Choosing the right energy source for your materials handling fleet:

Lead acid vs lithium ion vs hydrogen fuel cell.

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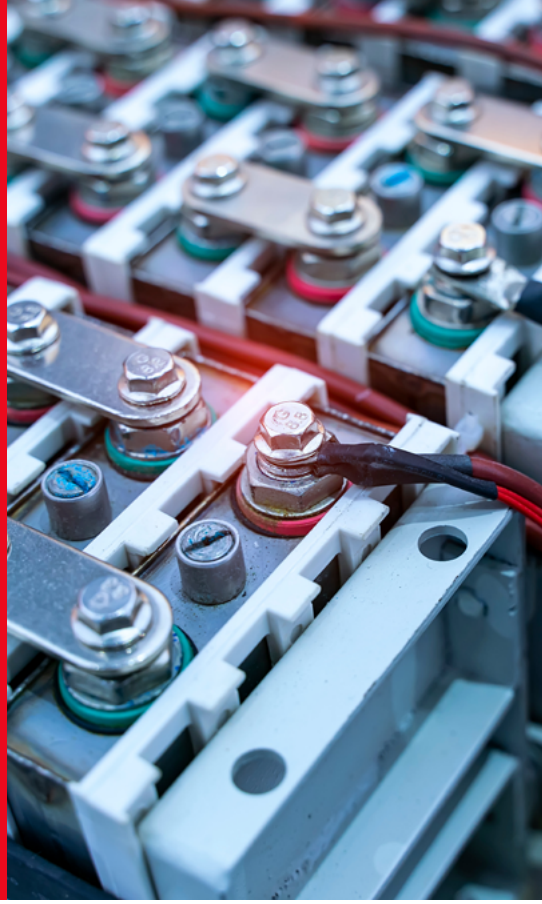
MATERIAL HANDLING

When choosing electric materials handling equipment it is important to be aware of the options you have, typically there are three energy sources: lead acid, lithium-ion and hydrogen fuel cell.



However, each of these power sources has its pros and cons, varies in cost and provides different levels of energy efficiency. It is important to choose the right energy source for your business to meet long-term goals, such as driving profitability and ensuring long-term business growth.

But where do you even start?

We want to make choosing the right energy source for your fleet as seamless as possible. That is why we have created this comparison guide. We have included a matrix that compares a range of factors related to fuel types, including:

- Initial costs
- Ongoing costs
- Performance
- Refuel time
- Energy efficiency
- Maintenance requirements
- Environmental impact
- Storage requirements

Energy sources for your fleet:

Factors to consider.

The choice of energy used to power trucks has been an increasingly important factor for businesses to consider in recent years.

Not only can the correct type of energy source positively impact your business, but it can also offer environmental benefits.

Of course, choice can be a good thing — but it can also be a little overwhelming. Especially when you are strapped for time and do not have the time to read through exhaustive articles weighing up pros and cons.

We wanted to make it easy for you. Below, you will find a matrix that offers a straightforward comparison of the energy solutions available so you can choose the right energy source for your forklift fleet.

	Lead acid.	Lithium-ion.	Hydrogen.
Initial costs.	The initial purchase price of lead acid trucks is much lower than other solutions.	The initial purchase price of lithium-ion batteries is currently around twice as high lead acid.	The initial purchase price of hydrogen fuel cell trucks is higher than other solutions.
Operating costs.	Whilst operating costs are fairly low, consideration for lost time due to maintenance and battery care in busy applications can be a factor.	The energy costs are much more affordable for lithium-ion. They are more energy efficient than lead acid, so energy use is lower, but opportunity charging at breaks is crucial.	Routine maintenance of the unit is required but the fuel if self generated could almost be free (green hydrogen through the use of solar or wind for example).
Performance.	Lead acid batteries can be used for 8 hours depending on the application or environment before needing a charge or change.	Lithium-ion batteries are smaller and run for less than lead acid. But with opportunity charging can keep going all day.	Hydrogen fuel cells runs similar to lithium-ion but can be fully refuelled much faster.
Refuel time.	Lead acid batteries can typically be recharged in 8-12 hours.	The complete charge time is typically 1-2 hours for a lithium battery.	Refuelling takes only 2-3 minutes and there is no need for battery changes.
Energy efficiency.	Lead acid batteries usually have a cycle life of 1,200 - 1,500 cycles if maintained correctly. This offers a medium level of energy efficiency.	Lithium batteries usually have 2-3 times the cycle life of lead acid and are more energy efficiency.	Hydrogen fuel cell can offer high levels of efficiency depending on the hydrogen source.

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Maintenance requirements.	Lead acid requires electrolyte topping on a routine basis. Good battery management is required to keep it at its best.	Lithium batteries are truly maintenance free operationally, only needing a periodic health check by a battery provider.	Hydrogen fuel cell units still require routine servicing and care.
Environmental impact.	Lead acid batteries are 99% recyclable and depending on the energy source, the environmental impact can be very low operationally.	Whilst lithium is not quite as recyclable as lead, operational energy usage is lower and they have a much longer life cycle.	With hydrogen fuel cells, trucks operate with zero emissions — as distilled water is the only waste product. Using 'green hydrogen' makes the entire hydrogen lifecycle carbon neutral.
Storage requirements.	Due to the chemicals and gases produced due to charging, lead acid batteries often need dedicated charging areas, potentially with ventilation.	Lithium-ion batteries have no by-products when charging, so can literally be charged anywhere, even within food industries.	Hydrogen is stored at very high pressure, so care must be taken as to where this is located and how it is accessed.

