WRIGHT ENERGY STORAGE TECHNOLOGIES

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The True Cost of Lithium-ion Batteries

At Wright Energy Storage Technologies (WEST), we believe energy storage is the key to energy transition and energy efficiency, but today's go-to energy storage technology is not delivering what the market needs. Different than what Lithium-ion (Li-ion) batteries offer, energy storage must be safe, sustainable, robust and economically viable.

WEST was founded to design, develop and commercialize a better energy storage solution because of a simple truth: Li-ion batteries often cost more and deliver less than promised. While the conversation around Li-ion usually stops at fire risk or technical jargon, it is important to focus on the real-world, under-performance we at WEST have witnessed over two decades of work in the renewable energy industry.

What does it actually cost to own and operate Li-ion energy storage systems, and are you therefore really getting the energy independence you paid for? This is the question we set out to answer here.

The analysis presented in this article is backed by decades of commercial experience and focused engineering expertise. William “Billy” De Jong, WEST's CTO, has been in the renewable energy trenches for over 20 years, specializing in long-duration energy storage. An electrical engineering graduate from Stellenbosch University, Billy is widely recognized for his pioneering work in supercapacitor-based storage systems, born from the frustrations of working with Li-ion storage systems in the heat of South Africa. His experience designing and commercializing energy solutions for some of the most demanding environments is at the core of WEST’s mission: building energy storage that is safer, longer lasting, and ultimately a smarter solution than Li-ion.

The True Cost of Li-ion Batteries

Li-ion has long been the go-to choice for energy storage. It dominates the market for energy storage in phones, cars, laptops, home batteries, industrial systems, and even grid-scale storage. But behind the familiar name and promising specs lies a far more complex truth. This article sets out to empower the consumer with knowledge, clarity, and transparency about the real cost of Li-ion ownership.

With Li-ion, there's no such thing as a simple upfront cost. The widely advertised low system prices are just the beginning. What follows are hidden expenses, inefficiencies, and ongoing operational costs that can more than double your total investment over the battery's lifetime. The true cost of Li-ion can be broken down into two core categories:

Upfront Battery Cost

The cost of the Li-ion battery system itself - and what you're actually getting vs. what is promised.

+

Additional Operating Costs

The cost of everything else: installation, replacements, design limitations, inefficiencies, and what it takes to keep a system running.

This isn't just about money - it's about energy literacy, consumer empowerment, and encouraging more transparency in the energy storage industry. Li-ion does have its place in the energy landscape, but understanding the full picture helps you choose the solution that is right for you.

The Battery

At first glance, a Li-ion battery seems like a straightforward, one-time investment - you pay for a system based on its storage capacity and price. However, because of its chemical composition, Li-ion comes with hidden costs that are rarely disclosed up-front, such as how much of the purchased nameplate capacity isn't accessible and how quickly degradation reduces that capacity.

1. Usable Capacity

When you buy a Li-ion system and use 100% of the capacity, you will very quickly destroy your battery. Scientific studies show that discharging deeply, below 20%, dramatically accelerates Li-ion degradation and shortens its lifespan[1][2]. For that reason, almost all Li-ion installers electronically prevent you from using the last 20% of the battery's capacity through their battery management system ("BMS"), effectively locking that portion away. That means that from day one, you're only getting 80% of what you paid for. You may be promised a 10 kWh battery, but you'll only ever be able to use 8 kWh of it. And this is just the starting point.

2. Efficiency Loss

With every charge/discharge cycle, a Li-ion battery loses a portion of the energy entering and leaving the battery due to internal resistance. How do you measure this loss? By looking at an energy storage devices' Round Trip Efficiency (RTE). This loss is quantified as the amount of energy you get out vs. the amount of energy you put in. Real-world Li-ion testing by the Australian Renewable Energy Agency (ARENA) shows that residential and commercial Li-ion systems deliver between 78% and 95% efficiency - meaning 5-22% of energy is lost per cycle[3][4]. On average, that's 13% of the energy storage that you paid for, but never get to use. This may seem minor, but over hundreds of cycles, it significantly reduces the actual energy output and increases the effective cost of ownership.

