



INCUBATENERGY LABS 2022 DEMO DAY

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October 26
Minneapolis
Minnesota

EPRI



Gravity Well Energy Storage Characterization Project

Supported/Hosted by: EPRI

EPRI Subject Matter Expert: Eva Gardow

Intensive study investigating the energy storage characteristics of a novel gravity energy storage technology developed by Renewell, which they refer to as “Gravity Wells”

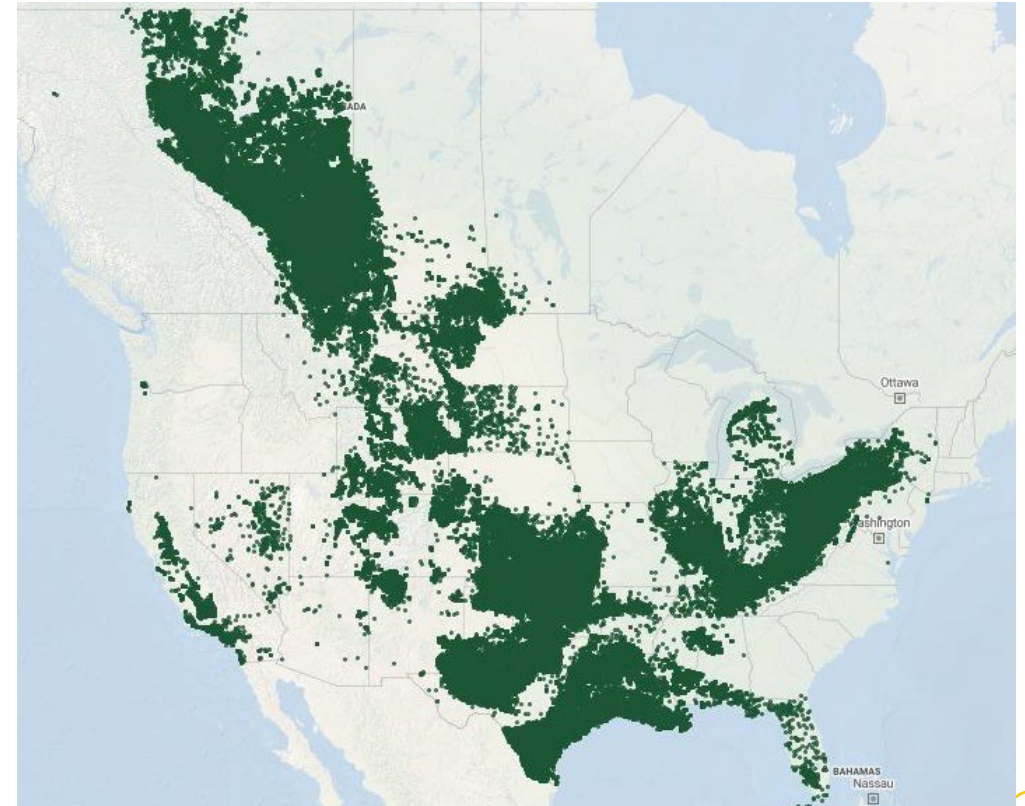
The Needs

Energy storage:

- US goal: net-zero carbon by 2050
- Increasing deployment of renewables
- Grid flexibility

