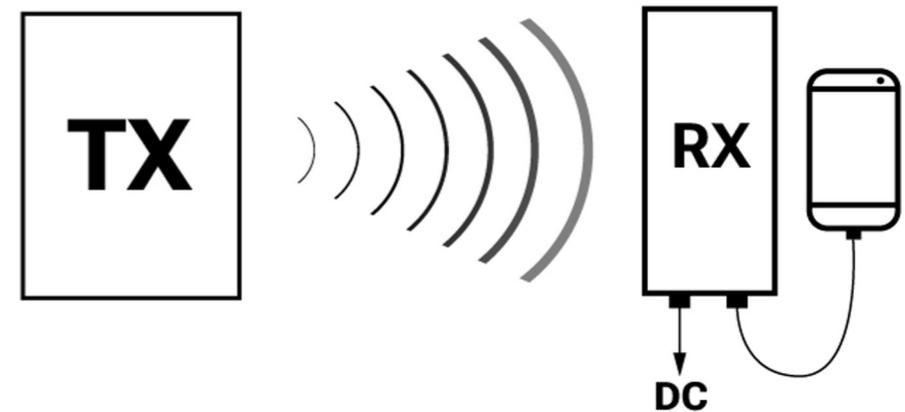
# Hardware: What is Directed Energy Harvesting?

Directing energy using Rx placement (Solar Panel)



The sun is a natural Tx. The Rx is man-made solar panels. Energy is stored in a solar battery (PowerBank).

Directing energy using the Tx placement (Plugged into Power Source)



The Tx sends electromagnetic energy. The Rx converts the energy (RF-to-DC). Energy is used by the device.

NOTE: RF-to-DC Radio Frequency to Direct Current  
NOTE: Without WiGL, the current charge rate using RF-to-DC is too small and too slow for many IoT devices

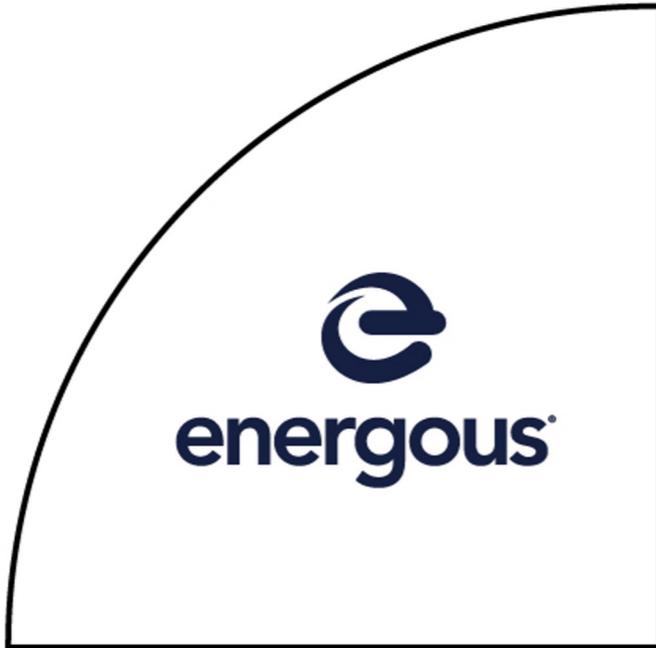
Natural wireless power has been used for decades

tWPT simply uses 100% man-made hardware

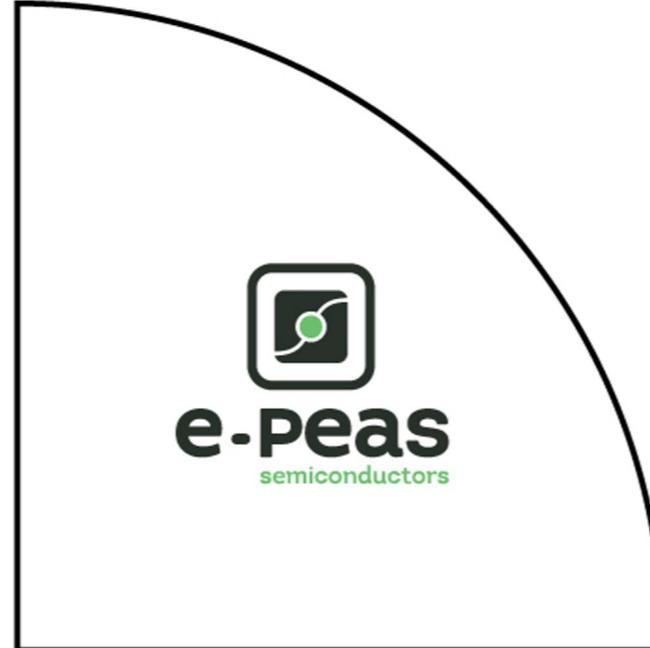


# 2023 tWPT Hardware Landscape

## WiGL Partners



## COTS Suppliers



Multiple companies have already developed hardware solutions for wireless energy transfer and harvesting of RF, Light, Laser, Optical and other forms of energy.

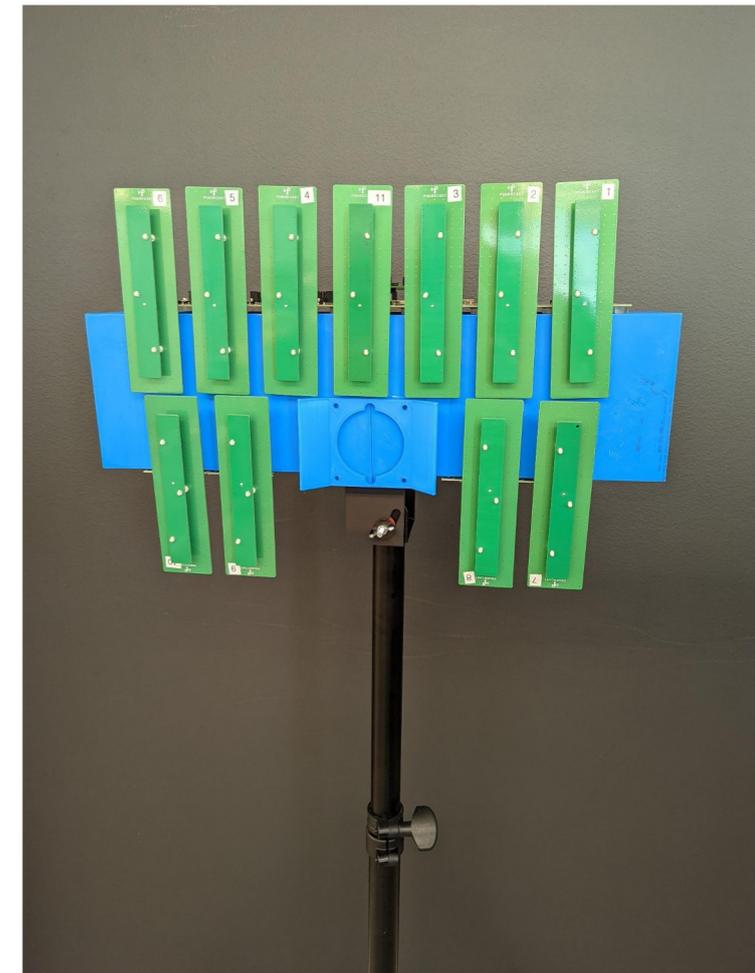
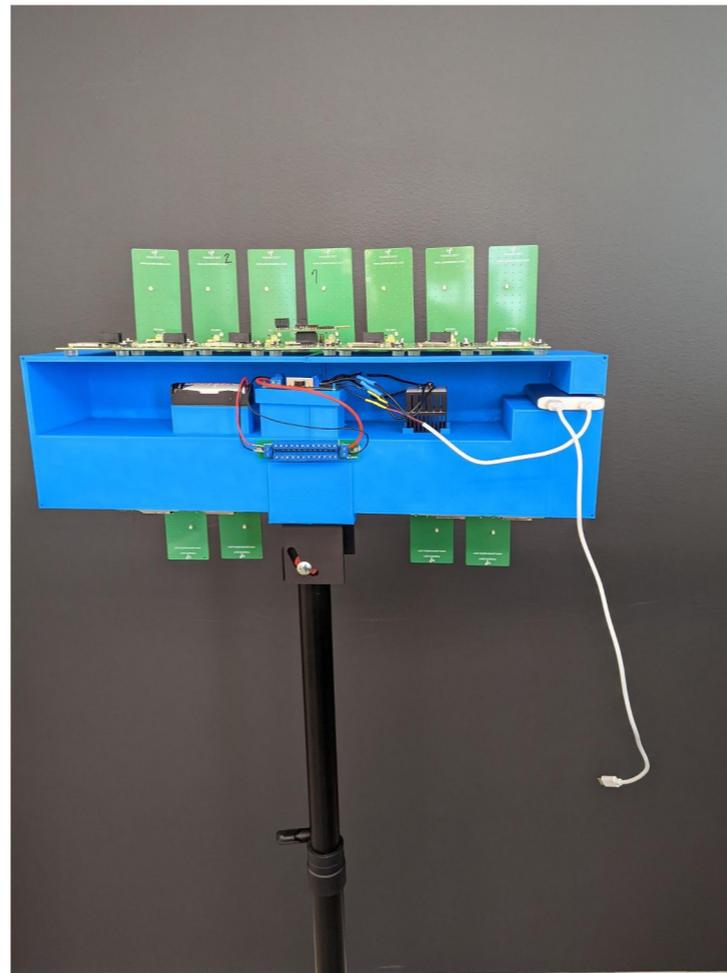
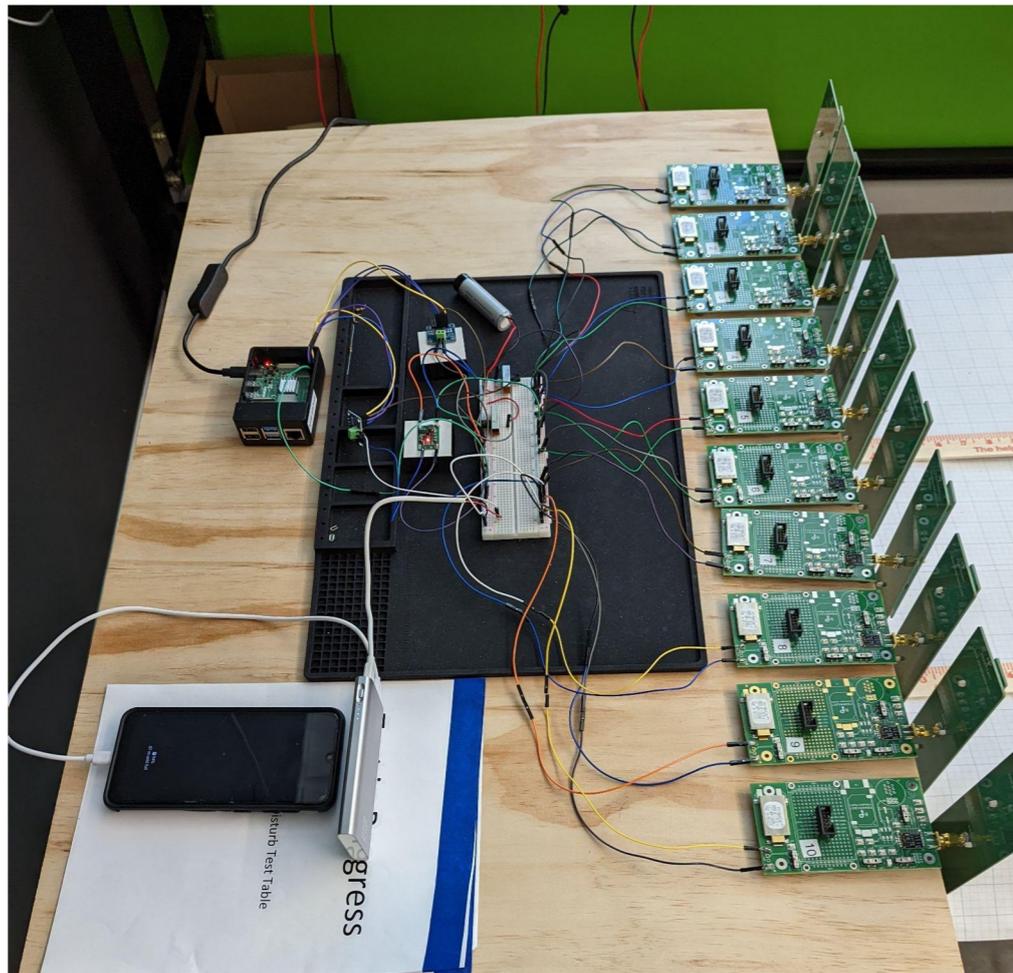
**NOTE:** there are many other tWPT RF hardware providers. WiGL is seeking to add partners to the WiGL-enabled tWPT networking infrastructure.