3. Degradation and Oversizing

Li-ion batteries naturally degrade over time due to their chemical composition. For instance, a smartphone's Li-ion battery will display a health status of approximately 79% after 18-24 months of regular use - indicating a 21% reduction in its original capacity. Now scale that to residential or industrial systems. From day one, only 80% of a system's rated capacity is available to you - and that number keeps dropping with the degradation experienced during each cycle. Out of 26 participants in real-world testing by ARENA, the two top-performing residential battery packs only retained 80% (and remember you are already prevented from using 20% of the battery) of their initial capacity after 2,000 cycles, confirming a steady capacity decline[5][6]. To keep meeting your energy needs over the battery's lifetime, you need to oversize the system, often by 30-40% just to compensate for limits on usable capacity upfront and degradation over time.

4. Short Lifespan

Unfortunately, most Li-Ion batteries do not last as long as the manufacturers tell you. We know of almost no stationary storage systems that have been operating more than 5 or 6 years. Unfortunately, during that period, degradation is eating away at your capacity while you are likely adding new loads to your system – both machinery and electronics – as you grow. If you install additional capacity to keep up, the newer batteries will have to do more work to assist the older batteries, thereby stressing the entire system. While out of the scope of this analysis, you can expect to replace your Li-ion energy system several times over the next twenty years. While that might not seem burdensome, the cost and hassle of purchasing and installing a brand new storage system every 5 or 6 years should give you pause – especially when you realize that you don't have to do that with a WEST system.

Overall Operating Costs

Purchasing a Li-ion battery is only the beginning of your investment. Beyond the system cost lies a series of additional expenses - each one essential to keep the system running safely and effectively. These costs fall squarely on the owner's shoulders. And they add up fast. You'll see by the end of this article that it's not easy to calculate the true cost of Li-ion battery ownership, but it's a lot higher than what you are charged upfront.

1. Safety Protocols

Every Li-ion battery carries a fire risk. If damaged or overheated, it can enter thermal runaway, igniting spontaneously and burning at extremely high temperatures in a self-

sustaining process. These are among the most destructive fires and require specialized suppression systems built for Li-ion incidents. For a typical home battery system, a lithium-compatible fire extinguisher costs around US $500-1,000, which represents approximately 5-10% of a 5 kWh system's installed cost. These extinguishers also incur ongoing costs: annual inspections, refills or hydrotesting every 5 years, and replacement following use or damage[7]. In larger systems, where you're dealing with equipment like cables, controls, HVAC, and integrated suppression, costs can climb to around 23% of the system cost, as identified by Pacific Northwestern National Laboratory (PNNL) in their 2020 assessment of residential-scale storage systems[8]. Industry-wide forecasts show the lithium-battery fire suppression equipment market is set to expand dramatically, projecting revenues to exceed US$114 billion by 2032 - highlighting just how critical, and costly, fire protection has become when storing Li-ion at any scale[9], So when you install a Li-ion battery, you're not just paying for energy storage - you're also investing significantly in safety infrastructure. These systems are often mandatory for insurance compliance and risk management.

2. Insurance Costs

Insurers are increasingly aware of the fire risk associated with Li-ion batteries. This concern has translated into significantly higher insurance premiums for homes and businesses[10][11]. Australia's major insurer, Suncorp, has publicly warned about rising Li-ion fire incidents and the resulting pressure on premiums[10]. Battery-related fire claims have surged in recent years, which helps explain why insurers are tightening underwriting and pricing for high-risk installations[12]. Homeowners across the market are already seeing 10-30% increases in their insurance premiums. Insurers are closely watching battery risks as a contributing factor[12]. If your battery has a five-year lifespan, the total insurance costs to cover your home for fires during those five years will be ~25% of the system's initial cost[13]. This is a substantial cost, resulting simply because your property now houses a hazardous material with a risk profile that only worsens as your battery ages.

