



## Uniqueness Analysis Report

Inventor Name: Paseo Demo

Invention ID: WEBDEMO-ENERGY-1

Title: Energy storage in mines

### Uniqueness: Low

Alternate Title: "Underground Gravity Energy Storage System Utilizing Regenerative Braking and Potential Energy Conversion for Enhanced Efficiency in Mining Operations"

Description: Underground Gravity Storage System will be used for storing energy in the coal or any deep mines. The system can be designed in such a mode that it can be operated over a very long time without any loss of efficiency. The entire system can be built from readily accessible materials. The system can be described as follows Large containers filled with sand are lowered into the mine shafts. As the containers descend, the motors controlling them use regenerative braking to generate electricity, which can be fed back into the grid. The electricity will be generated by converting the potential energy of the sand barrel to kinetic energy in the wheel to electricity in the turbine connected to the shaft. When there is surplus of electricity, the containers are hoisted back up the shaft, using the grid s power to turn the motors and store energy as potential energy. The image depicts a diagram illustrating the concept of saving energy in mines. It shows two vertical structures on the sides, labeled Mines Sides. Between these structures, there is a pulley system with a rope running over it. Suspended from the rope is a bucket containing weights. An arrow pointing upwards indicates the Discharge Energy, while another arrow pointing downwards represents Save Energy. The diagram demonstrates how the potential energy stored in the raised weights can be utilized to perform work or generate power, thereby conserving energy in mining operations.

### Summary:

Here is a 100-word summary of the key points from the text:

The Underground Gravity Storage System is a feasible innovation that leverages existing mining infrastructure to provide efficient energy storage and generation. By utilizing deep mines, the system stores excess electricity as gravitational potential energy, which can be released as needed. This addresses the challenges of energy storage and grid stability, particularly for renewable energy integration. The system's use of regenerative braking and potential energy storage aligns with principles of energy efficiency. Overall, the concept appears technically viable and could offer a sustainable solution for energy management in mining operations and beyond.



## **Feasibility Analysis:**

This is a feasible idea. The concept of using underground gravity storage systems in mines leverages existing infrastructure and materials, making it practical. The use of regenerative braking to generate electricity during the descent of the containers is a sound approach to energy efficiency. Additionally, the ability to store energy as potential energy by hoisting the containers back up aligns with established principles of energy storage. Overall, the idea appears to be technically viable and could provide a sustainable method for energy storage and generation in mining operations.

## **Problem Analysis:**

The invention disclosure for the Underground Gravity Storage System addresses the problem of energy storage and management, particularly in the context of renewable energy integration and grid stability. It aims to provide an efficient and sustainable method for storing excess electricity generated during periods of low demand or high renewable energy production, such as solar or wind power.

By utilizing deep mines for energy storage, the system leverages gravitational potential energy to store and release energy without significant efficiency loss over time. This solution also addresses the challenge of energy storage in locations where traditional battery systems may be impractical or costly. Additionally, it promotes the use of existing mining infrastructure, thereby reducing the need for new materials and construction, and contributes to the overall efficiency and sustainability of energy systems.

The problem addressed by the Underground Gravity Storage System is significant for several reasons:

1. **Energy Storage Needs**: As the world increasingly shifts towards renewable energy sources like solar and wind, there is a growing need for effective energy storage solutions. These sources are intermittent, meaning they do not produce energy consistently throughout the day or year. Without adequate storage, excess energy generated during peak production times can be wasted, leading to inefficiencies in the energy grid.
2. **Grid Stability**: The integration of renewable energy into the power grid can create instability due to fluctuations in supply and demand. Energy storage systems help to balance this by storing excess energy when supply exceeds demand and releasing it when demand exceeds supply. This is crucial for maintaining a reliable and stable electricity supply.
3. **Environmental Concerns**: Traditional energy storage solutions, such as lithium-ion batteries, have environmental impacts related to resource extraction, manufacturing, and disposal. The Underground Gravity Storage System proposes a method that utilizes readily available materials and existing mining infrastructure, potentially reducing the environmental footprint associated with energy storage.
4. **Long-Term Efficiency**: Many existing energy storage technologies suffer from efficiency losses over



time, whether due to chemical degradation in batteries or mechanical wear in other systems. The proposed system aims to operate over a long period without significant efficiency loss, making it a more sustainable option for long-term energy storage.

5. **\*\*Cost-Effectiveness\*\***: By using existing coal or deep mines and materials that are readily accessible, the system could potentially lower the costs associated with energy storage compared to building new facilities or relying on more expensive technologies.