Plug and Abandonment (P&A) Alternative

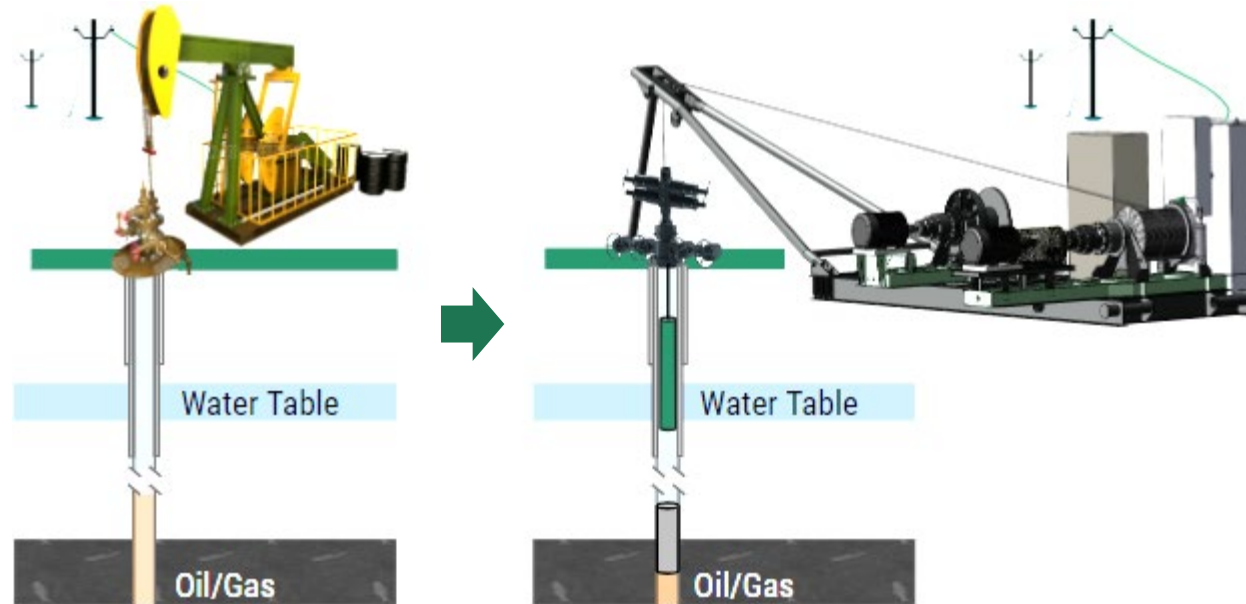
- Current remediation efforts are too slow -> there are now >2M
- 40% pollute methane or carcinogens
- Remediation expenses currently provide no payback so they are avoided whenever possible



