



# Pioneer Mobile Hydrogen Refuelling Station

**A MOBILE 350 BAR AUTOMATIC FLEXIBLE CASCADE SYSTEM**



Fast to Deploy. Easily Scalable.

# The Revolution of Hydrogen as a Fuel Source Has Begun



Hydrogen is rapidly being recognised as a leading, clean fuel for commercial transport and many other applications.



Zero emissions, only clean water



Fast refuelling capability (minutes, rather than hours)

The environmental, social and performance benefits of hydrogen are pretty well understood, but it has failed to get off the launchpad as a solution for transport fuel.

## Why, what's missing?

### An affordable hydrogen refuelling infrastructure!

Up until now, infrastructure has been subscale, expensive, and unreliable. Regulation, financing and construction has been clunky.

## Resolving the 'chicken and egg' problem



Industry insiders often talk about Hydrogen's 'chicken and egg' problem. Vehicle manufacturers cannot sell hydrogen vehicles without a refuelling infrastructure; fuel network providers cannot recoup their investment if there are not enough vehicles using hydrogen. **The result is Gridlock!**

### Our approach

has been to redefine the Chicken and Egg problem as simply:

"Refuelling infrastructure is too expensive".

**Now that's an engineering problem we can fix!**



# Pioneer Mobile Hydrogen Refuelling Station

Efficient, Safe, Fast Hydrogen Refuelling

If you're looking for a low cost, reliable refuelling solution that can help you get your hydrogen vehicle fleet or equipment off the ground fast, then you need Pioneer.

- ✓ Combined solution
- ✓ Fast deployment
- ✓ Easily scalable
- ✓ Low-cost capital
- ✓ Reliable network



The Pioneer is suitable for a wide range of applications



Buses

HGVs

Delivery Vans

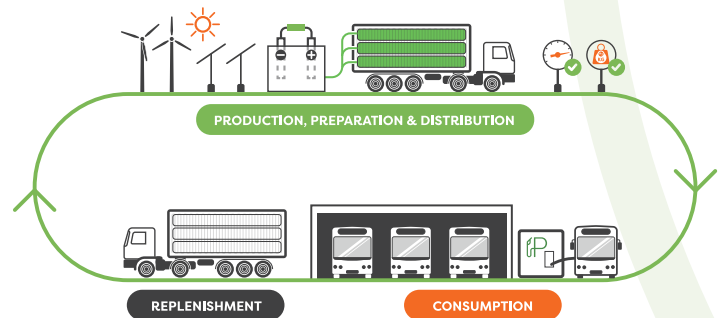
Excavators

Forklifts

# Pioneer Value Chain & Deployment

## Hydrogen Reliability & Scalability

Our Pioneer Mobile Hydrogen Refuelling Station facilitates the implementation of low-carbon commercial vehicles, by enabling a hydrogen value chain that offers the perfect path to the lowest total cost for hydrogen fuel.



### Production

Renewable, green hydrogen production is carried out at large hydrogen plants.



### Preparation

Pioneer stations are filled with hydrogen fuel at the correct conditions of pressure and quantity.



### Distribution

Full Pioneer stations are transported from the plant to the point of use.

This value chain enables Pioneer to offer a reliable refuelling infrastructure for high pressure hydrogen that vehicle operators can depend on; both upon launch of an introductory fleet and through long-term establishment.



### Consumption

End users connect to Pioneers and refuel their hydrogen powered vehicles on-site.



### Replenishment

Empty Pioneers are replaced with a full unit and returned to the plant for refilling.



Combined Solution



Fast Deployment



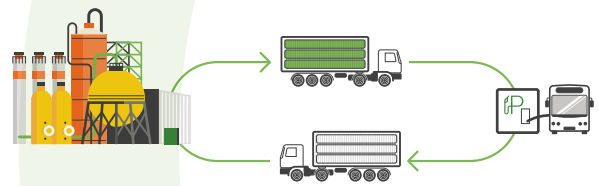
Easily Scalable



Low-cost Capital

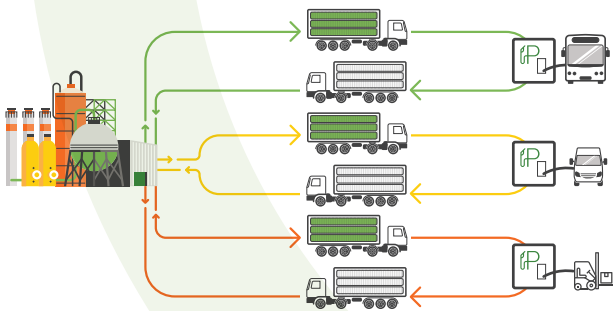


Reliable Network



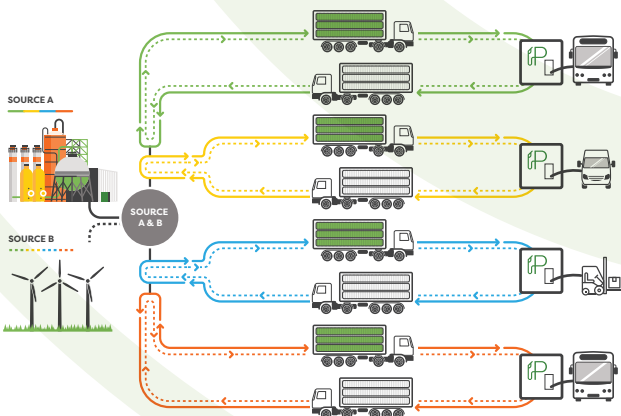
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Each Pioneer unit is filled at a clean hydrogen production plant and transported to a commercial vehicle depot or to a filling station where it directly refuels the vehicles. Simple to operate, with minimal utilities and deployment requirements, Pioneer delivers a direct on-site replacement for the traditional diesel tank and pump.