6. **\*\*Utilization of Existing Infrastructure\*\***: The system takes advantage of existing mining operations, which may be underutilized or facing economic challenges. This can provide a dual benefit of enhancing energy storage capabilities while also supporting the mining industry.

In summary, the Underground Gravity Storage System addresses critical issues related to energy storage, grid stability, environmental impact, long-term efficiency, cost-effectiveness, and the utilization of existing infrastructure, making it a relevant and timely solution in the context of the global energy transition.

## **Technology Analysis:**

The invention disclosure for the "Underground Gravity Storage System" falls under the category of "Energy Engineering" or "Renewable Energy Technology." This system involves energy storage and conversion mechanisms, utilizing gravitational potential energy, which is a key aspect of energy engineering focused on sustainable energy solutions.

The "Underground Gravity Storage System" could be utilized in several industries, including:

1. **\*\*Mining Industry\*\***: Specifically in coal and other mineral extraction operations, where the system can be integrated into existing mine shafts to enhance energy efficiency and reduce operational costs.
2. **\*\*Energy Sector\*\***: Particularly in renewable energy companies that focus on energy storage solutions, as this system can help balance supply and demand by storing excess energy generated from renewable sources.
3. **\*\*Construction Industry\*\***: For projects that require energy-efficient solutions for heavy lifting and material transport, the technology could be adapted for use in construction sites.
4. **\*\*Utilities and Grid Management\*\***: Electric utility companies could implement this system to manage energy loads and provide grid stability, especially during peak demand times.
5. **\*\*Environmental Technology\*\***: Companies focused on sustainable practices and reducing carbon footprints may adopt this technology as part of their energy management strategies.



6. **Research and Development**: Academic and industrial research institutions may explore this technology for further innovations in energy storage and efficiency.

Overall, the invention has potential applications in any industry that requires energy storage, efficiency improvements, or sustainable practices.

Several companies across various sectors might be interested in utilizing the "Underground Gravity Storage System." Here are some examples:

1. **Mining Companies**:

- **Peabody Energy**: A leading coal producer that could benefit from energy efficiency in their mining operations.
- **Arch Resources**: Another major coal mining company that may explore innovative energy storage solutions.
- **BHP**: A global mining company involved in various minerals, including coal, that could implement energy storage systems in their operations.

2. **Energy Storage and Renewable Energy Companies**:

- **Tesla**: Known for its energy storage solutions, Tesla may explore gravity-based systems as part of its product offerings.
- **Fluence Energy**: A company specializing in energy storage technology that could integrate gravity storage into its portfolio.
- **Siemens Gamesa**: Involved in renewable energy solutions, they may look into innovative energy storage systems.

3. **Utility Companies**:

- **Duke Energy**: A major utility provider that could use such systems for grid management and energy storage.
- **Pacific Gas and Electric (PG&E)**: A utility company that may explore energy storage solutions to enhance grid reliability.
- **National Grid**: An electricity and gas utility company that could implement energy storage technologies to balance supply and demand.

4. **Construction and Heavy Equipment Companies**:

- **Caterpillar Inc.**: A manufacturer of construction and mining equipment that may be interested in energy-efficient solutions for their machinery.
- **Komatsu**: Another heavy equipment manufacturer that could explore energy storage systems for their operations.



5. **Research Institutions and Universities**:

- **MIT Energy Initiative**: Engaged in research on energy technologies, they may explore gravity storage systems for innovative energy solutions.
- **National Renewable Energy Laboratory (NREL)**: A research facility that focuses on renewable energy and energy efficiency technologies.

These companies and organizations may find value in the Underground Gravity Storage System for improving energy efficiency, reducing operational costs, and enhancing sustainability in their respective fields.

## **Products & Services:**

The Underground Gravity Storage System described in the text can lead to the development of several innovative products and services across various sectors. Here are some potential applications:

1. **Energy Storage Solutions**:

- **Gravity-Based Energy Storage Systems**: These systems can be marketed as a sustainable alternative to traditional battery storage, providing a way to store excess energy generated from renewable sources like wind and solar.

2. **Mining Operations**:

- **Energy-Efficient Mining Equipment**: The technology can be integrated into existing mining operations to enhance energy efficiency, reducing operational costs and carbon footprints.
- **Automated Energy Management Systems**: Software solutions that monitor and optimize energy usage in mines, utilizing data from the gravity storage system.

3. **Renewable Energy Integration**:

- **Smart Grid Solutions**: Products that facilitate the integration of this energy storage system into smart grids, allowing for better management of energy distribution and consumption.
- **Microgrid Systems**: Development of localized energy systems that can utilize the stored energy for community use, especially in remote areas.

