

# Hydrogen and its storage in UK decarbonisation: stakeholder perspectives

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## WORK PROGRAMME

4x expert stakeholder workshops covering different perspectives on hydrogen: engineering; environment; policy; innovation/R&D;

Stakeholder interviews: trade associations; environmental NGOs; government; R&D;

Social media analysis: insights into Twitter engagement on hydrogen around key focusing events;

Review and synthesis of existing social science literature.



# **SUMMARY: Hydrogen in society: social media analysis**

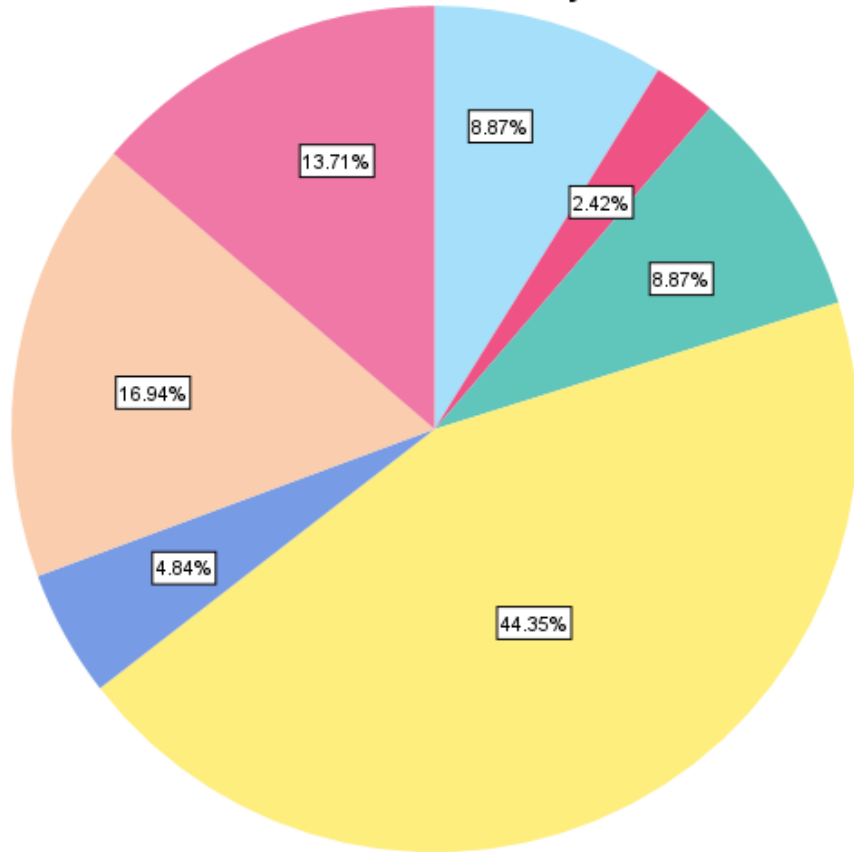
- Controversies or major news items as ‘focusing events’ that give us an insight into how society thinks about an issue;
- Media as both reflecting society, and also influencing what people think;
- Twitter – statistical analysis of who is talking about hydrogen, and what they are saying;
- Focus on final stage of COP26 negotiations, and reaction to New York Times story on blue hydrogen emissions.



