Air energy storage patent

What is the history of liquid air energy storage plant?

2.1. History 2.1.1. History of liquid air energy storage plant The use of liquid air or nitrogen as an energy storage medium can be dated back to the nineteen century,but the use of such storage method for peak-shaving of power grid was first proposed by University of Newcastle upon Tyne in 1977 .

What is liquid air energy storage?

Concluding remarks Liquid air energy storage (LAES) is becoming an attractive thermo-mechanical storage solution for decarbonization,with the advantages of no geological constraints,long lifetime (30-40 years),high energy density (120-200 kWh/m 3),environment-friendly and flexible layout.

What is compressed air energy storage (CAES)?

Compressed air energy storage (CAES) is an effective solution for balancing this mismatchand therefore is suitable for use in future electrical systems to achieve a high penetration of renewable energy generation.

When was liquid air first used for energy storage?

The use of liquid air or nitrogen as an energy storage medium can be dated back to the nineteen century,but the use of such storage method for peak-shaving of power grid was first proposed by University of Newcastle upon Tyne in 1977. This led to subsequent research by Mitsubishi Heavy Industries and Hitachi .

What is a standalone liquid air energy storage system?

4.1. Standalone liquid air energy storage In the standalone LAES system,the input is only the excess electricity,whereas the output can be the supplied electricity along with the heating or cooling output.

What is hybrid air energy storage (LAEs)?

Hybrid LAES has compelling thermoeconomic benefits with extra cold/heat contribution. Liquid air energy storage(LAES) can offer a scalable solution for power management,with significant potential for decarbonizing electricity systems through integration with renewables.

Patent Document 1 discloses an adiabatic compressed air energy storage (ACAES) power generation device that recovers heat from compressed air before storing the compressed air and reheats the compressed air when the ...

A system of flattening electric energy demand of an air-conditioner from an electric grid including an air conditioner, a Thermal Energy Storage system, and a controller, wherein the controller is programmed to implement the above method. ... 2020-03-27 Priority to US17/598,373 priority Critical patent/US20220187028A1/en 2020-10-01 Publication ...

The Institute of Electrical Engineering, Chinese Academy of Sciences has obtained a patent right in an

"air-sand energy storage power station" in Chinese patent CN 110905744 B. The patent describes an upper sand storage warehouse (labelled 35 in the image) and a lower sand storage warehouse (labelled 33 in the image) and a gas supply system ...

Compressed air energy storage is a promising technique due to its efficiency, cleanliness, long life, and low cost. This paper reviews CAES technologies and seeks to demonstrate CAES"s models, fundamentals, operating modes, and classifications. Application perspectives are described to promote the popularisation of CAES in the energy internet ...

United States Patent, Patent number: 5431482, 1967. Schainker, R.B., Nakhamkin, M. Compressed-air energy ... Results indicated that shallow salt mines are suitable for compressed air energy ...

Patent: Compressed air energy storage system ... engine is operable as a compressor during slack demand periods utilizing excess power from a power grid to charge air into an air storage reservoir and as an expander during peak demand periods to feed power into the power grid utilizing air obtained from the air storage reservoir together with ...

Over the past decades, rising urbanization and industrialization levels due to the fast population growth and technology development have significantly increased worldwide energy consumption, particularly in the electricity sector [1, 2] 2020, the international energy agency (IEA) projected that the world energy demand is expected to increase by 19% until 2040 due to ...

A hybrid compressed air energy storage system is provided . A heat exchanger 114 extracts thermal energy from a com pressed air to generate a cooled compressed air stored in an air storage reservoir 120, e.g., a cavern . A heat exchanger 124 transfers thermal energy generated by a carbon - neutral

Liquid air energy storage (LAES) uses air as both the storage medium and working fluid, and it falls into the broad category of thermo-mechanical energy storage technologies. The LAES technology offers several advantages including high energy density and scalability, cost-competitiveness and non-geographical constraints, and hence has attracted ...