The Proposed Solution

Seal well, install gravity energy storage and monitor seal integrity

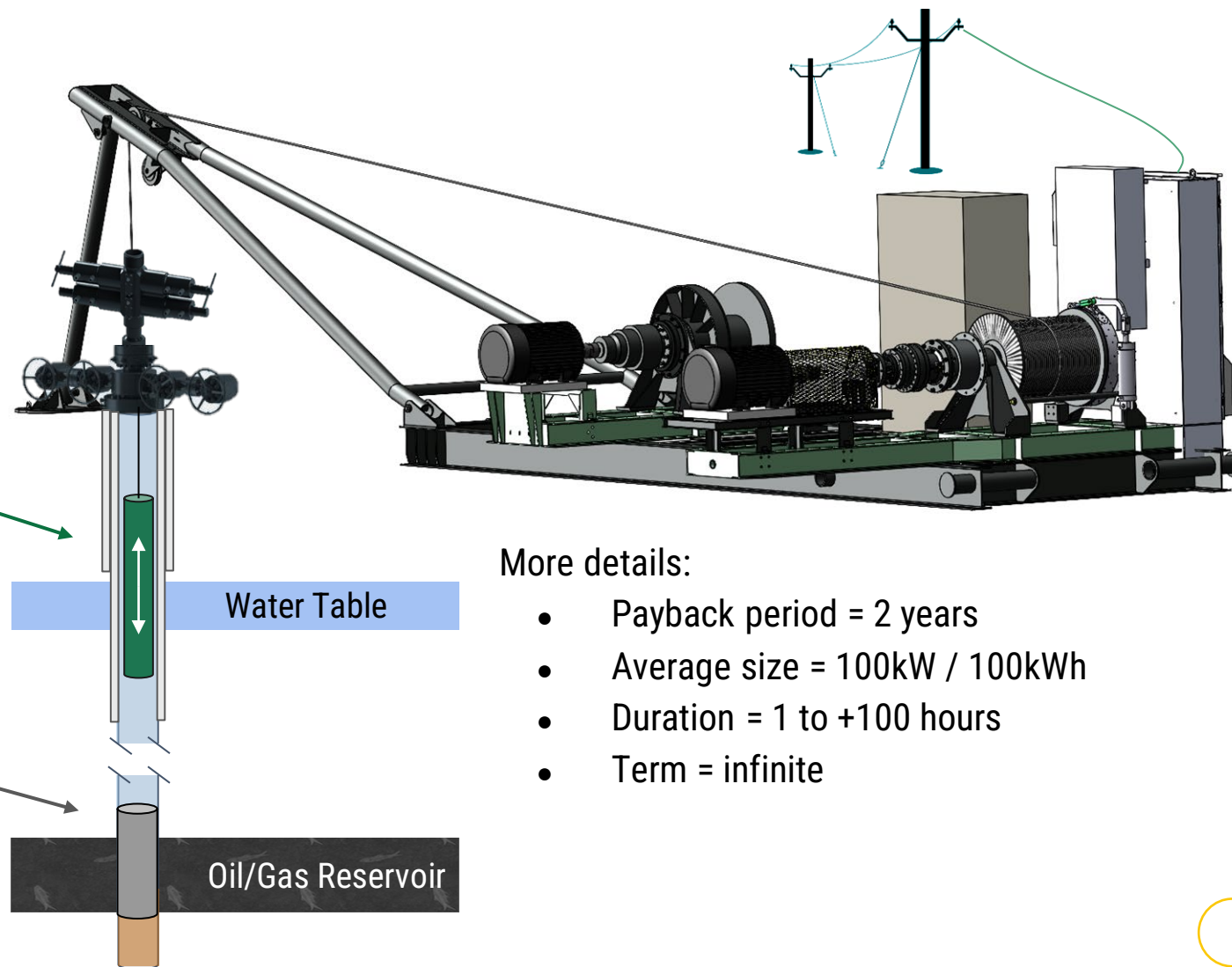
- Lowest cost (~\$62/kWh), greenest (abatement of CH₄), most flexible storage
- Decrease cost of remediation
- Provide payback on P&A expense
 - Installing energy storage -> new revenue stream -> incentive to remediate



The Proposed Solution – How it Works

Weight moves up and down inside well, converting potential energy to electrical energy.

Cement plug stops methane leakage from oil/gas reservoir.



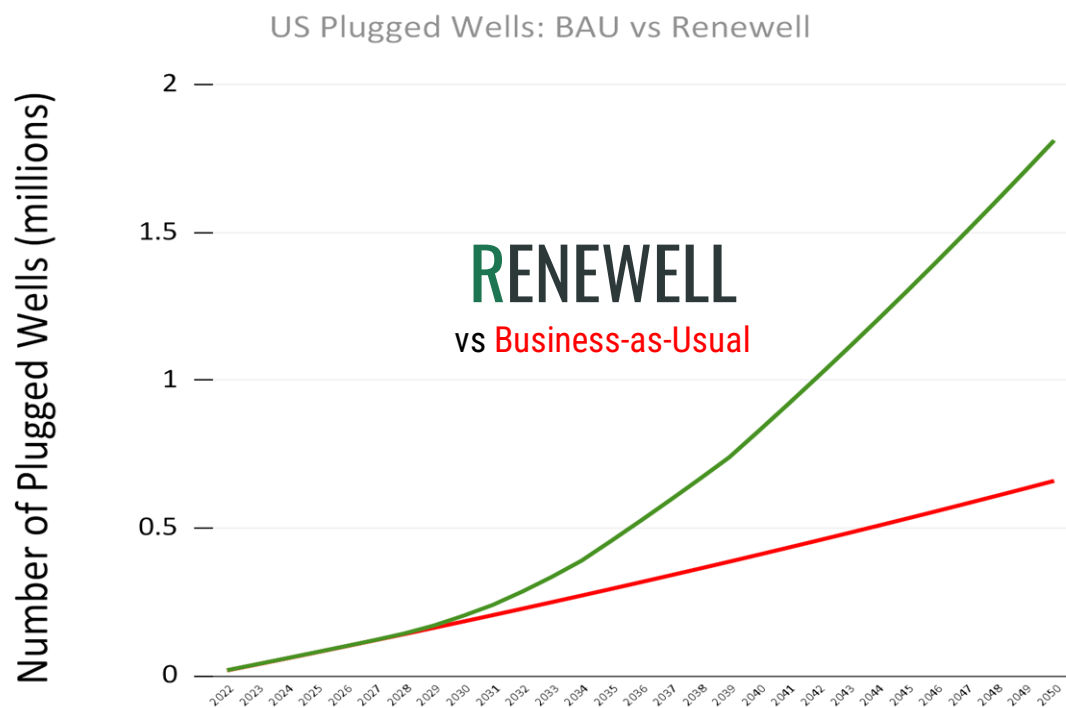
More details:

- Payback period = 2 years
- Average size = 100kW / 100kWh
- Duration = 1 to +100 hours
- Term = infinite

Environmental Benefits at Scale

IMPACT: IDLE WELLS

1.2 million more wells plugged by 2050



IMPACT: CARBON EMISSIONS

Annual CO₂ abated by 2050 in the US:*

Base Load Displacement (coal on the margin)	345,300,000 tons CO ₂ / yr
Methane Leakage Prevention	10,600,000 tons CO ₂ e/ yr
Total	355,900,000 tons CO₂e/ yr

** There are another ~1,000,000 wells in the rest of the world*

Scope

Objective:

- To assess Renewell's pilot Gravity Well installation in Bakersfield, California through collecting test data and evaluating it regarding the energy storage system characteristics to provide information to utilities and the team on Renewell's developing product

Gravity Well energy storage system was installed in Bakersfield, CA prior to Incubatenergy project testing

Deliverables:

- June: Test plan, methods, and metrics finalized
- July – September: Interconnection discovery, upgrades to metering for accurate data
- August: Midpoint review presentation
- October: Data collection



The Team

Renewell



Kemp Gregory

CEO



Petroleum Eng 5 years, Shell: managed \$50M operations campaign, MS in Environmental Eng



Stefan Streckfus

CTO



Product Eng 6 years, BK: created \$30M innovation budget, MS in Environmental Eng



Andrew Tidd

Intern



BS Engineering Physics '24, VP Stanford Energy Club

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Principal Technical Leader



Andrew Maxson

Program Manager



Kelyn Wood

Engineer/Scientist

Interconnection and Installation Learnings

- Gravity Wells installations can be covered by existing interconnection agreements
- Wire rope to weight crossover fit to wellhead must be investigated prior to installation
- Friction reducer needs to be mixed as well is filled with water (not after)
- Low profile trip tank is required for remediation monitoring
- Leash for wire rope provides safety during failure event
- Air compressor system for brake must be purged between uses



Characterization Test Results

- Zero self-discharge confirmed: 0.000 kWh of power lost over 3 weeks
- The pilot device was shown to be GHG-negative after only 2 years of operation
 - Embodied carbon of pilot system calculated at 6,658 kg CO₂e
 - Average GHG emissions reductions per well was found to be 3,500 kg CO₂e

Key Takeaways and Next Steps



Key Takeaways:

- Interconnection process requires careful attention to pre-existing contracts
- Air brake should not be used in product
- Zero self-discharge and GHG emissions confirmed!
- Controls optimization will be key to minimize response time and maximize value creation

Next Steps:

- Application-specific performance testing (peak shaving, frequency reg., etc.)
- Develop full-scale commercial prototype
 - Destructive wire rope testing to optimize sizing and construction
 - Controls development
- Build out sales pipeline in key locations
- Work with regulators to remove penalty for installation



Thank You

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