The more Tx's on the network the larger the coverage size.

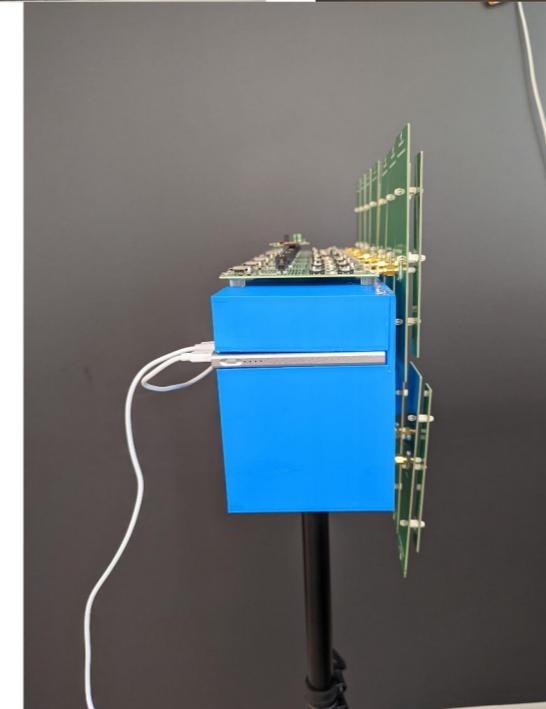
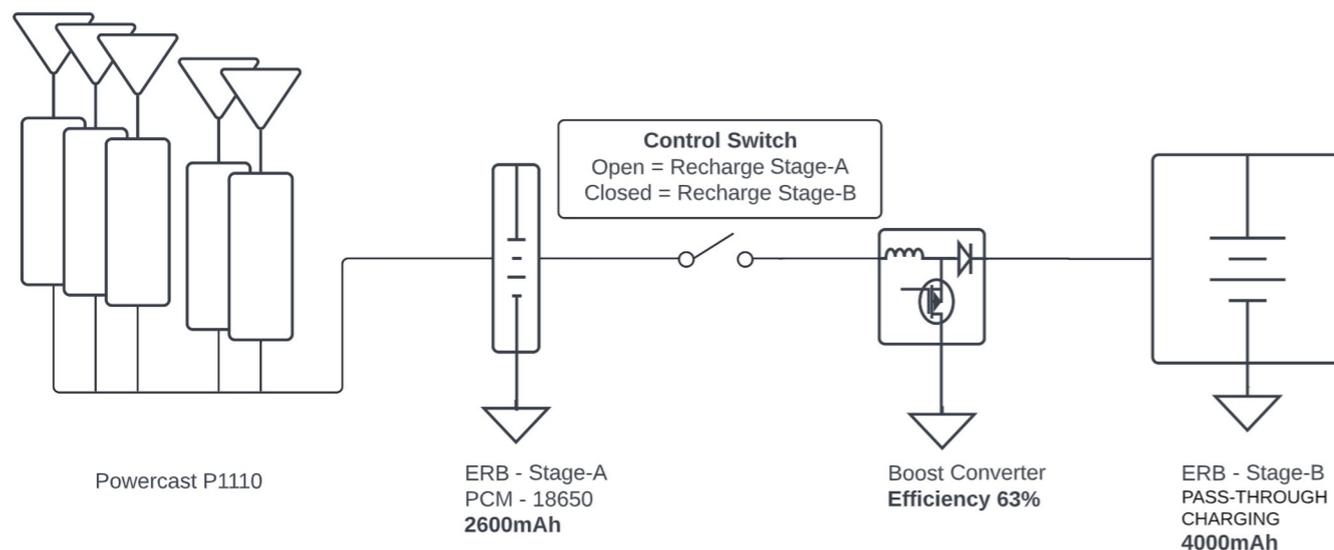
COTS: Commercial Off the Shelf



# Hardware: Generation (Gen) 0.5 External Device (2022)



WiGL - External Device Block Diagram



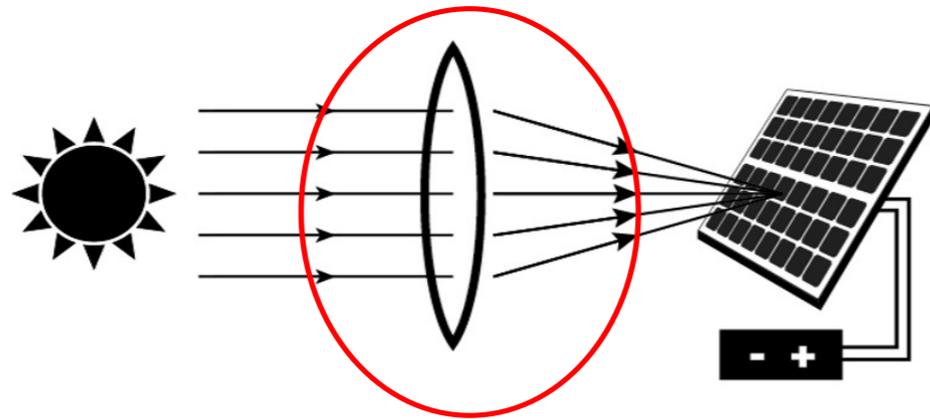
Gen 0.5  
Dimensions:

- Length: 21.5"
- Width: 6"
- Height: 14.5"



