Grid-Scale Electricity Storage Overview

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Company Goals:
- Build large scale electricity storage systems superior to power plants and current energy storage technologies
- Sell systems and/or energy services under contract to utilities
- License technology in strategically selected markets

Development Sequence:
- Phase 1: Prototype Development & Test (2010-2011)
- Phase 2: Ancillary Service Plant Commercialization (2011+)
- Phase 3: Peaking Plant Commercialization (2013+)
The Grid: Huge Supply Chain with No Warehouse

- US generation capacity: 1088 GW
- US storage capacity: 22 GW
- Fast growing renewable energy is causing severe problems:
  - Wind is variable....
  - Solar is worse....
  - ...but the grid can’t compensate – it requires dispatchable energy.

Energy storage is the only viable solution
Worldwide Energy Storage Capacity

- Pumped Storage Hydro (PSH) is the only commercially successful bulk storage technology.
- Many more PSH installations would exist if not for all its problems.
- Gravity Power can solve those problems.
The Gravity Power Module (GPM)

- Modular, underground pumped storage
- High efficiency (75-80%)
- Ramps far faster than gas turbines (peaking plants)
- Low cost materials (cement, iron ore, steel)
- Environmentally benign
- Flexible siting
- Fast permitting
- Rapid construction
- Expandable
- Short time to revenue
- Patents Pending
Prototype Development

- Follows standard hydropower industry procedure:
  - Design → simulation → tests at sub-scale

- Design & simulate:
  - Pump-turbine, weights, seals, power system, controls, system dynamics

- Fabricate at sub-scale:
  - Pump-turbine
  - Complete GPM (1.5m x 60m shaft, site selected)

- Test and validate
  - Component capabilities
  - System operation & dynamics

- Design advanced shaft-boring machine
Initial Product: Ancillary Service Plants

A-GPM Parameters
- 6m storage shaft, 2m return pipe
- 500m deep
- 8000-tonne storage mass
- ~25 MW with 8.5 MWh per module initially, more energy later

Market
- ~50 GW in U.S.
- ~2000 GPMs @ ~$25M each
- Performs better than thermal plants
- System payback time: ~5-10 years
- System lifetime: 30+ years
Second Product: Peaking Plants

B-GPM Parameters

- Bulk energy storage
- 10m storage shaft
- 3m return pipe
- 1000-2000m deep
- Up to 150 MW for 4 hrs per shaft
- Up to 210,000 tonnes/shaft
- Up to 2400 MW in 2.5 acres

Market

- Buy cheap energy off peak
- Sell valuable energy on peak
- Differential can exceed $100/MWh
- ~200 GW in U.S. = 4000 big GPMs
- Foreign market is much larger
Example Installation Layouts

8 GPMs = Up to 1,200 MW
~100 x 100 meters (2.5 acres)

16 GPMs = Up to 2,400 MW
~50 x 200 meters (2.5 acres)
Key Enablers

Francis pump/turbine
- High efficiency
- Not yet mass-produced anywhere
- Custom design in development at GP
- Mass production will slash costs

Advanced Shaft Boring Machine
- Radically reduces shaft construction cost
- Strategic collaborator on board

Local Content
- GPM cost is mostly determined by labor and material costs at the construction site
- Lower cost in developing countries
Pumped Storage Hydro is the only successful large-scale electricity storage technology

Gravity Power makes it feasible everywhere

Contact us to find out more

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