# Headline messages

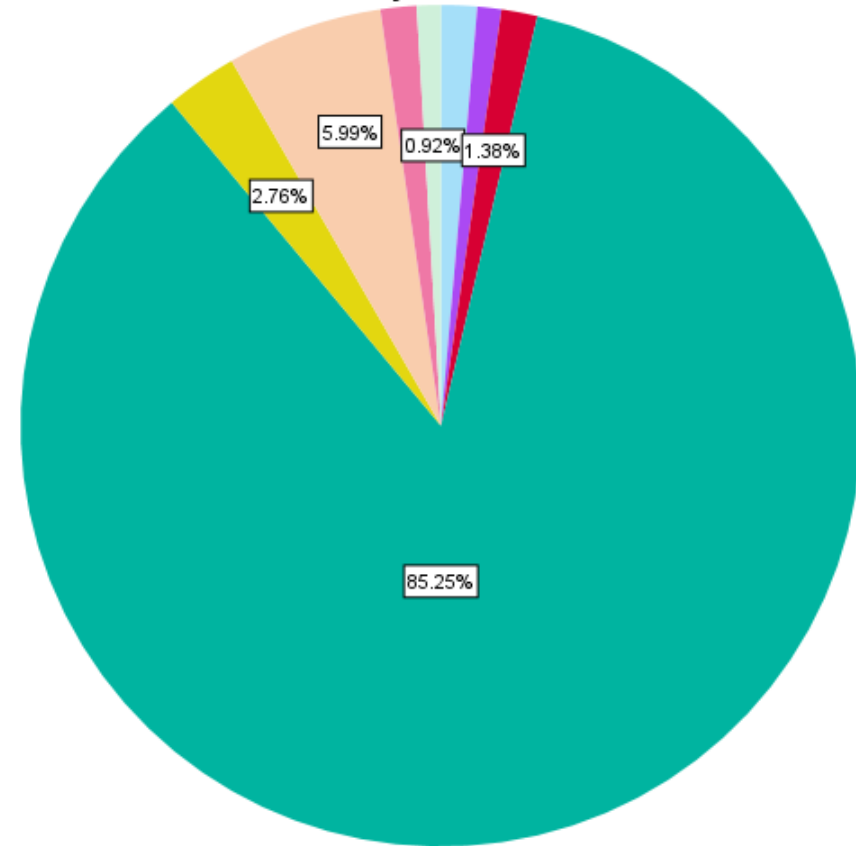
- Significant correlation between tone (positive/negative) and sector ( $X^2$  119.14,  $p = <0.001$ ). Research, government and industry overwhelmingly positive, individuals more negative;
- Significant correlation between tone and use of hydrogen ( $X^2$  19.87,  $p = <0.001$ ). Most positive sentiment for industrial applications or combination with renewables, more mixed/negative for heat or overall energy system;
- Significant correlation between tone and topic ( $X^2$  118.28,  $p = <0.001$ ). **Most negative arguments around safety, environmental impacts, or association with fossil fuel industry.**

Tweets by Sector: COP26



SectorCo  
 Academia  
 Gouverne  
 Individu  
 Industry  
 Internat  
 Media  
 NGO

Tweets by Sector for NYT Article on Jacobson Paper



SectorCo  
 Academia  
 Arts  
 Finance  
 Individu  
 Industry  
 Media  
 NGO  
 Politics

# Hydrogen and COP26

- Significant correlation between tone (positive/negative) and sector ( $X^2$  19.17,  $p = <0.005$ ). Attitude towards hydrogen positive across all sectors – but NGOs more cautious;
- Weaker correlation between tone and use of hydrogen ( $X^2$  9.34,  $p = <0.05$ ). Most positive sentiment for industrial applications or transportation, more negative for heat;
- Significant correlation between tone and topic ( $X^2$  34.71,  $p = <0.001$ ). Most negative arguments around safety or association with fossil fuel industry, **but positive arguments around getting things deployed!**