# 3 Major WiGL Breakthroughs

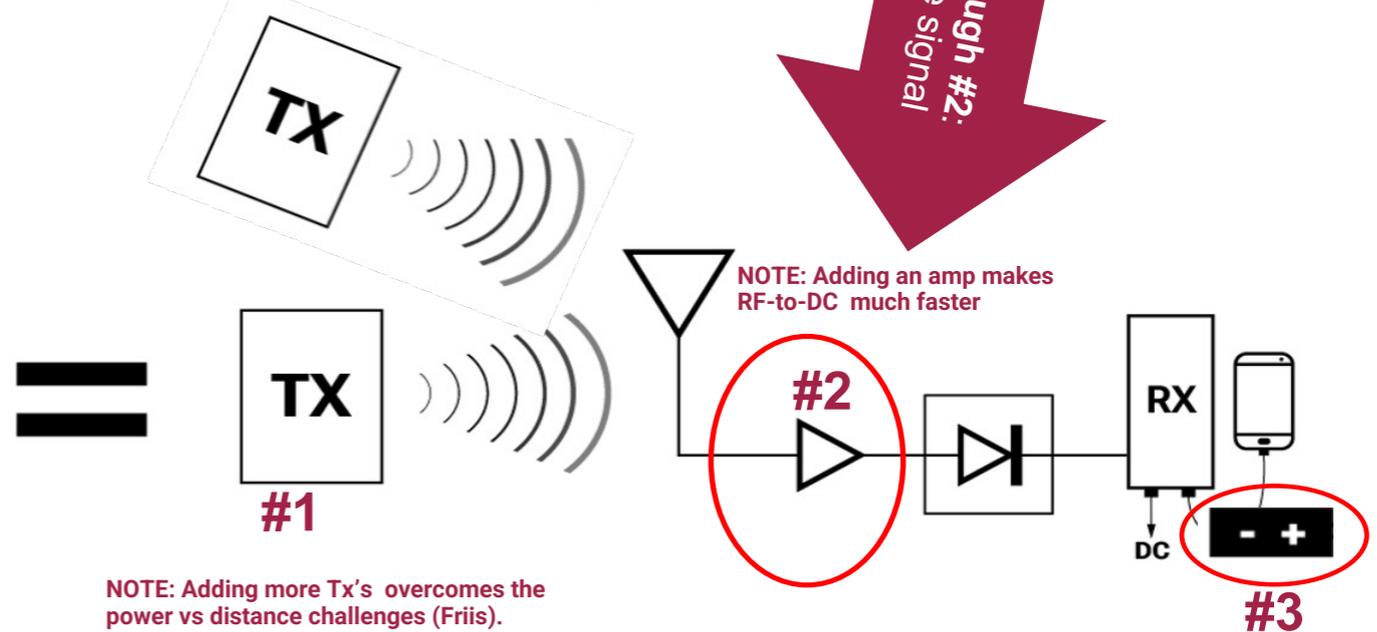
The sun is everywhere



Add a magnifying glass to steer the beam

Amplify & steer the signal, gets more power

Put small Tx's everywhere



NOTE: Adding more Tx's overcomes the power vs distance challenges (Friis).

NOTE: Adding an amp makes RF-to-DC much faster

NOTE: Adding a PowerBank makes recharging IoT devices faster

Breakthrough #1:  
use a network of Tx's

Use a network of Tx's. Add a RF amplifier.

1. A network of Tx's gets around Inverse Square
2. Amplifying the signal, gets more power
3. Adding a PowerBank allows the end user to recharge faster

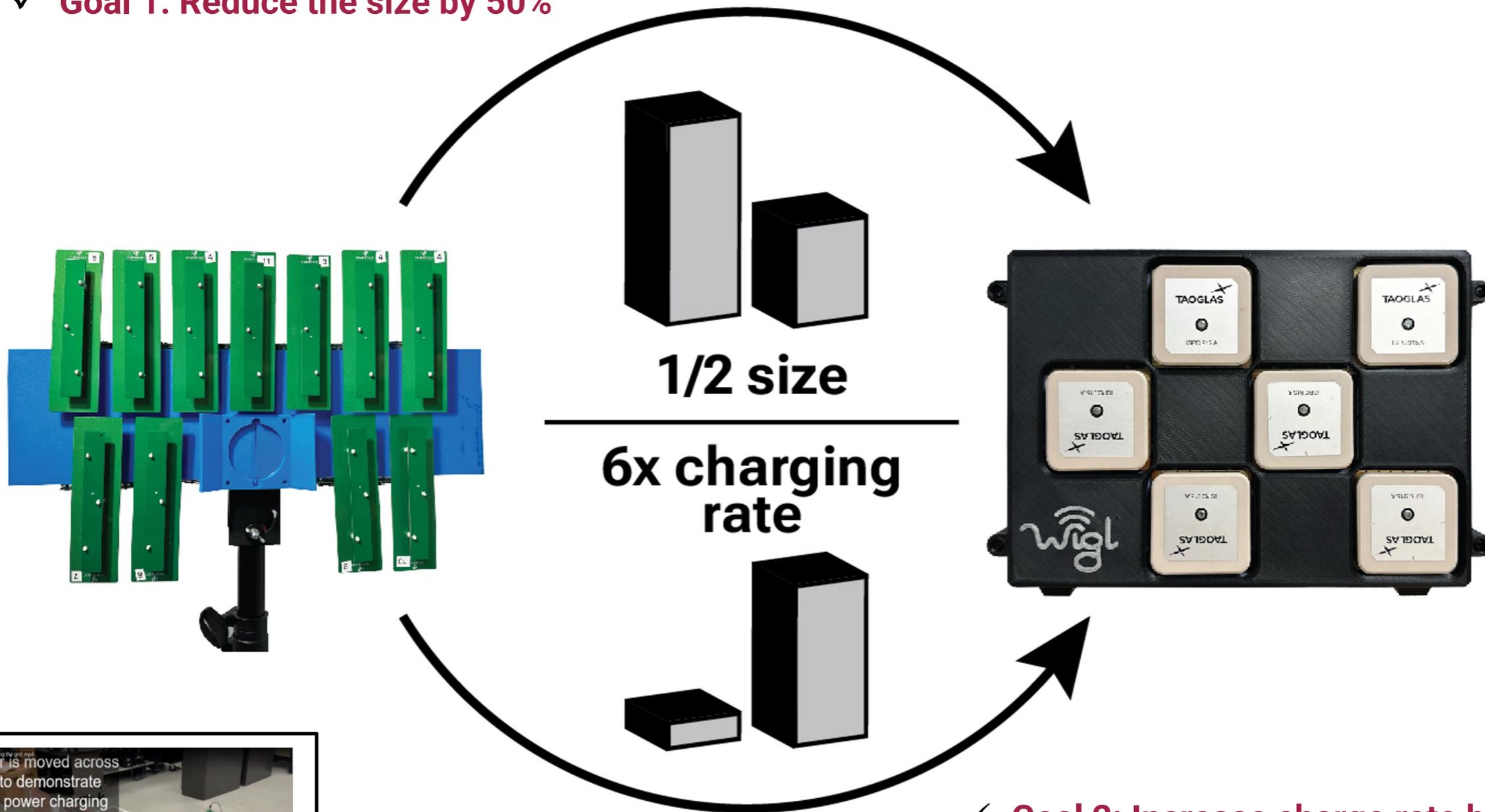
Breakthrough #3:  
Store the power for rapid reuse

NOTE: Amplifying the signal has a cost. There is a managed balance between amplification and harvesting.