4. **Regenerative Braking Systems**:

- **Electric Vehicle (EV) Components**: The regenerative braking technology can be adapted for use in electric vehicles, enhancing their efficiency and range.

5. **Educational and Research Tools**:

- **Demonstration Models**: Scaled-down models of the gravity storage system for educational purposes, helping students and researchers understand energy storage concepts.



- **Simulation Software**: Tools that simulate the performance of gravity storage systems under various conditions for research and development purposes.

6. **Construction and Infrastructure**:

- **Sustainable Building Materials**: Utilizing the materials and technology from the gravity storage system in the construction of energy-efficient buildings or infrastructure projects.

7. **Consulting Services**:

- **Energy Efficiency Consulting**: Services that help mining companies and other industries implement gravity storage systems and optimize their energy usage.

8. **Environmental Impact Solutions**:

- **Carbon Offset Programs**: Products or services that help companies offset their carbon emissions by implementing gravity storage systems and promoting renewable energy use.

By leveraging the principles of the Underground Gravity Storage System, a wide range of products and services can be developed that promote energy efficiency, sustainability, and innovation across multiple industries.

## **Feature Analysis:**

1. Utilizes underground coal or deep mines for energy storage.
2. Operates over a long time without loss of efficiency.
3. Built from readily accessible materials.
4. Large containers filled with sand are used for energy storage.
5. Motors use regenerative braking to generate electricity during descent.
6. Converts potential energy of sand barrels into kinetic energy and then electricity.
7. Surplus electricity is used to hoist containers back up the shaft.
8. Energy is stored as potential energy when containers are raised.
9. Includes a diagram illustrating the energy-saving concept in mines.
10. Features a pulley system with a rope and suspended weights.
11. Demonstrates the conversion of potential energy into usable work or power.

## **CPC Analysis:**

Based on the provided invention disclosure text, the CPC classification codes are as follows:

1. F03G7/08 - Mechanical-power-producing mechanisms, not otherwise provided for or using energy sources



not otherwise provided for, using potential energy, e.g. gravity

2. H02J3/28 - Arrangements for circuit control in electricity supply or distribution systems for storing electrical energy

3. E21F17/18 - Safety devices, e.g. for preventing dangerous gases from escaping from mines

4. F03G7/00 - Mechanical-power-producing mechanisms, not otherwise provided for or using energy sources not otherwise provided for

5. H02J15/00 - Systems for storing electric energy

## Potential Claims:

### **\*\*Patent Application Claims for Underground Gravity Storage System\*\***

1. **\*\*A method for storing energy in underground mines, comprising:\*\***

- lowering large containers filled with sand into a mine shaft;
- utilizing regenerative braking of motors controlling the descent of the containers to generate electricity;
- converting the potential energy of the descending containers into kinetic energy, and subsequently into electrical energy via a turbine connected to the shaft;
- feeding the generated electricity back into the electrical grid.

2. **\*\*The method of claim 1, wherein the containers are hoisted back up the mine shaft using electrical power from the grid, thereby converting electrical energy into potential energy stored in the raised containers.\*\***

3. **\*\*An underground gravity storage system, comprising:\*\***

- a mine shaft configured to accommodate the vertical movement of large containers filled with sand;
- a pulley system operatively connected to the containers for controlled descent and ascent;
- motors configured to control the descent of the containers and to generate electricity through regenerative braking during descent;
- a turbine connected to the shaft for converting kinetic energy into electrical energy.

4. **\*\*The underground gravity storage system of claim 3, wherein the containers are constructed from readily accessible materials, allowing for cost-effective construction and maintenance.\*\***

5. **\*\*The underground gravity storage system of claim 3, further comprising a control system for managing the operation of the motors and the flow of electricity to and from the grid.\*\***

6. **\*\*The method of claim 1, wherein the energy storage and retrieval process can be repeated over an extended period without significant loss of efficiency.\*\***



7. \*\*The underground gravity storage system of claim 3, wherein the system is designed to operate in various types of underground mines, including coal mines and other deep mines.\*\*
8. \*\*A system for energy conservation in mining operations, comprising:\*\*
  - a vertical structure configured to support a pulley system;
  - a rope running over the pulley system, with a bucket suspended therefrom containing weights;
  - means for converting the potential energy of the raised weights into usable energy for performing work or generating power.
9. \*\*The system of claim 8, wherein the weights are adjustable to vary the amount of potential energy stored, allowing for customization based on energy needs.\*\*
10. \*\*A method for enhancing energy efficiency in mining operations, comprising:\*\*
  - utilizing a gravity-based energy storage system as described in claims 1-9 to balance energy supply and demand during mining activities.