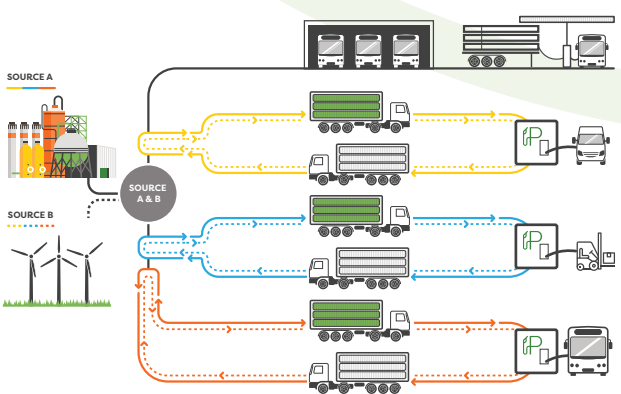
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For small hydrogen powered vehicle fleets, a single Pioneer unit is initially deployed. As vehicle fleets grow to such a scale that a larger refuelling network is required, more Pioneer systems are added to provide a continuous, reliable refuelling cycle.



3

To add further resilience, a new hydrogen source can be added, allowing for additional Pioneer stations to service more refuelling points.



4

Using this deployment model, Pioneer delivers a low-cost, hydrogen infrastructure that vehicle developers can implement quickly. The Pioneer's flexibility and deployable nature, also makes it the perfect back-up solution should a hydrogen refuelling stations suffer outages, whilst its robust and reliable design can additionally be employed to mitigate hydrogen supply chain issues.

The Pioneer provides a continuous, **reliable**, **low-cost network** for the refuelling of hydrogen vehicle fleets.

# NanoSUN Cascade Technology

## Optimising Hydrogen Utilisation



NanoSUN's Pioneer Mobile Hydrogen Refuelling Station utilises flexible cascade refuelling, which is essentially an automated sequence of individual decants.

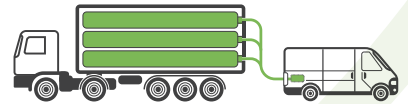
The pressure differential between the cylinders in the Pioneer and the application tank is the driving force behind the hydrogen transfer. By utilising the 9 cylinders within the Pioneer in a range of cascade stages, you are able to maintain a higher-pressure differential for longer.

This technique delivers greater hydrogen utilisation from the refueller than simple decant method, enabling multiple consecutive vehicle refuelling operations to higher fill pressures.

**Decant fill**  
Tube trailer mode



**Cascade fill**  
Individual sequential control



Multiple full fills achieved



No compressor required

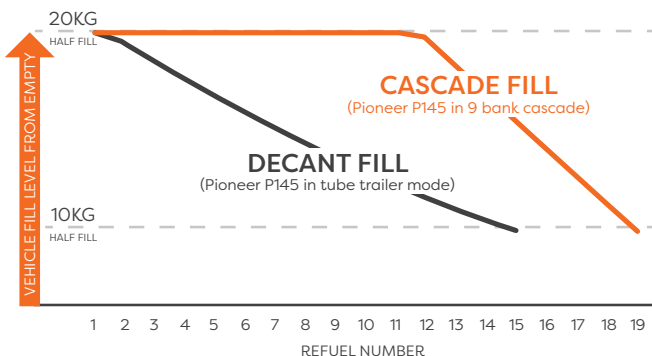


No high power electricity supply required



Simple to use interface

**Pioneer P145 Decant vs Cascade - Typical bus application**



**Pioneer can deliver full fills of 20kg for typical large hydrogen bus applications.**

Pioneer's cascade technique achieves a significantly higher rate of vehicle refuels to the target pressure versus a standard decant; with no need for a compressor. It eliminates the requirement for this significant source of cost, mechanical failure and unreliability, while providing all the same flow control functionality.

This allows for centralised production to be carried out at large hydrogen plants to drastically reduce the cost associated with hydrogen refuelling stations.

# Why Choose NanoSUN?

Dedicated, Passionate  
& Experienced

NanoSUN is a world-leading engineering company synonymous with innovation and expertise within the hydrogen industry.

We specialise in the development and supply of mobile hydrogen refuelling stations. Using our novel cascade technology, our forward-thinking and experienced team deliver the cutting-edge refuelling technology required to facilitate hydrogen mobility and rapid, low-cost deployment to support the infrastructure needed to enable the adoption of hydrogen vehicles.

## Built on Innovation & Expertise



**Experience** – Veterans of the industrial gases and hydrogen fuel-cell industries, we are a team of highly experienced industry professionals, all dedicated to responding to the needs of hydrogen users.



**Expertise** – From established engineers and scientists to inventive graduates and industry analysts, NanoSUN holds extensive knowledge and expertise in the development and advancement of refuelling technology to deliver our customers with quality products and a reliable service.



**Innovation** – Our Research and Development team hold prestigious credentials and work alongside respected academia, associations and industry authorities to develop innovative ideas and concepts into new solutions directly applicable to the needs of our customers.



**Reliability** – All Pioneer products are subject to rigorous testing to meet all industry standards and regulations, while ensuring optimal performance.



**Sustainability** – NanoSUN is a member of the 'Race to Zero' campaign, to which we are committed to reducing our carbon footprint across the business, whilst also actively encouraging others to do so.

# Contact us

If you're looking for further information on our refuelling solutions, please contact us:

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