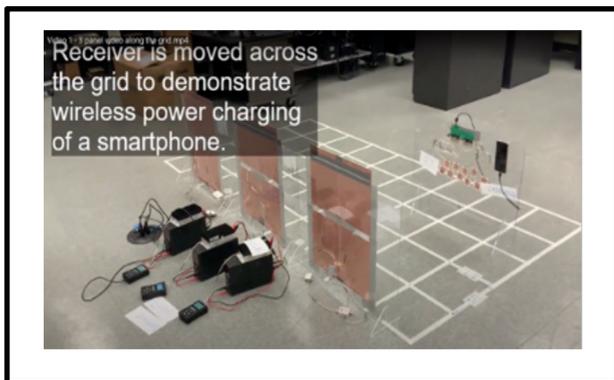


# Hardware: Gen 1 PowerBank (2023)

✓ Goal 1: Reduce the size by 50%



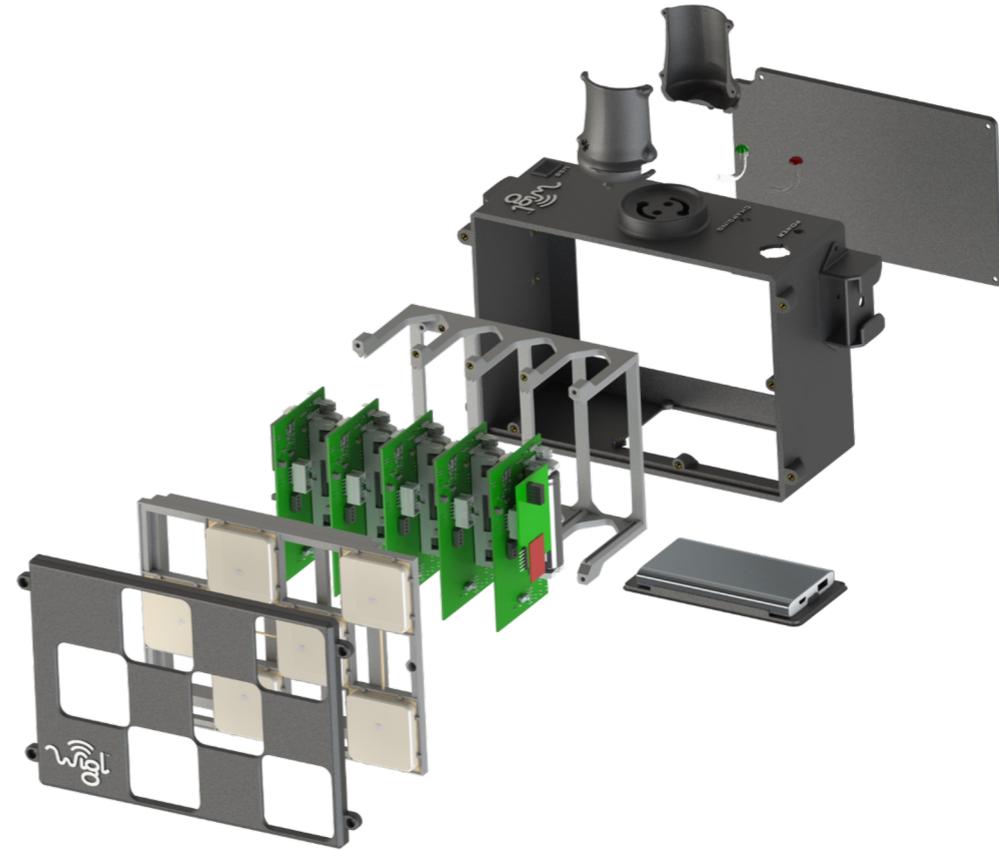
✓ Goal 2: Increase charge rate by 100%



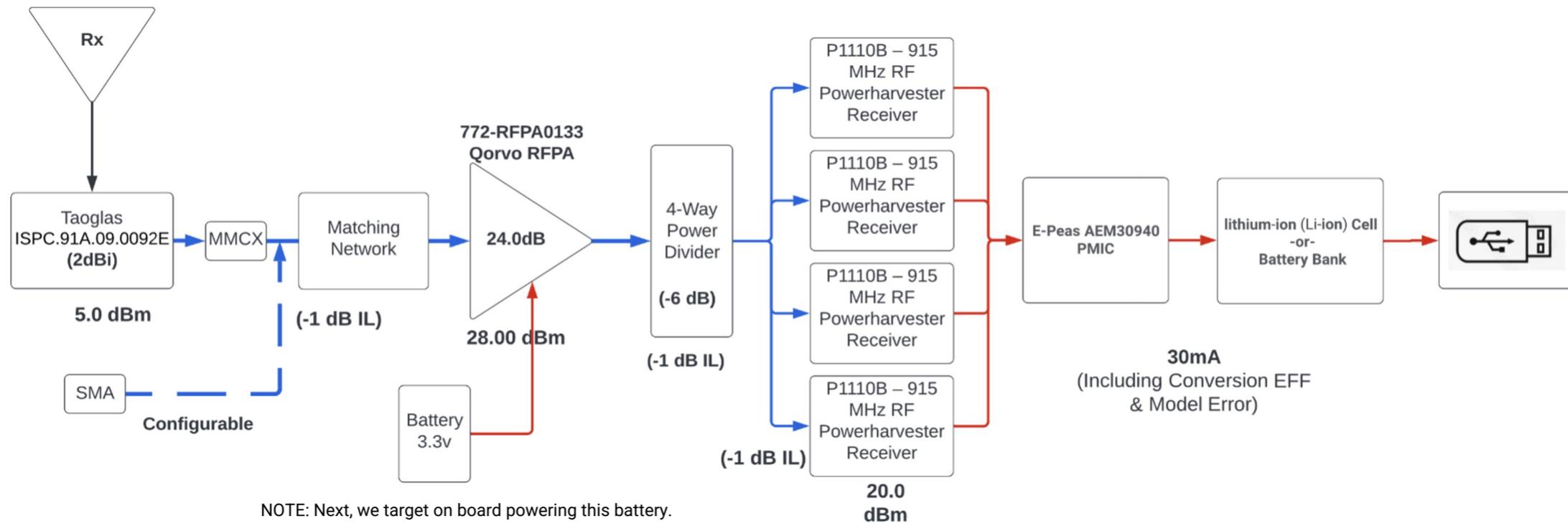
NOTE: Gen 0.1 was 3-4x larger than Gen 0.5



# Hardware: Gen 1 PowerBank (2023)



✓ **Goal 3: Increase end user up time by 30%**





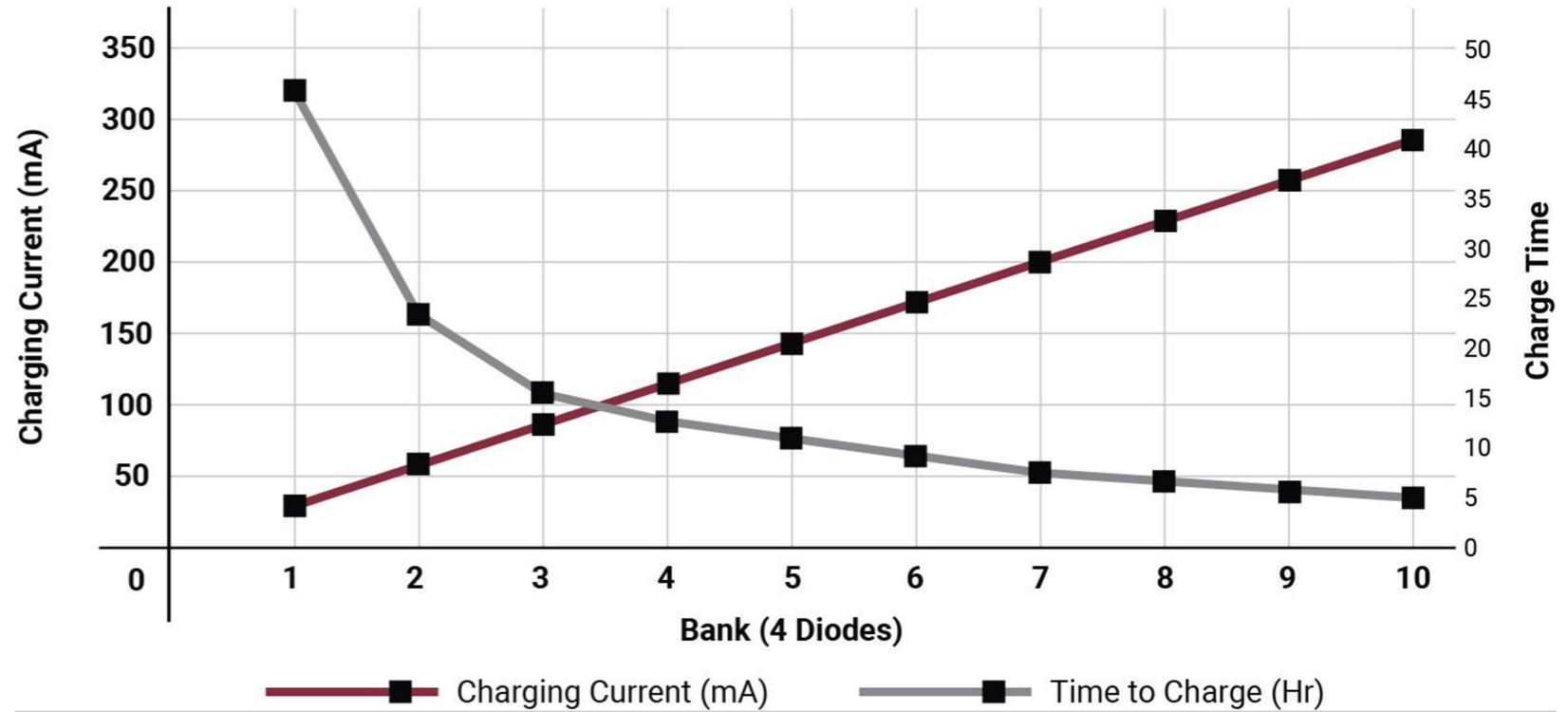
# Hardware: Gen 1 PowerBank (2023)

## Battery Charge Time

End User Battery Capacity	4400	mAH
Up Time Extension	30	%
Power Bank Capacity	1320	mAH
Charging Rate	29.07	mA
Number of Banks	5	
Total Charge Rate	145.33	
C-Rate	0.03	
Time to Charge	9	hours

NOTE: The 9 hours is based on the goal of 30% up time extension of a 4400 mAH PowerBank

## Charge Rate vs Banks



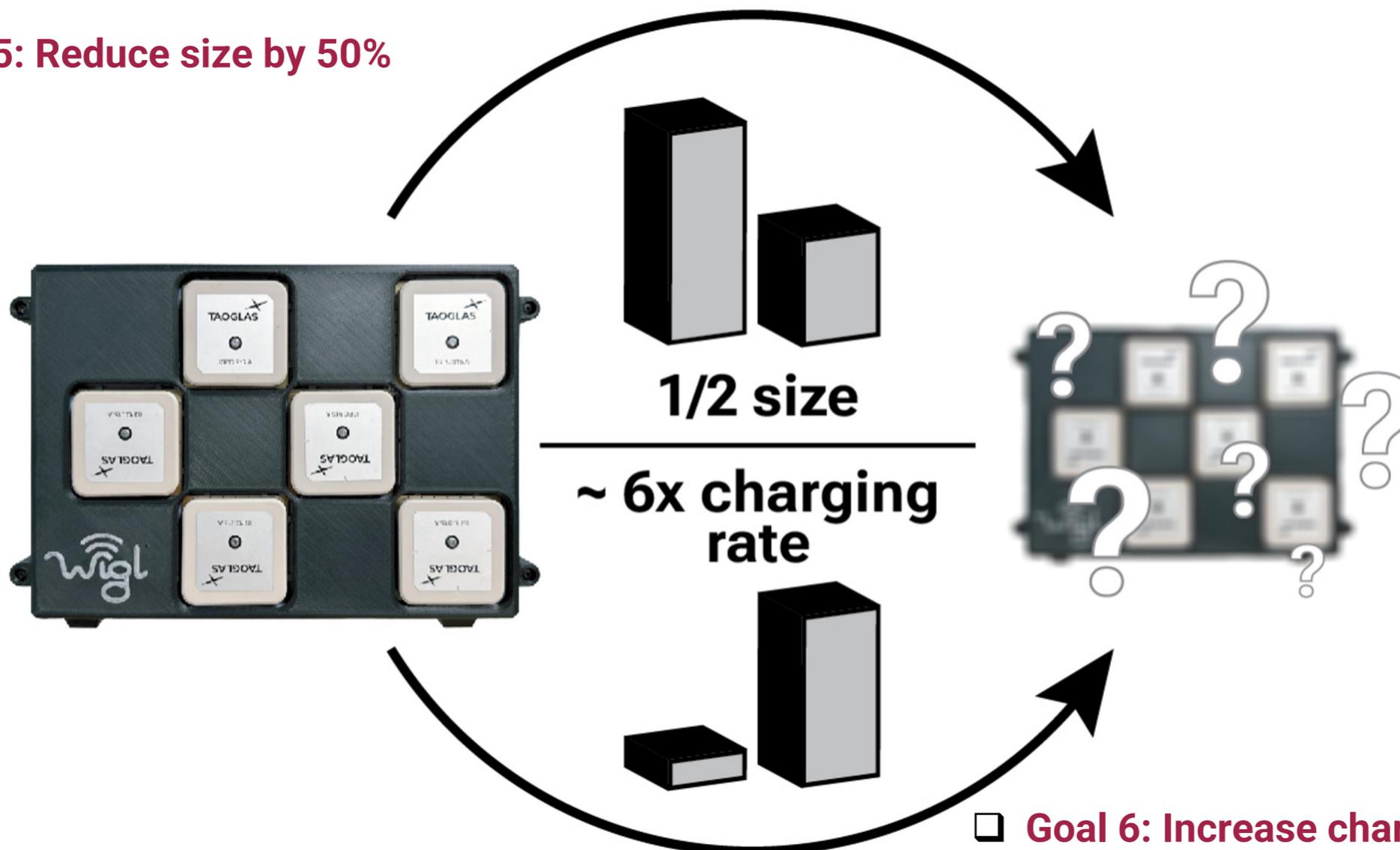
## ✓ Goal 4: Reduce time to wirelessly recharge Gen 1 PowerBank

