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Electrical Energy Storage

Management Reports from EscoVale Consultancy Services

Report #5060

Electrical Energy Storage: Application Analysis and Market Forecast

This document should contain 10 pages: this introductory page; a four-page leaflet / order form; and the contents pages from Energy Storage Report #5060.

Report #5060 is at the heart of EscoVale's storage work program. Other reports will build on this platform, including a series investigating particular energy storage technologies. The next two will cover:

#5061: Flow Batteries

#5062: Electrical Energy Storage Based on Thermal Techniques

More than ten flow battery technologies are at various stages of development, from the laboratory to pre-commercial / early commercial production. Flow batteries have the potential for exceptional cycle life, together with low capital costs per unit of stored energy. They will be amongst the strongest electrochemical competitors in multi-hour storage applications.

Several different approaches are being developed for electrical energy storage based on high temperature / low temperature / cryogenic media. These include attractive contenders that justify attention in their own right. Another reason for reporting on this group ahead of some of the more obvious candidates is simply because they are the least familiar of the emerging storage categories. As such, a sensible report on this topic should be of value to potential users, investors and developers of rival storage technologies. Finally, this will give an opportunity to review thermal-output storage systems, which operate in the same business area and directly influence the market for electrical-output storage.

Sure Insight's mission is to provide world class information and consultative services. If you need further information on any of the above reports, or if anything requires clarification, please contact:

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Electrical Energy Storage

Report #5060: Application Analysis and Market Forecast

The core report in a major management study examines global opportunities for long-duration (hour-plus) storage technologies, with detailed forecasts of short-, medium- and long-term market development in stationary and mobile applications

EscoVale's latest multi-client study is backed by nearly 100 clients from five continents

Electrical energy storage has remarkable diversity. Over 300GW is already installed, just in stationary applications. Some require short bursts of power for milliseconds or minutes; others call for substantial amounts of energy, delivered over a period of hours or even days. *Much* larger opportunities await the development of novel storage technologies, to meet requirements associated with:

- support of renewable and distributed energy resources
- effective production, delivery and management of power
- the provision of secure, high-quality power at end-user sites
- enabling technologies within the transportation sector.

These opportunities are now capturing the imaginations of a wide range of developers, potential users and investors.

Dozens of largely unproven technologies are vying for a stake in a market with tantalizing prospects but many uncertainties. Decision-makers are hampered by a lack of reliable, unbiased information. EscoVale has an unrivalled 30-year track record in meeting this need for many hundreds of clients in six continents.

This leaflet describes the core report within a large management study examining high-energy storage solutions (typically capable of delivering nominal rated power for an hour or more). Worldwide coverage of stationary and motive power applications starts at single-digit kW ratings and extends to GW-scale projects.

The core report (#5060) investigates the role of energy storage in a wide range of applications, with detailed market forecasts. It is available separately (as described here) or as a key component of the wider management study. Clients for this report can add other elements later, if they wish to do so.

Report #5060 contains:

- An introduction to the long-duration energy storage sector and its established and emerging technologies.
- Reviews of areas that will help define the storage market, with original data on the future size and structure of the electricity supply and vehicle industries.
- Chapters examining storage in the electricity supply industry (with a separate chapter for renewables), at end-user sites, and in motive power – each with detailed market forecasts.
- An analysis and forecast of the total storage market, with estimates in terms of power, energy, value and units.

Which is closer to the truth?

“Economic and performance limitations will restrict energy storage to a very minor role in public power and transportation markets”

... or ...

“Advanced batteries and other storage products are about to change the entire framework of the million-dollar-a-minute electricity supply and transportation industries”

Opinions are as varied as the storage sector itself.

In the past, many people simply ignored storage, arguing that, unlike other forms of energy, electricity needs an instantaneous match between production and demand.

In practice, of course, there is a multi-\$bn business in established storage systems serving grid-connected, remote power and motive power applications.

The fact that it has been commonplace to disregard this, simply underlines the huge opportunities open to emerging technologies with more attractive characteristics

OBJECTIVES

The main objectives of this study are: to examine the role of long-duration storage across the application spectrum; to give a thorough understanding of the technical and commercial issues; and to produce realistic forecasts of market development. This is intended to provide a solid framework within which potential users, investors and suppliers can make informed decisions.

Report #5060 provides the foundation for much of the other work within the wider management study. The overall work program includes additional reports and consultancy entitlements for individual clients.

ENERGY STORAGE TECHNOLOGIES

Pumped hydro has dominated the high power long-duration energy storage sector, while **conventional batteries** have a near monopoly at low powers. There are many other candidates, ranging from early stage developmental technologies, to products with years of operating experience. These include:

- a variety of electrochemical storage systems (**advanced low temperature batteries, various high temperature batteries, metal / air batteries, flow batteries etc**)
- **compressed air energy storage** (mainly large-scale systems, but also mini-CAES)
- **thermal systems** (based on high temperature and cryogenic media – with an electrical output)
- **chemical energy storage** (notably with hydrogen, but this is one of many alternatives).

