Grid-scale electricity storage
using an innovative form of
Compressed Air Energy Storage

Technical Uniqueness of Storelectric's CAES

All Storelectric's CAES:

1. **Built with existing standard equipment with little or no modification**
   - Benefits from 100 years of product development, efficiency and reliability
   - Buildable and operable using existing skills
   - All other CAES uses specially modified and accredited equipment, which is therefore novel, expensive and less reliable
2. **Much more efficient than existing CAES**
   - Existing: Huntorf, 42%, McIntosh 50%
   - Storelectric Hydrogen CAES ™ 57% at scale
   - Storelectric Green CAES ™ 67-70% at scale
3. **More Flexible than Any Technology on the Grid**
   - More potential configurations
   - Any size of catalogue equipment can be used, singly or multiply
   - More potential revenue streams
4. **More Configurable than Any Other Storage**
   - Any size of catalogue equipment can be used, singly or multiply
   - Charge rating (MW), discharge rating (MW) and storage volume (MWh) are all independently variable, enabling plants to be configured to different usage cases
   - Vast range of air pressures are possible
5. **Not tied to any supplier**
   - All other CAES uses specially modified and accredited equipment, which is therefore tied to a single supplier
   - Storelectric's CAES uses standard equipment with little or no modification, obtainable competitively from any suitable supplier

Green CAES CAES ™:

6. **Green CAES ™ has never been built before**
   - Storelectric's zero-carbon technology, using Thermal Energy Storage (TES)
   - The world's most efficient
7. **Green Hybrid ™**
   - Hydrogen compatible
   - Doubles energy storage for extreme need, e.g. long adverse weather, black start
8. **Green CAES ™ for Black Start**
   - Add battery and grid forming capability
   - Need sufficient duration of reserve capacity (i.e. best with Green Hybrid)
9. **Green CAES ™ delivery of real inertia 24/7**
   - Clutches to spin motor and/or generator when not in use
10. **Different charge rating from discharge rating**

- All CAES (and batteries, pumped hydro and other common storage technologies) are always proposed with charge rating = discharge rating
- Different charge and discharge ratings (measured in MW) enable plants to be optimised most cost-effectively for different load cases, especially when built in conjunction with renewable generation and/or interconnectors
- Ratios between charge and discharge ratings will vary with the required input and output loads and their characteristics
- Storage volume (measured in MWh) is also an independent variable, dependent on the required input and output loads and their characteristics

11. **Thermal storage is highly efficient and immediately controllable, not only in thermal storage but also in thermal transfer**
    - Unlike most other adiabatic CAES proposals
    - Born from a relentless focus on technical and design simplicity
12. **Thermal storage is benign, cheap and plentifully available, and cheaply implementable with the high efficiencies**
    - Unlike all other adiabatic CAES proposals

Hydrogen CAES ™

13. **Hydrogen CAES ™ has never been built before**
    - Much more efficient than existing plants (McIntosh)
    - Much cheaper than any other CAES technology
    - Hydrogen ready, or may use methane and mixes if hydrogen is unavailable
    - Can operate as a power station *in extremis*, e.g. after the stored air is depleted, in case of longer-duration need
14. **CAES has never been retro-fitted before**
    - Re-purposing substantial stranded assets
    - Reduction in capital costs
15. **Hydrogen CAES ™ delivery of real inertia 24/7**
    - Clutches to spin motor and/or generator when not in use
16. **Hydrogen CAES ™ for Black Start**
    - Add battery and grid forming capability
17. **Hydrogen CAES ™ Hybrid has never been built before**
    - Adding thermal storage to Hydrogen CAES ™
    - Increases the range of operating modes
    - Adds some much more efficient operating modes
18. **Split Hydrogen CAES ™**
    - No CAES has ever had compression and expansion separated geographically
    - Combine with Pipeline for Air Transmission
19. **Hydrogen CAES ™ with heat network**
    - Best with the split CCGT CAES ™
    - CAES has never been combined with outputs of heat to a heat network
20. **Hydrogen CAES ™ is hydrogen compatible**
    - As hydrogen becomes available commercially, replace the methane consumption to eliminate emissions

Green CAES ™ and / or Combined Hydrogen CAES ™ & Electrolysis

21. Method of renewable integration

- Delivering total efficiency greater than CAES efficiency
- Reducing grid connection for renewables size by a factor of 2.5 – 8 depending on renewable technology / de-rating factor and desired output load case
  - ◊ Corresponding reductions in grid constraints and reinforcement
  - ◊ Corresponding reductions in annual grid access charges (per MW)
- Eliminating grid access charges (per MWh) for renewables
- Reducing curtailment for renewables
- Eliminating grid connection costs and charges for storage
- Improving operating margins for storage
- Enables renewables to put out baseload and/or dispatchable electricity
- Adds both balancing and real inertia to the grid at the point of greatest benefit
  - ◊ Eliminates the need for separate purchase of these services
  - ◊ Eliminates the need for grid reinforcement to the locations of such separate purchases
- Can be done with any project using Green CAES ™ or combined Hrydrogen CAES ™ with hydrogen electrolysis

22. Method of integrating with interconnectors

- Delivering total efficiency greater than CAES efficiency
- Enabling exports and imports to occur when there is no concurrent surplus and deficiency at opposite ends, thereby increasing utilisation of interconnectors
- Can be done with any project using Green CAES ™ or combined Hydrogen CAES ™ with hydrogen electrolysis

Air Storage:

23. Potash caverns have never before been used for CAES

- Different from sodium salt
- Has been proposed before, but never done

24. Pipelines have never before been used for CAES

- Converting existing assets
- Challenges in validating and maintaining pipeline hermeticity through plant life (40-60 years)
- New pipes have been proposed before, but never done

25. Pipelines for Air Transmission

- Combine with split Hydrogen CAES ™
- Compress at one end of the pipeline, expand at the other
- Challenges in validating and maintaining pipeline hermeticity through plant life (40-60 years)
- Uses existing assets instead of laying new transmission lines

26. **Other Geologies, to be explored later** ***(each one being a separate innovation or group of innovations as the issues to be addressed differ):***
    - Mines (e.g. salt, potash, anhydrite, gypsum)
    - Aquifers (saline or sweet)
    - Depleted hydrocarbon wells (for non-hydrogen CCGT CAES ™)