Gen 0 Proof of Concept: UNK recharge time (used capacitors not a PowerBank)  
 Gen 0.5 External Device: 6.5 Days to recharge a two on-board batteries  
 Gen 1 PowerBank: 9 hours to increase 4400 mAH Powerbank by 30%



# Hardware: Gen 1.5-2.0 PowerBank (>2024)

- ❑ Goal 5: Reduce size by 50%



- ❑ Goal 6: Increase charge rate by 10x
- ❑ Goal 7: Reduce time to recharge PowerBank by 50%

## 2023/24 Technology Improvements

- Improved Power Conversion Efficiency and Sensitivity



## Saltwater Generator (SWG)

## Power On-Demand



# Advantages / Use Cases

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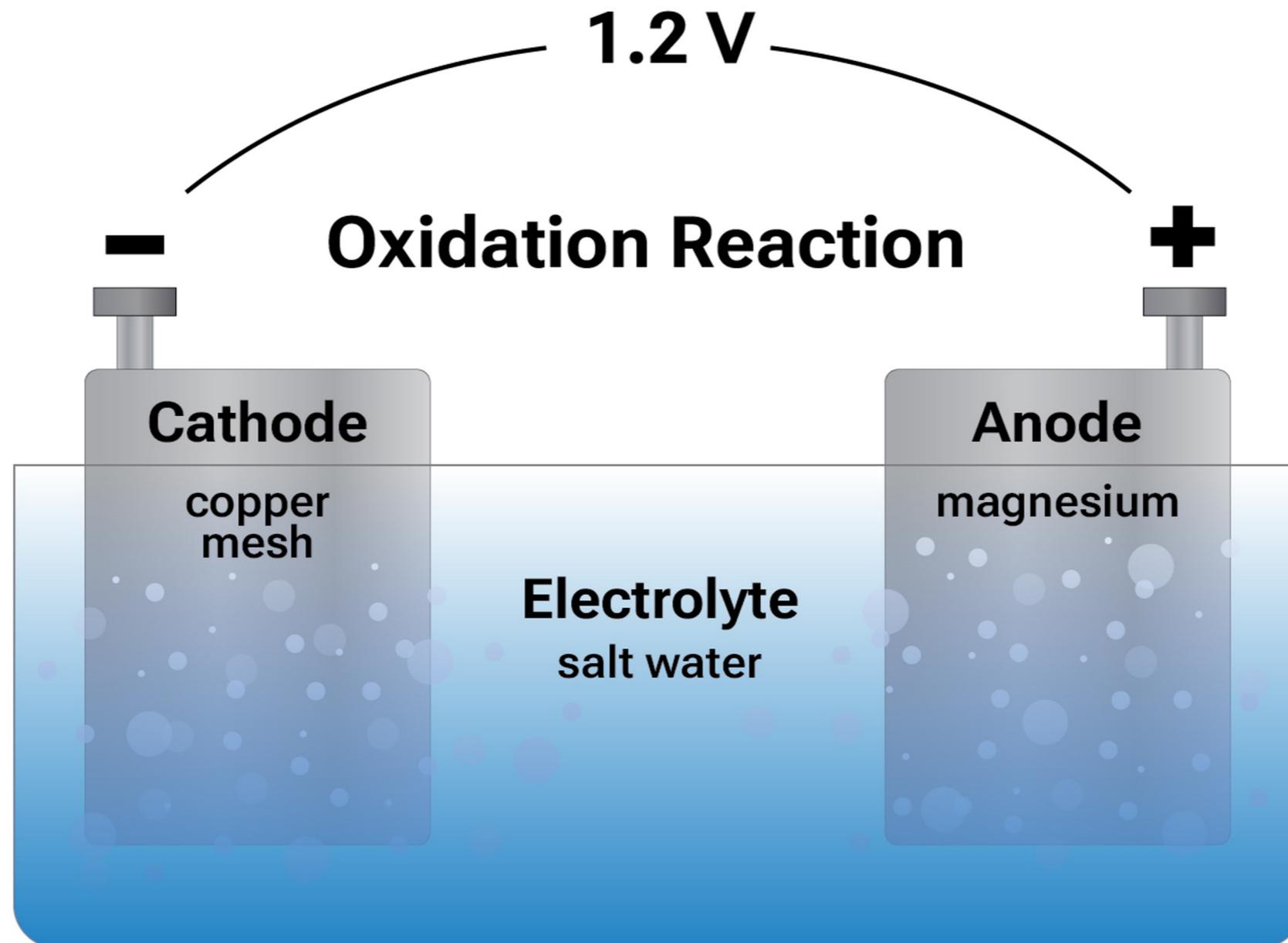
WiGL eENERGY, also called “SWG” is renewable

## Advantages

- Availability of MG
  - 8x more abundant than lithium
  - 1/3 the cost of lithium
  - Mined in the USA
- Long shelf life
  - User chooses when to add electrolyte to the system
  - Indefinite dry shelf life

## Use Cases

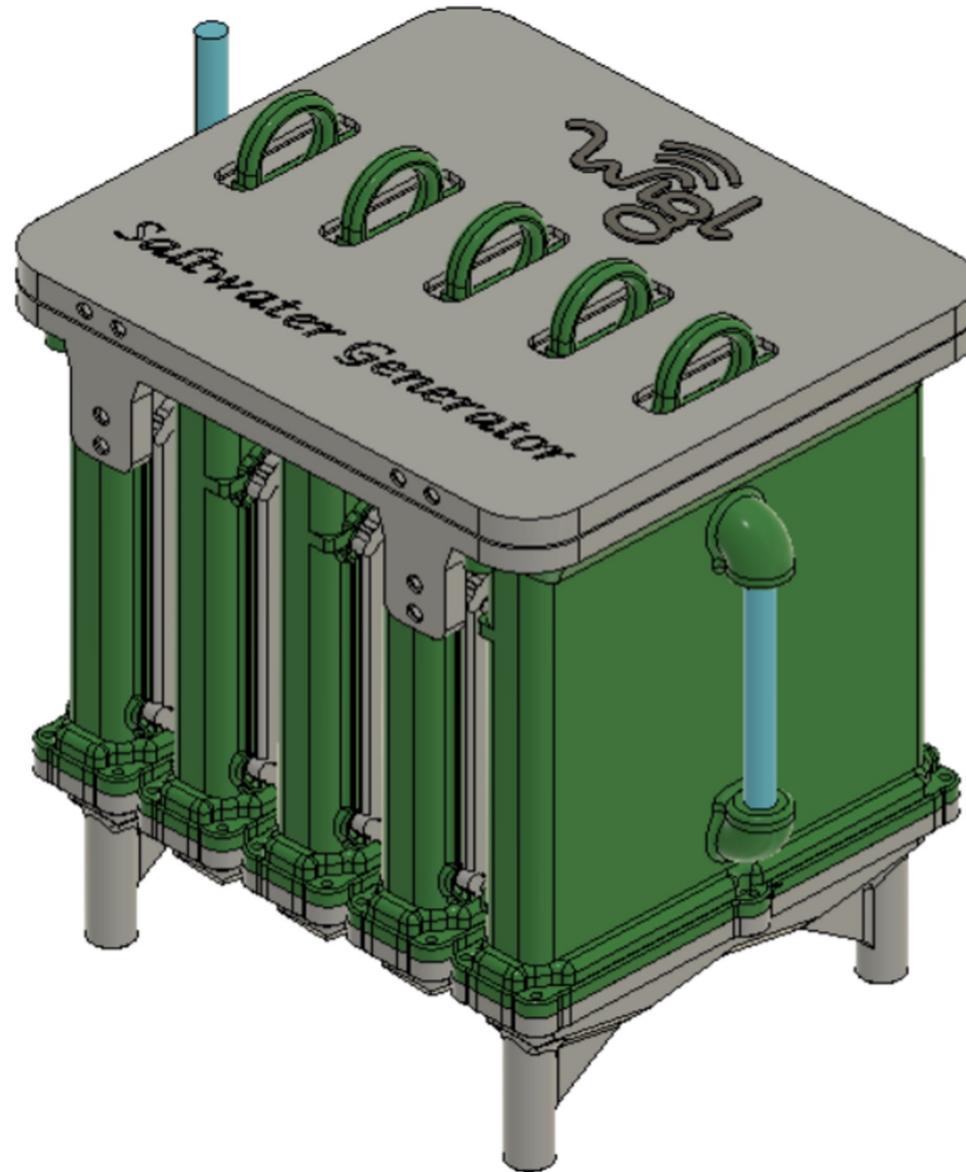
- Military / Natural disaster / Emergency
- Off grid / Remote
- Tiny Home / Forward Operating Base
- EV Recharging – **while they move**