The list goes on, and includes technologies associated mainly with short-duration applications, where some developers are also eyeing hour plus opportunities (e.g. high energy **ultracapacitors** and **flywheels**).

Other components of EscoVale's management study will build on the information in Report #5060 to examine specific storage technologies. The function of Report #5060 is to provide a timely analysis of the wider storage market and its future development. Naturally, this requires an assessment of the evolution of many storage technologies (and the progress that will be made by alternatives to storage) but this report amalgamates the principal data into three categories:

- physical storage technologies (e.g. pumped hydro, CAES, thermal)
- electrochemical
- other (e.g. hydrogen-based electrical energy storage systems).

There can be no doubt that some of the emerging technologies would be on the receiving end of a \$bn stampede, if products were available today at the performance and price levels envisaged for mature systems. Energy storage has all the hallmarks of a winning technology, characterized by:

- obvious but largely unexploited market opportunities
- great diversity in terms of application areas and credible technologies
- massive potential markets
- powerful market drivers, with decision makers becoming increasingly receptive to storage as a means of tackling some of their most intractable problems
- a proven track-record, demonstrating that at least some new technologies actually work
- plausible routes to achieving cost-reduction / performance-improvement targets
- modest technical risk.

This is a dangerous time, as developers of every other wunderkind energy technology can testify! As ever, completing the development of acceptable, market-ready products will take longer and cost more than developers and impatient investors can readily afford; and still more time will elapse before these are accepted as mainstream solutions by cautious purchasers – who are faced with a difficult choice of technologies and have got by quite well up to now, without much help from storage. A sizeable casualty list will grow further, but the rewards for those still standing when the market finally lifts off are already attracting new developers, backers and well-wishers.

REPORT PREPARATION

The report team, led by Frank Escombe, includes experienced EscoVale personnel and others (notably Anthony Price of Swanbarton). EscoVale has supplied more than 500 management reports concerned with emerging energy technologies, giving it a leading position in this area.

Frank Escombe has an R&D background in power engineering, together with more than 30 years' experience in business consultancy relating to the electrical, electronic and transportation industries. He has carried out research in 30 countries and prepared almost 100 reports on distributed generation, electric propulsion, energy storage and related topics.

Anthony Price has worked for engineering contractors and consultants in a variety of technical and commercial roles and has considerable experience in developing and commercializing energy storage technologies. He has worked in intellectual property strategy and administration, market research and due diligence work for technology transfer and new business development. He is a member of the US DOE's Peer Review Panel on Energy Storage Systems, and a member of the Electricity Storage Association's advisory committee, having been an elected director for five years.

REPORT CONTENT

Key objectives are to examine the opportunities for long duration storage, and to make sensible forecasts, taking account of the remarkable changes occurring within the power, transport and other sectors, and within the energy storage industry itself.

The forecasts cover the difficult near-term transition to the next market expansion phase and its evolution to 2025, together with the subsequent development to 2050 (important in an area where decisions over the next few years will be guided by longer term objectives, when key market drivers will be much more potent than they are today). Forecasts are given in MW/year (aggregate rated power), GWh/year (aggregate storage capacity per cycle), value and units. The report includes estimates of the market distribution: by territory; application; rating; and technology.

Report #5060, published in Q2 2010, contains 10 Chapters, more than 230 pages and about 60 charts and tables:

- **Introductory Chapters:** (about 40 pages in all, setting the scene in terms of concepts, types of energy storage and selection criteria, an overview of storage applications, and a forecast of developments within the electric power sector and its position within the wider energy market)
- **Storage Applications & Markets:** (four chapters, over 150 pages, examining numerous applications for storage associated with: renewable energy; management of electricity supply systems; use at end-user sites and in off-grid / weak grid situations; vehicular and other mobile markets. Each chapter includes detailed forecasts of storage markets, and their accessibility to electrochemical, physical and other storage technologies)
- **Market Overview & Conclusions:** (this draws together the previous forecasts; considers the interaction and overlaps between the different sectors; and presents estimates and forecasts for the overall market (in terms of power, energy, value and units) broken down by application, territory, power range and technology).

The contents pages of the report are available on request (they are usually appended to the pdf version of this leaflet).

Please contact william.breame@sureinsight.co.uk if you have any questions regarding this report or for further information on other aspects of the energy storage management study

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EscoVale Report #5060
“Electrical Energy Storage: Application Analysis and Market Forecast”

Currency	US Dollars	Euro	Yen	GB Pounds
Price	\$5,000	€3,500	¥ 400,000	£3,000

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