Demand mapping Who wants the hydrogen?

Jabulani Nyathi, Consultant at **Ricardo** outlines how demand mapping can be a powerful planning tool

The Net Zero agenda has become a hot topic as the realities of climate change become more obvious and nations commit to agreements such as the Paris Accord.

With decarbonisation at the forefront of global focus, greater attention is being placed on understanding the place for alternative fuels in various sectors. Many of these fuels, such as green hydrogen and green ammonia, are not yet produced at significant levels and the related demand from the transport sector or other sectors has not yet materialised.

The latter is largely a result of the poor economics relating to alternative fuels which affects technology readiness of various equipment/machinery to utilise these fuels as well as the development of infrastructure to support delivery, among other factors.

It is crucial to map out the potential future demand in order to: establish the necessary infrastructure for the supply of a fuel like green hydrogen; foster investor confidence in the opportunities within the hydrogen supply chain; and facilitate market movement through collaboration between multiple stakeholders (including government, the private sector, and consumers).

In this article, Ricardo will delve into the significance and benefits of demand mapping, the obstacles that may arise, and explore a case study in the aviation sector where demand mapping has been implemented.

What are the opportunities?

Demand mapping is key in quantifying and forecasting the potential future alternative fuels requirements disaggregated based on demand points across a geographical area, thus helping to build a picture of the developing market and areas of high demand or "hotspots".

This is calculated based on an individual sector, a mode of transport, or even across multiple sectors and is hugely beneficial because it addresses the 'chicken and egg' dilemma commonly encountered with alternative fuels, where potential suppliers are unsure about the demand, and consumers are unsure about the supply and associated costs.

This type of scenario is apparent, for example, in how there are less than 15 public access hydrogen refuelling stations (HRS) in the UK today, with many unfortunately closing, when by the end of 2023 there should have been 40 HRS to reach the UK's goal of 80 HRS by 2025. The original requirement was to create a national hydrogen refuelling network for mobility based on the UK H_2Mobility study[1]. Until there is clarity on alternative fuels demand and suppliers step up to meet it, the infrastructure required to support alternative fuels will not be developed at pace. By undergoing a demand mapping exercise for hydrogen in transport and industry, refuelling stations can be planned in locations as close to high demand centres as possible whilst ensuring there are no underserved areas.

The mapping aids in creating strategic partnerships, help drive policy, and give investors clarity for decision making to accelerate the transition to alternative fuels. This all sounds exciting, however, there is of course no 'silver bullet' to solving any sustainability related problem and demand mapping presents its own challenges when applied.

Challenges faced when mapping alternative fuel demand

The process of demand mapping is challenging as the exercise is entirely dependent on the quality of the data, along with the methodology applied, which inherently implies there is varying uncertainty in all analysis.

Furthermore, assumptions need to be made regarding aspects such as the development and deployment of new technologies, together with the adoption of fuels, which will all be driven by policy and market forces. These assumptions require sound reasoning to avoid the entire exercise lacking indicative meaning. A notable area of significant uncertainty is around technology development and commercialisation.

For example, hydrogen in aviation for narrow and widebody airliners is currently at the development phase, which relates to a technology readiness level (TRL) of three-four, and sector uptake has not been clear to this point. With so many technical challenges to overcome, it is uncertain when hydrogen will see significant uptake in the aviation sector, if any, considering other fuels such as e-kerosene show potential[2].

That said, based on publicly available analyses and current government policy, one can make an informed assumption on these issues. One certainty is that demand mapping on its own will not prompt timely uptake of alternative fuels by any of the links in the value chain such as government, suppliers, and consumers.

The most difficult element is ensuring a coordinated effort between multiple stakeholders and demand mapping is only meant to provide the evidence to catalyse policy change, and drive strategic investment to create the future alternative fuels market.