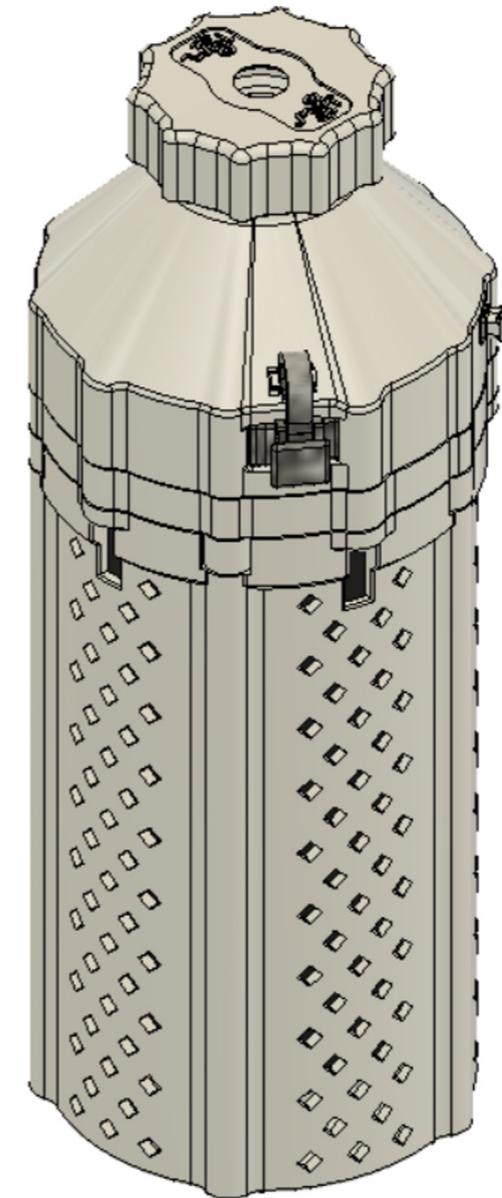
# Gen 1 Form Factors: Backpack and Bottle

12-24V



24-hrs of operations  
between cleaning  
5-Days of continues use

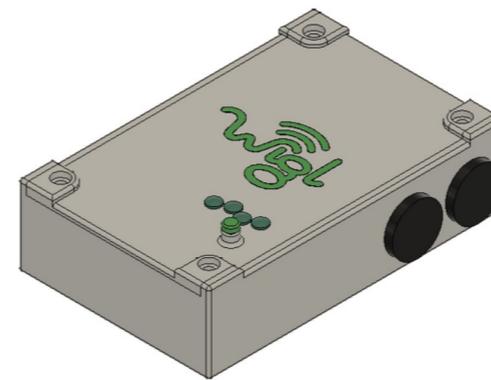
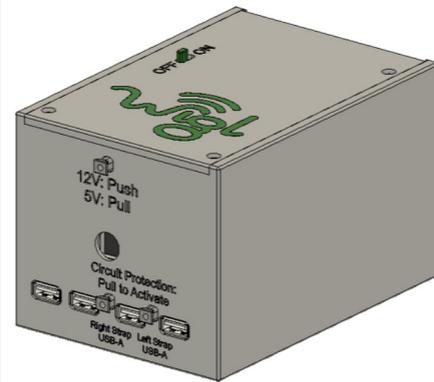
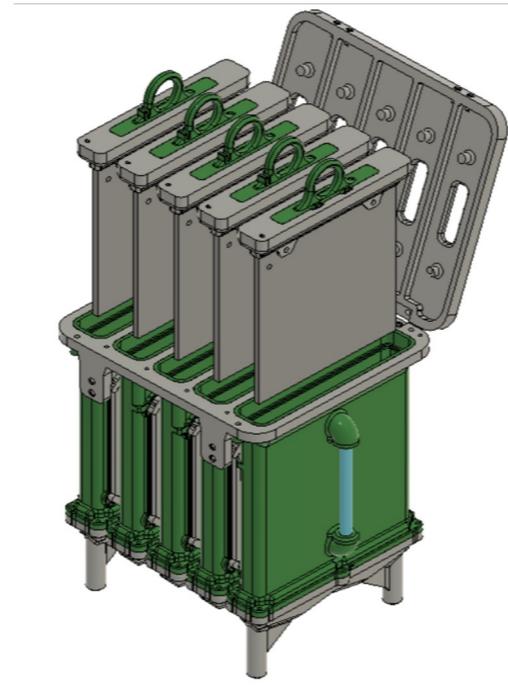
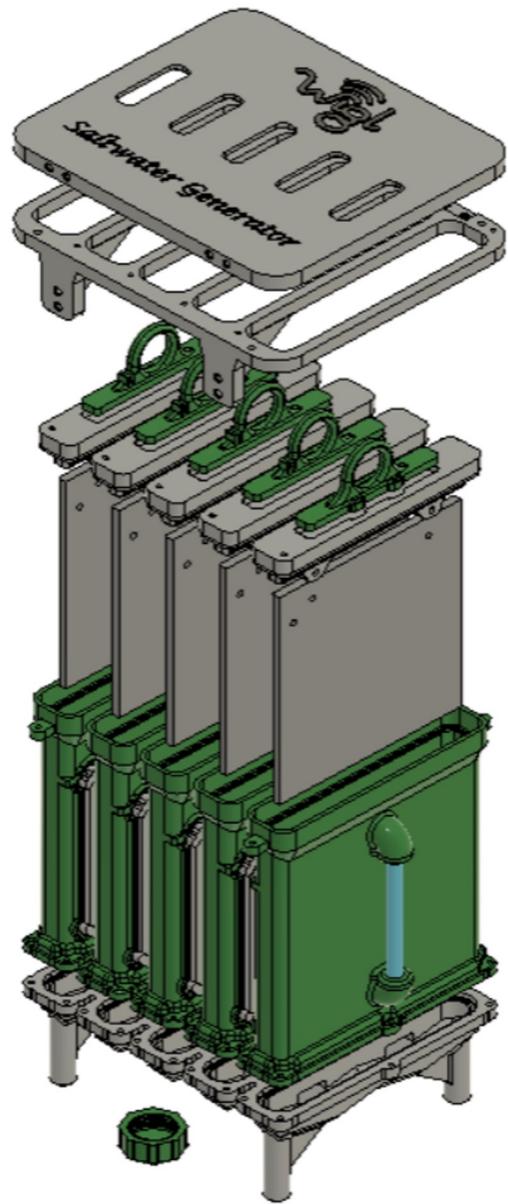
5V



