

### **Cryogenic Energy Storage:** Clean, Cost-Efficient, Flexible and Reliable

Highview Power's CRYOBattery technology makes use of a freely available resource – air – which is cooled and stored as a liquid and then converted back into a pressurized gas which drives turbines to produce electricity. Just as pumped-hydro harnesses the power of water, the CRYOBattery unleashes the power of air. It is the only long-duration energy storage solution available today that offers multiple gigawatt hours of storage, is scalable with no size limitations or geographic constraints, and produces zero emissions. Our cryogenic energy storage system delivers the lowest cost clean energy storage solution for large scale, long-duration applications.



30-40 year lifespan with mature components



Lowest cost locatable technology at utility scale







Proven technology with established supply chain



~70% efficiency by utilising waste heat/cold



\$662 bn Market size of energy storage by 2040\*

## 56%

of the global long-duration energy storage market is cryogenic energy storage\* The energy market is transitioning to renewable power—energy that is clean, but intermittent. Highview Power's cryogenic systems enable this transition by delivering performance and reliability equivalent to traditional sources of power while releasing zero emissions and storing energy for up to multiple weeks.

### Applications of Highview Power's Cryogenic Systems

Highview Power's CRYOBatteries are adaptable and can provide services at all levels of the electricity system: supporting power generation, providing stabilization services to transmission grids and distribution networks, and acting as a source of backup power to end users.

Power generation	Transmission	Distribution	End users	
Managing intermittent	Ancillary services	Reactive power	Power reliability	
renewable generation	Transmission constraints	Voltage support	Energy management	
Energy arbitrage	Inertia services	Local security	Waste heat recovery	
Peak shaving	Responsive flexibility services	Distribution losses	Waste cold usage	
Improved heat rate		Distribution 103303	Waste cold usuge	
Waste heat	voitage support			

\*Source: Bloomberg New Energy Finace and Navaigant

## Pulling energy out of thin air



### How it works

Our patented cryogenic technology draws on established processes from the turbo machinery, power generation and industrial gas sectors.

#### Stage 1. Charging the system

An air liquefier uses electrical energy to draw air from the surrounding environment, and then the air is cleaned and cooled to subzero temperatures until the air liquifies. 700 litres of ambient air become 1 litre of liquid air.

#### Stage 2. Energy store

The liquid air is stored in an insulated tank at low pressure, which functions as the energy reservoir. Each storage tank can hold a GWh of stored energy.

#### Stage 3. Power recovery

When power is required, stored heat from the charging system is applied to the liquid air via heat exchangers and an intermediate heat transfer fluid. This produces a high-pressure gas that drives a turbine and generates electricity.

# Other types of storage

For grid-scale, long discharge storage Highview Power's systems mitigate many of the constraints posed by other storage technologies. The CRYOBattery has a small footprint, uses no hazardous materials, has no associated fire risk and can easily meet strict urban building codes.



#### 30-year lifetime Levelized Cost of Storage

Significant cost decreases expected for CRYOBattery supported by an increasing standarization of the system and mass deployment

LCOS 50 MW System (50 MW-in and 50 MW-out 350 cycles/year)



		Response	Expandability	Black start	Renewable curtailment avoidance	Efficiency (%)	Lifespan (years)	Scalability (MW) 4 hour +	Sustainability	Locatability
compares	Cryogenic Engergy Storage					60-75	30-40			
	Flow battery					60-75	20	9		
	Li-ion battery					75-85	<10	9		
	CAES					NZA	40		9	$\bigotimes$
	Pumped hydro					80	50			$\bigotimes$

How Highview Power's Cryogenic Energy Storage

## **About Highview Power**

At Highview Power, our mission is to unleash the power of renewable energy with clean, reliable and cost-efficient long-duration energy storage. Founded in 2005, Highview Power built the world's first cryogenic energy storage plant and is now expanding globally. Using proprietary technology, our systems deliver pumpedhydro capacity and needed grid reliability. A standard plant configuration of 50 MW/500 MWh can be easily, and cost-effectively scaled up to multiple gigawatt hours without limitation. With Highview Power, a 100% renewable energy future is within reach.

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# Commercial partners and supply chain

We source the component parts of our technology from well-established OEMs to ensure that our plants have the best possible equipment in place, with proven lifetimes and performances.