Case Study: mapping demand in the aviation sector

The big question now is how exactly one goes about conducting demand mapping. There are broadly three main steps when demand mapping. >>

- Firstly, the fuel demand must be determined based on the consumer group chosen e.g., fleet, sector, etc. This can either be done based on a top-down or bottom-up approach (this is further discussed below).
- Based on determined demand, data is to be apportioned to geographical points such as airports, or geographical areas such as counties or boroughs, and considering expected varying levels of demand, for example using fleet density.
- Represent results on a map using software such as ArcGIS.

To demonstrate these steps, an analysis conducted by Ricardo mapped hydrogen demand in the Scottish aviation sector. The data utilised in this exercise was referenced from a hydrogen for transport study[3]. When completing the first step of the mapping process, a top-down approach was employed whereby fuel demand was determined based on datasets of air traffic movements (ATMs), aircraft fleet mix, and average distances travelled.

Assumptions are made regarding fuel uptake in the future (see the full transport study for further details). The determined fuel demand was apportioned to Scottish airports based on domestic and international ATMs. In line with market predictions hydrogen use was biased to domestic flights. Finally, the resulting data was distributed across Scotland as can be seen in figure 1.

Following the methodology described, it can be established that by 2045, Glasgow and Edinburgh airports would have high hydrogen demands. Furthemore, Aberdeen and Inverness airports are also seen to have notable hydrogen demand forecasts. Complexity can be added to the map by considering other modes of transport, industrial demand and even demand for hydrogen derivatives such as ammonia and sustainable aviation fuels. With all this information clearly represented, the appropriate planning can take place to ensure that by 2045, the necessary infrastructure is available to support the emerging demand.

Conclusion

The IPCC sixth assessment report highlights that human activity has already caused warming of up to 1.1°C compared to pre-industrial levels, which has had slow but significant impacts on our climate, biodiversity, ecosystems, and human life. If we would like to safeguard our planet and future generations, we need to act now. Unfortunately, political will, economic reform and societal change have not moved at the pace required to limit our adverse impacts on the planet. A clear vision coupled with political, societal, and economic will to change is what is required to manage the crisis.

Demand mapping, will not single-handedly cause the various actors to transition, however, it is a powerful tool to be utilised for proactive planning to accelerate the Net Zero transition. As French writer and aviator Antoine de Saint-Exupéry said, “A goal without a plan is just a wish”; it’s up to us to decide whether Net Zero is a goal to be relentlessly pursued or merely a wish. H2V

References

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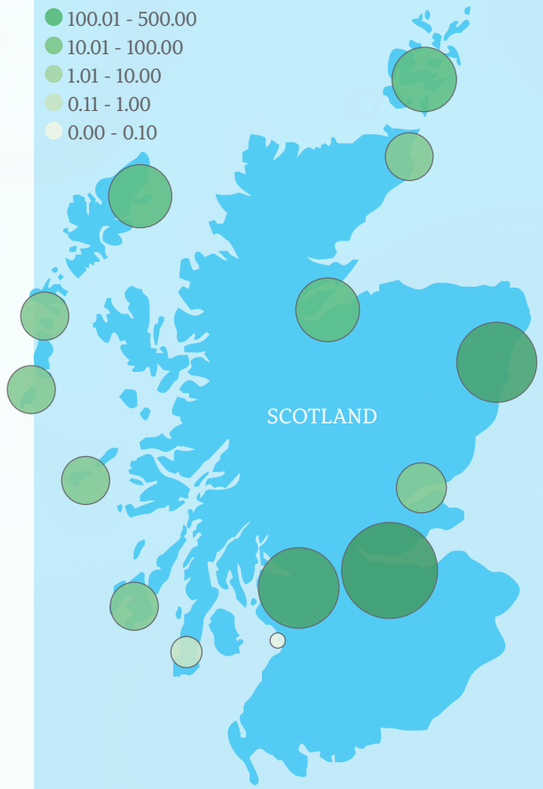

Figure 1: Projected hydrogen demand scenario for the Scottish Aviation sector in 2045 (Ricardo Hydrogen Demand Study).