12-hrs of operations  
between cleaning

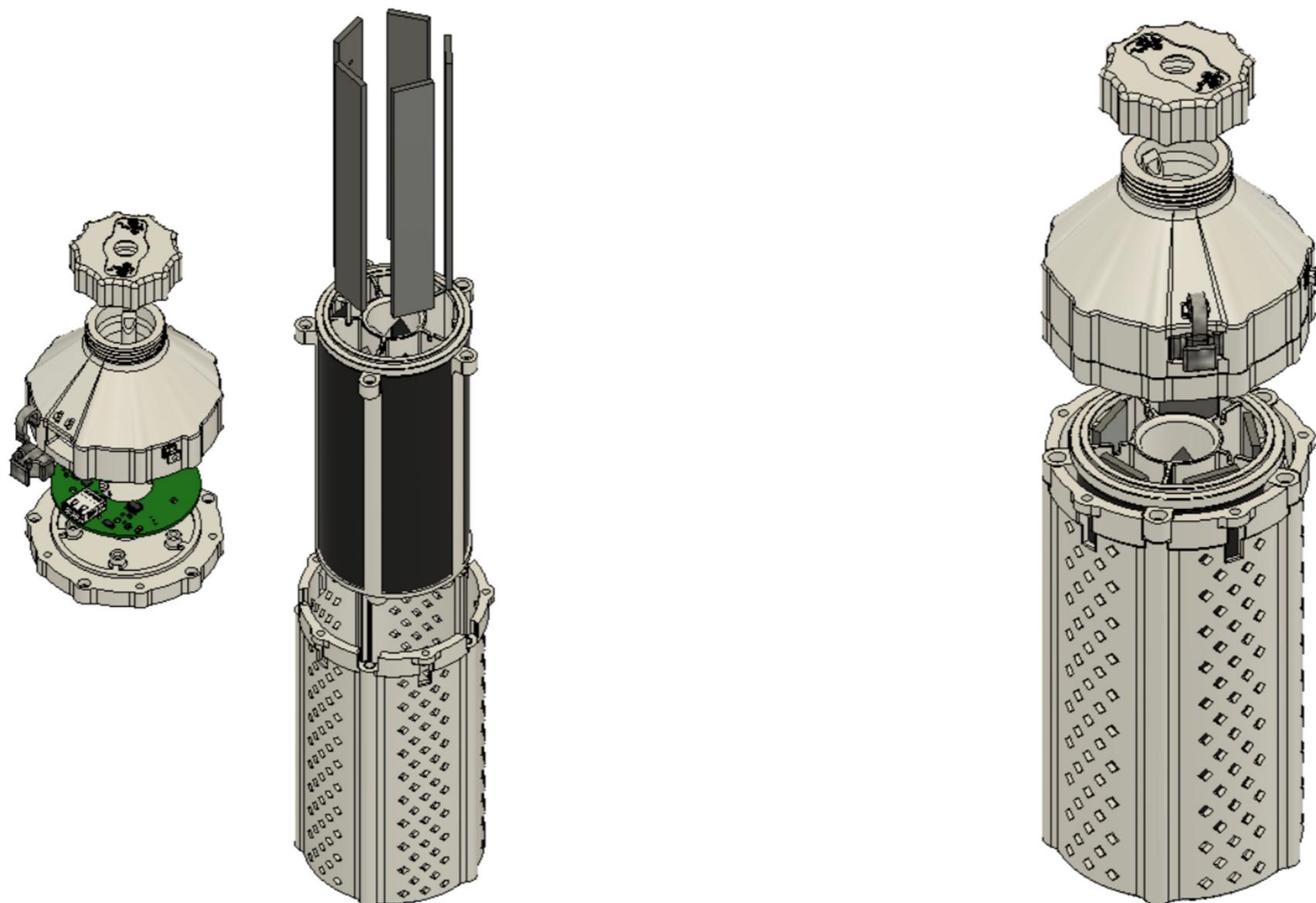


# Gen 1 Form Factors: Backpack





# Gen 1 Form Factors: Bottle





# Gen 1 2023 System: Backpack

## Inputs

- 5 Mg alloy plates (14 cm x 15 cm)
- 2 Liters of water
- ~8 tablespoons of salt

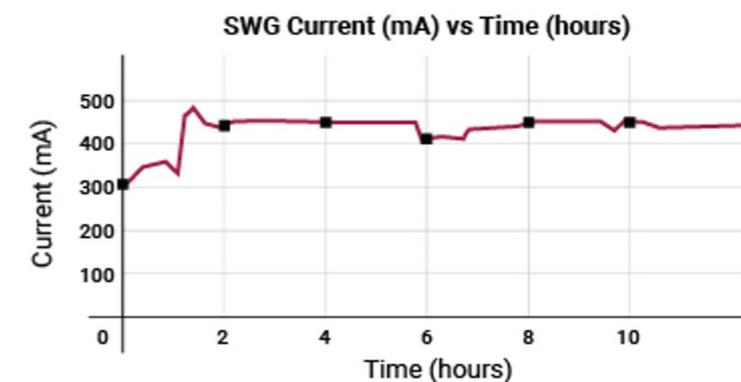
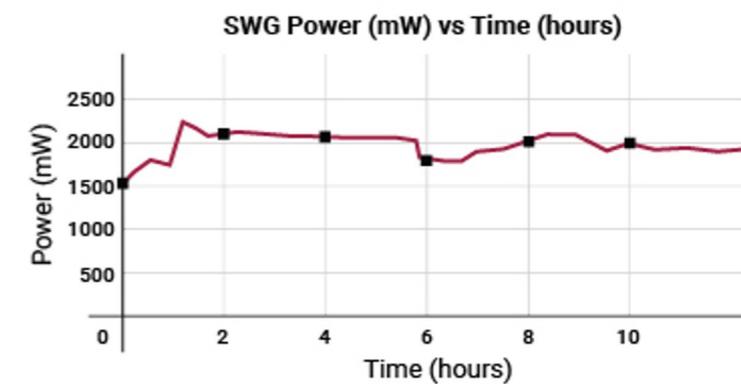
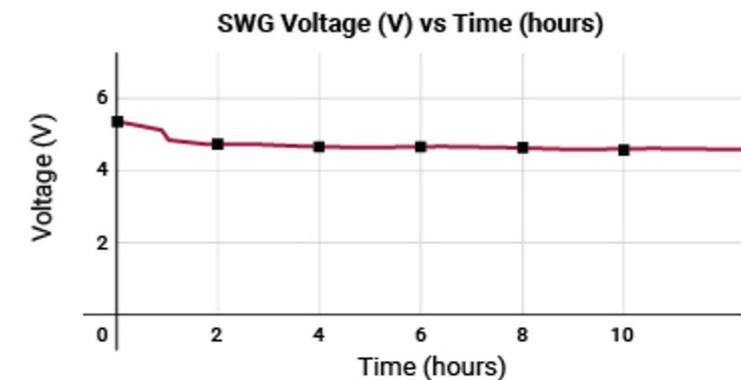
## Rated Outputs

- 4 5V USB ports (rated for 1A)
- 1 12V barrel plug (rated for 2A)

## Features

- Circuit protection
- System status LED's
- 100,000 mAh over 5 days

## Backpack Key attributes





# Gen 1 2023 System: Bottle

## Inputs

- 5 Mg alloy plates (2 cm x 14 cm)
- 300 mL water
- ~1.5 tablespoons of salt

## Outputs (directly from the SWG)

- 6V
- 1.5A

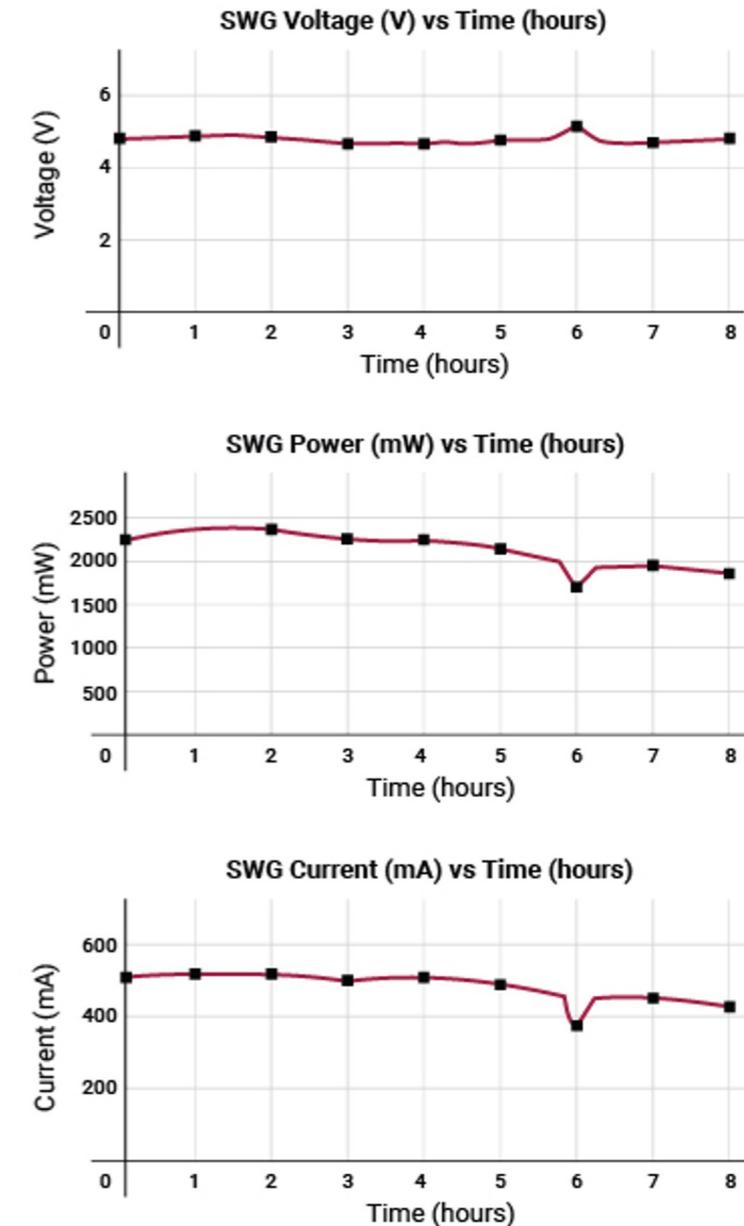
## Outputs (from the system)

- 1 5V USB port (rated for 1A)

## Features

- Circuit protection
- 12,000 mAh over 24 h

## Bottle Key attributes



# WWF 2.0 – Electrical Power Reimagined

## May 2023

TRL 8 – tWPT & SWG systems completed qualification through test and end user demonstration at Altus AFB

### Live Demonstrations



**Create / Transmit / Store**



# TRL 8 Demo Overview

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## OBJECTIVES:

- ✓ Demonstrated the ability to use tWPT to recharge a DBIDS and cellphone
- ✓ Demonstrated the ability to use SWG to recharge a DBIDS and cellphone
- ✓ Demonstrated the ability to use SWG and tWPT to power expeditionary lighting

## CONOPS:

1. Two demonstrations
2. Three scenarios per demonstration

## THE THREE SCENARIOS:

1. Small room inside the innovation room (AC Power), tabletop SWG (DC Power)
2. Outside without power (Expeditionary) (SWG)
3. Outside at the base entry gate (AC Power and DC Power) (SWG)

NOTE: Due to weather done indoors



## Part 1 - tWPT

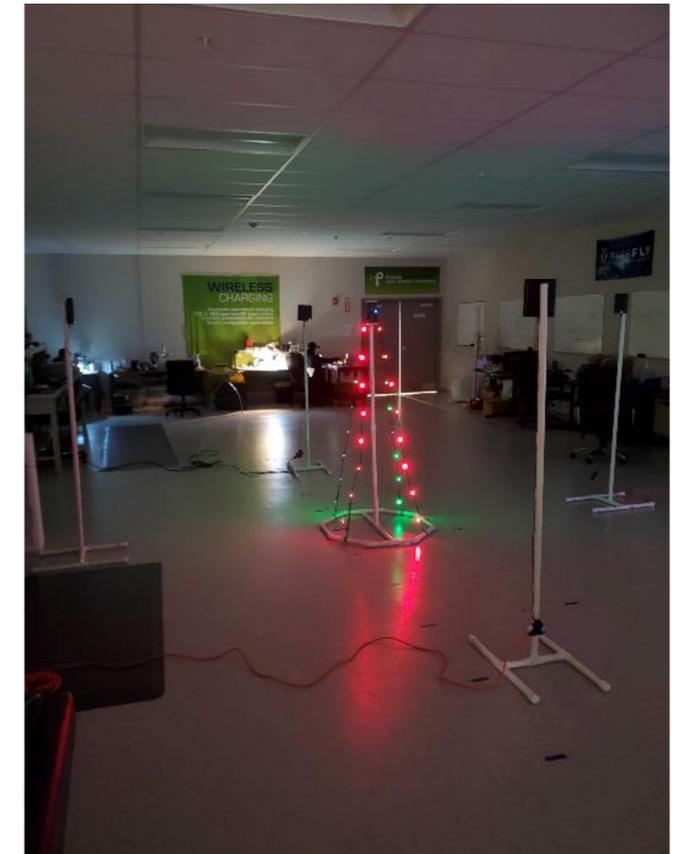
1. 10' by 10' room
2. Four PowerCast Transmitters (Tx's) (mounted on a tripod), 1 on each wall in the middle of the wall pointed at the center of the room
3. The Tx's are plugged into AC wall outlets
4. The top of the Tx's measure 4.5 feet in height from the ground
5. Cellphone plugged into the G1 PB
6. Used WiGL software to manage the network (Auto and Manual)
7. The G1 PB (with cellphone) roams in the room and recharge
  - ✓ **GOAL:** Showed the cellphone continuously recharging via the Gen 1 PB (network of 2-4 Tx's)