Read on to learn more about the different energy sources available for your forklift fleet, including performance benefits and the situations they would be useful in.

Lead acid battery solutions.

Electric powered forklifts have historically derived power from lead acid batteries.

Below, we have provided a breakdown of the key advantages and disadvantages of lead acid battery solutions.

What are the advantages of lead acid battery powered trucks?

Low investment costs: Lead acid batteries have the lowest initial cost. They can be purchased for significantly less than other solutions, which make them a great option if you are looking to stretch your budget.

A recyclable product: These batteries are also 99% recyclable. This means that they can positively contribute to your waste management goals and support you when building a green operation.

High durability: Although lead acid batteries require regular maintenance, with proper care, they can be used for up to more than five years.

What are the disadvantages of lead acid solutions?

Regular maintenance: While lead-acid batteries have the lowest initial cost, they do require regular maintenance to remain in peak condition. This can result in downtime and higher maintenance costs each month.

Longer charging times: Lead acid batteries require a separate charging room and take 8-12 hours to be fully charged. The battery also requires water top-ups regularly.

Lower performance in cold environments: This solution is not as versatile as some of the other options. With a lead acid battery, capacity can decrease when used in colder environments.

Lithium-ion solutions.

Lithium-ion batteries have fast become a popular power source. This is because it is one of the most energy efficient solution available, easier and faster to charge than lead-acid and allows opportunity charging.

They also provide higher cost savings and a hassle-free maintenance schedule for your team. But this solution isn't for everyone, there are potential drawbacks to keep in mind. Read on to discover the key advantages and disadvantages of lithium-ion solutions.

What are the advantages of lithium-ion solutions?

Cost savings and lower total cost of ownership: This provides your business with cost-saving opportunities and ensures you can use the same fleet for longer periods. They are also much more environmentally friendly, meaning you have a solution to help you meet your sustainability goals for years to come.

Zero maintenance: Unlike lead acid battery-powered trucks, lithium-ion solutions are maintenance free. They only require a periodic health check by a forklift battery provider. This can dramatically reduce downtime and help you cut back on labour costs.

A versatile solution: Lithium-ion batteries thrive in operations where trucks need to be used in cold environments. They are also highly versatile and are now capable of being operated in outside environments too.

Opportunity charging and increased productivity: Highly suited to both single and multi-shift environments, it is easier and faster to charge than lead-acid and allows opportunity charging. This eliminates the need to change batteries during the day, maximising overall truck productivity rates.

What are the disadvantages of lithium-ion solutions?

Higher upfront costs: Lithium-ion batteries cost twice as much than their lead-acid counterparts on average. However, they do have a lower cost of ownership.

Cost more to recycle: Lithium-ion batteries' end-of-life cycle is not as straightforward as that of lead acid batteries because there are costs associated with recycling them.

Unable to connect to older forklifts: Many older forklifts are not designed to connect with lithium-ion batteries. This means you would have to consider investing in an entirely new fleet if you decide this energy source is suitable for your business needs.

Hydrogen-powered solutions.

Hydrogen fuel cell trucks combine the sustainability of an electric truck with the practicality and short refuelling time of an internal combustion engine. If you switch to this solution, you will need to make initial changes to your facility to include the right hydrogen infrastructure.

However, that investment starts to pay itself back immediately if the hydrogen is self generated and green hydrogen (solar or wind for example). This solution is the most effective way to improve your sustainability credentials. Let's look at some of the advantages and disadvantages of hydrogen-powered solutions in more detail.

What are the advantages of hydrogen-powered solutions?

High levels of flexibility: Hydrogen-powered forklifts can operate effectively indoors and outdoors. However, hydrogen is stored at very high pressure so care must be taken as to where this is stored and accessed.

A sustainable option: These trucks operate on a zero-emission basis. Compared to lead-acid and internal combustion engines, they are a much more sustainable solution and will help you reach sustainability goals more quickly. With no toxic chemicals, these trucks are also safe for operators in all settings.

High cost savings in the long run: Hydrogen-powered trucks can operate for longer times and with less frequent refuelling than other solutions. This ensures you can build an efficient operation, maximise productivity and reduce downtime — contributing to profitability over time.

What are the disadvantages of hydrogen-powered solutions?

Most suitable for large fleets based at one location: This might be a drawback for a smaller business or those that operate in multiple locations. However, it is worth noting that this type of solution can still work; you may just not see as quick a return on investment.

Hydrogen storage: Hydrogen must be stored in high-pressure tanks, so you will have to factor an additional cost of purchasing these tanks into your budget.

Fuel cell efficiency: Hydrogen performance and efficiency is similar to lithium-ion but can be fully refuelled much faster.

So, there you have it — a round-up of the different energy source options available for your fleet. Of course, there is plenty to consider and what you need will depend on your situation and what you are trying to achieve.

You are likely working to a budget and have unique ways of operating that leave you a little unsure about which solution is best for you. That is why it is always worth speaking to a specialist who can get to know your business and provide the guidance you need.

We understand this is a big investment. The last thing you want to do is spend money on a solution that ultimately does not reap the benefits you hoped it would. If you would like to speak to one of our specialists and feel rest assured that you make no mistakes when choosing the right energy source for your materials handling fleet, we would love to start a conversation.

Helping you do what you do best — book a consultation today.

Toyota Material Handling is the world's number one in developing and producing innovative, high-quality material handling solutions. We are here to ensure you get the most out of your equipment and warehouse configuration — from the shop floor to the site infrastructure.

If you have more questions about warehouse automation or automated vehicles, talk to one of our experienced specialists.

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