3. Cost of Upkeep & Power Usage

To keep a Li-ion battery running effectively, you need to operate it in within a limited ambient temperature range, which is typically 15 °C to 35 °C. Outside this range, battery efficiency drops, degradation accelerates, and safety becomes a concern. As a result, most systems require thermal management infrastructure, including active cooling/heating, insulation, and environmental controls inside of the battery enclosure. These temperature control mechanisms require power, and it is the battery that must carry what is known as the "parasitic load" to keep them operational. However, the need for these controls again diminishes the net benefit of the battery. A real-world evaluation found that control systems and thermal management systems use approximately 5-10% of your system's battery output[14][15]. Unfortunately, without this ongoing operational cost your battery risks faster degradation, underperformance, safety issues, and a shortened lifespan.

4. Maintenance & Fault Costs

When a Li-ion battery develops a fault or a component needs servicing, it often must be sent back to the manufacturer or a certified repair center at the owner's expense for repair. Beyond repair fees, you also pay hazardous-goods shipping costs, which can be substantial. Because Li-ion batteries are classified as dangerous goods (UN 3480/3481), shipping them, even domestically, requires certified packaging, trained personnel, and compliance with strict regulations. For residential systems, these

elevated shipping costs typically range from US$500-1,500 per shipment depending on distance, carrier, and regulatory complexity[16][17]. Once at the repair center, and in the unlikely event that repair is even an option, diagnostic and component replacement can add another US$1,000-2,000, depending on warranty coverage and fault complexity[18]. A single fault event can therefore cost 15-25% of the original system's investment when combining transport, labor, and repair charges before you even start calculating the cost of downtime[16][18].

5. Disposing of the Battery

When your Li-ion battery reaches the end of its life, disposal isn't as simple as unplugging and tossing it out. Due to the hazardous nature of chemical batteries, proper decommissioning and disposal are both complex and costly[7]. The majority of countries lack accessible, commercially viable Li-ion recycling facilities, concentrating recycling capacity to only a few countries - meaning end-of-life batteries frequently need to be exported for disposal[19]. This process involves several steps:

- Decommissioning Fees: Authorized installers are required to safely disconnect and remove a battery, incurring additional costs.
- Transportation Costs: Given that Li-ion batteries are classified as hazardous materials, shipping them—especially internationally—requires hazardous goods handling and compliance, which commonly adds roughly US$10-30 per kWh in transportation and handling fees (and can be higher for long-haul international shipments)[15].
- Recycling Expenses: The actual recycling process is intricate. Current industry estimates put recycling processing at about US$26 per kWh, with additional decommissioning and transportation on top of that[7].
- End-of-life handling, transportation, and recycling costs can rise substantially and typically reach 10-25% of the system price in regions without local recycling. All of these costs are typically borne by the consumer[7][19].

More Than a Price Tag

Between efficiency losses, hidden upkeep, insurance hikes, complicated and costly repairs, and end-of-life handling, what you pay upfront for a Li-ion battery is only part of the story. Knowing the full picture empowers you to invest wisely, ask the right questions, and choose a solution that genuinely delivers on its promise. Energy independence shouldn't come with invisible strings.

WHAT YOU TRULY GET	WHAT IT TRULY COSTS
- 80% usable capacity out of the box	+ 35% for oversizing
- up to 13% efficiency loss for every charge/discharge cycle	+ 18% for recycling and disposal
- 6-7% degradation per year	+ 8% for fire suppression systems
	+ 8% for parasitic heating and cooling
	+ 20% for shipping and maintenance
	+ 25% for insurance

In the end, despite the promises, you're only getting about 50% of the nameplate capacity you paid for, and you can expect to spend an estimated 114% more on top of your Li-ion system's price tag just to own and operate it safely over time.

Li-ion batteries rarely deliver the long-term value they promise. At WEST, we've built our mission around offering something better: energy storage that is safer, longer lasting, more efficient, more powerful, and easier to maintain. With our expertise in supercapacitor-based technology, WEST gives you not just energy storage, but energy independence you can trust. **Store Energy the *Wright Way*.** Visit us at **www.wright.energy.**

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