## Part 2 - SWG

1. Plugged the DBIDS and cellphone into the SWG – backpack
2. Plugged the DBIDS and cellphone into the SWG – bottle
  - ✓ **GOAL:** Showe the DBIDS and cellphone continuously recharging via the SWGs

## tWPT and SWG

1. Outdoor area
  2. Four PowerCast Tx's (mounted on a tripod), equidistant each pointing at its own receiver
  3. The Tx's are plugged into SWGs
  4. The top of the Tx's measure 6 feet in height from the ground, which match the height of the receivers on the Xmas tree
  5. Used WiGL software to manage the network (Manual)
  6. Demonstrated the three harvesting modes
- ✓ **GOAL:** Showed the ability to light up a room using tWPT powered by the SWG, and discuss other military applications (used SWGs to build and power a network of 2-4 Tx's)



## Part 1 - tWPT

1. Lane 1 (closest to guard shack)
2. One PowerCast Tx (mounted on a tripod), pointed at the Airman
1. The Tx is plugged into an AC wall outlet
2. The top of the Tx measures 4.5 feet in height from the ground
1. DBIDS plugged into the G1 PB
2. Show the DBIDS continuously recharging via the G1 PB



**GOAL:** Active duty Airman charging DBIDS effectively to scan IDs entering the base

**Modified – Airmen recharged DBIDS in a room**

NOTE: due to DBIDS software issues and weather, this was demonstrated indoor for the 2<sup>nd</sup> 1300 demo  
 NOTE: WiGL was able to show Airmen recharge DBIDS on the tWPT network (Modes 1-3 & ummy mode)

## Part 2 - SWG

1. Lane 2 (furthest from the guard shack)
2. Have Airmen wear the backpack
3. DBIDS plugged into the SWG – backpack
4. Team WiGL holds the SWG bottle
5. DBIDS plugged into the SWG – bottle
6. Show the DBIDS continuously recharging via the G1 PB

**GOAL:** Active Duty Airman uses charging DBIDS effectively to scan IDs entering the base

**Modified – Airmen recharged DBIDS in a room**

NOTE: due to DBIDS software issues and weather, this was demonstrated indoor for the 2<sup>nd</sup> 1300 demo



# WWF 2.0 – Electrical Power Reimagined



## Take Away

**Create / Transmit / Store**



# TAKE AWAY - Technical Readiness Level



TRL 7 (2022)

✓ **May 2023 TRL 8**

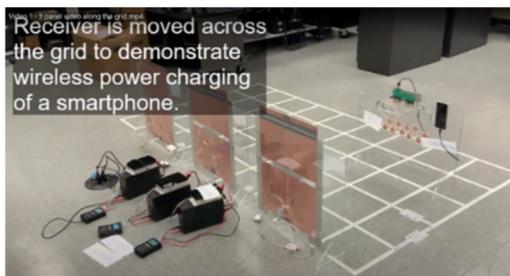
TRL >9

## Stage I: Proof of Concept & MVP

In 2022 AFWERX awarded WiGL a contract to demonstrate WiGL for a specific military function for the DBIDS. The WiGL's World's Fair 2.0 is building tWPT networks using readily available COTS.

Feasibility study, customer search, selection of battery- powered device for first use case in the DoD.

Over 8 patents granted and more in the pipeline.



## Stage II: On-Device

1<sup>st</sup> gen products Rx + PowerBanks, wearable SWGs and quasi adhoc COTS networking. Use existing electronic devices (cellphones), and warfighter devices (DBIDS) in their operational environments.

### Demo #4 (WWF 2.0) with end-users in six recorded demonstrations:

- ✓ GOAL: Show the DBIDS and cellphone continuously recharging via the PB
- ✓ GOAL: Show the DBIDS and cellphone continuously recharging via the SWGs
- ✓ GOAL: Show the ability to light up a room using tWPT
- ✓ GOAL: Show that the SWG can power the tWPT and/or provide continuously recharging and power/light.

## Stage III: Inside-Device

2<sup>nd</sup> & 3<sup>rd</sup> Gen products: Miniaturization / integration of WiGL-enabled Tx & Rx's inside multiple applications. Extend tWPT & SWG commercial applications for multiple powered devices (e.g., Evs, Phones, Laptops, Drones).

*Evolve & Modernize*



*Further develop the App & Cloud Operating Systems*

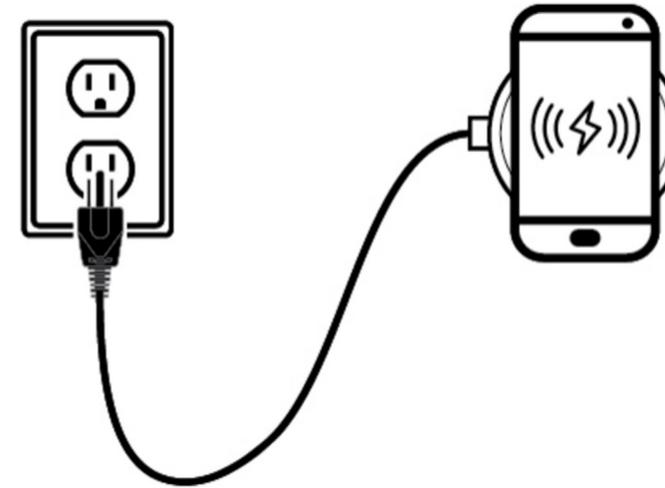
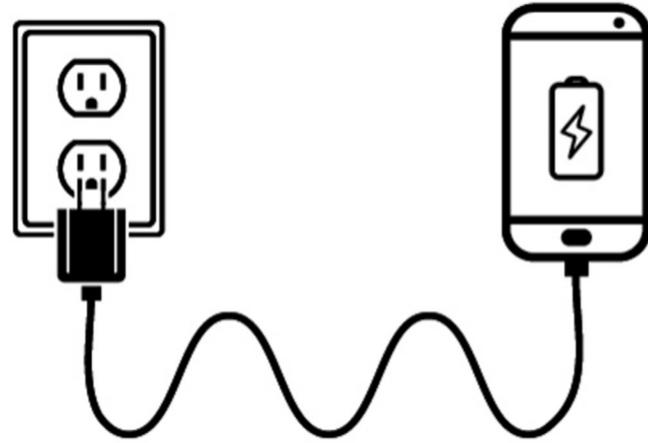


# State of the tWPT Industry – May 2023

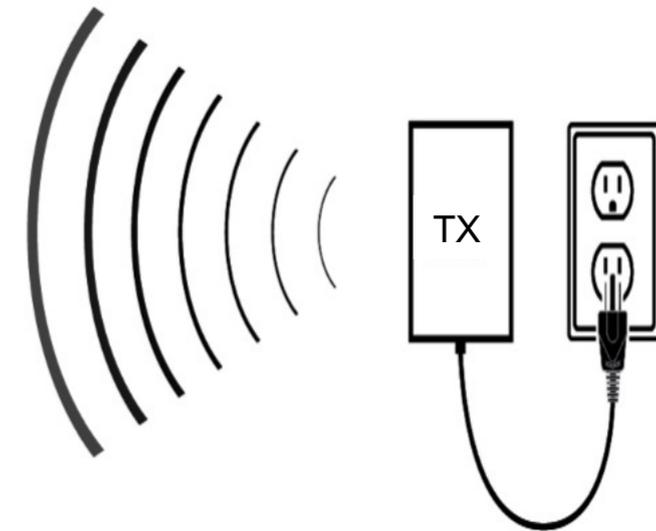
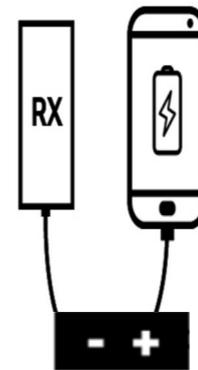
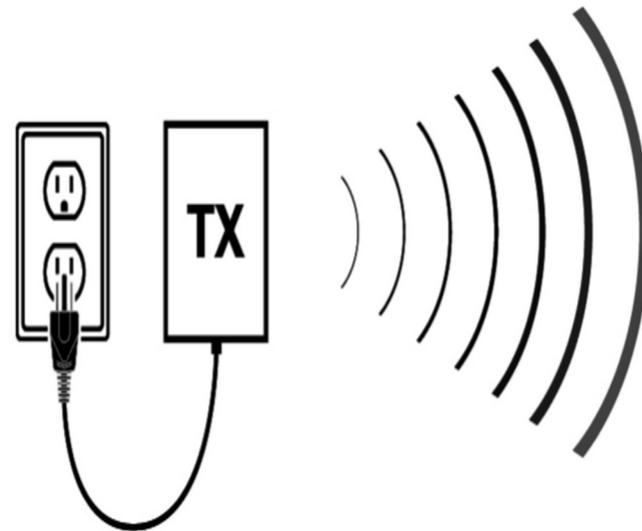
Standard charging

Inductive charging

TODAY



WiGL-enabled  
2023





# Let's WiGL



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StartEngine.com/WiGL