If we look at filing activity for liquid air energy storage compared to compressed air storage, we see there is a slower and later increase in patent filing activity. Looking more deeply, the activity in 2010 included patent applications by Lightsail Energy Inc and Expansion Energy LLC. Chart: Ben Lincoln / Potter Clarkson Mass-based energy storage

A method of liquid air energy storage is provided. This method includes liquefying and storing air to form a stored liquid air during a first period of time; during a second period of time, introducing a compressed air stream into a cryogenic system, wherein the cryogenic system comprises at least one cold compressor, and at least one heat exchanger.

Compressed air energy storage systems may be efficient in storing unused energy, but large-scale applications have greater heat losses because the compression of air creates heat, meaning expansion is used to ensure the heat is removed [[46], [47]]. Expansion entails a change in the shape of the material due to a change in temperature.

The present invention provides a compressed air energy storage power generation device including: an electric compressor configured to compress air using electric power; a pressure...

Liquid air energy storage (LAES) refers to a technology that uses liquefied air or nitrogen as a storage medium. This chapter first introduces the concept and development history of the technology, followed by thermodynamic analyses. ... US Patent (2009) Google Scholar [2] E.M. Smith. Proc. Inst. Mech. Eng. 1847-1982, 191 (1977), pp. 289-298 ...

A provisional patent has been issued for this prototype Stirling dual-engine apparatus constructed by NPS Systems Engineering students Lts. Christopher Girouard and Nicholas Bailey, with the support of advisor Dr. Anthony Pollman. The students" theses led to this novel approach, using a dual-Stirling engine charge and recovery method for liquid air energy ...

Air Storage Energy System; Mitsubishi Heavy Industries Ltd., Technical Review Vol. 35 No. 3 (1998) 117-20. ... Cold Heat-Reused Air Liquefaction / Vaporization and Storage Gas Turbine Electric Power System; United States Patent Application Publication US2001/0004830A1 (2001). H. Chen, Y. Ding, T. Peters, F. Berger: A Method of Storing Energy and

Energy storage systems are increasingly gaining importance with regard to their role in achieving load levelling, especially for matching intermittent sources of renewable energy with customer demand, as well as for storing excess nuclear or thermal power during the daily cycle. Compressed air energy storage (CAES), with its high reliability, economic feasibility, and ...

Compressed-air energy storage (CAES) is a commercialized electrical energy storage system that can supply around 50 to 300 MW power output via a single unit (Chen et al., 2013, Pande et al., 2003). It is one of the major energy storage technologies with the maximum economic viability on a utility-scale, which makes it accessible and adaptable ...

In contrast to other platforms using compressed air energy storage, the NPS team"s innovation would not necessitate large tanks for storage, or the geographical limits that hydro-electric recovery platforms need. The greatest benefit of this type of energy storage system using liquid air, is that the resource is all around us.

@article{osti_1531732, title = {High-efficiency liquid heat exchange in compressed-gas energy storage systems}, author = {Bollinger, Benjamin and Magari, Patrick and McBride, Troy O.}, abstractNote = {In various embodiments, efficiency of energy storage and recovery systems employing compressed air and liquid heat exchange is improved via control ...

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A method for operating the liquid air energy storage (LAES) includes production of the storable liquid air through consumption of a low-demand power and recovery the liquid air for co-production of an on-demand power and a high-grade saleable cold thermal energy which may be used, say, for liquefaction of the delivered natural gas; in so doing zero carbon footprint is ...

a proposed LAES system may comprise in combination: a compressor unit consuming off-peak power and providing compression of charging air up to pressure above a critical pressure, a hot thermal energy storage unit adapted to capture, storing and recovery of compression heat for superheating and reheating a discharged air, regenerable adsorber unit providing physical ...

@article{osti_863939, title = {Compressed air energy storage system}, author = {Ahrens, Frederick W and Kartsounes, George T}, abstractNote = {An internal combustion reciprocating engine is operable as a compressor during slack demand periods utilizing excess power from a power grid to charge air into an air storage reservoir and as an expander during peak demand ...

A compressed air pumped hydro energy storage and distribution system includes a first reservoir of water and a second reservoir of air and water. An air pressure source, connected to the second reservoir, develops a pressure head in the second reservoir. ... While in accordance with the patent statutes only the best mode and preferred ...