# Jacobson and NYT Controversy

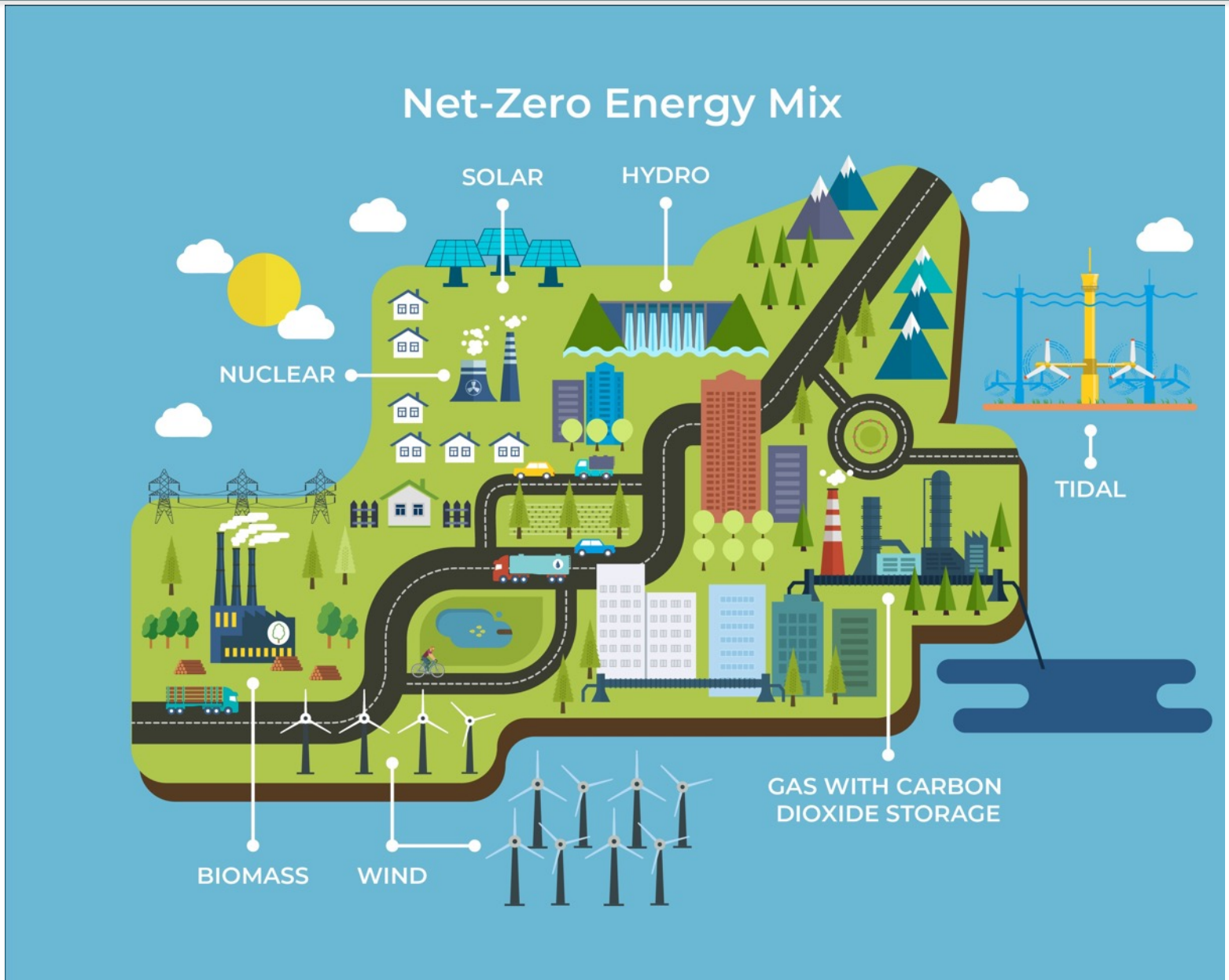
- No significant correlation between tone (positive/negative) and sector ( $X^2$  8.82,  $p = 0.27$ ) – although public and media attitude to hydrogen largely negative;
- Slight correlation between tone and use of hydrogen ( $X^2$  19.87,  $p = 0.025$ ) More positive sentiment towards hydrogen for industrial applications, but negative sentiment towards hydrogen for transportation or as a component of the overall energy system. Note also hydrogen for heat does not feature;
- Significant correlation between tone and topic ( $X^2$  14.98,  $p = <0.001$ ). **Strong negative sentiment towards environmental impacts, safety and feasibility/fossil fuel associations.**



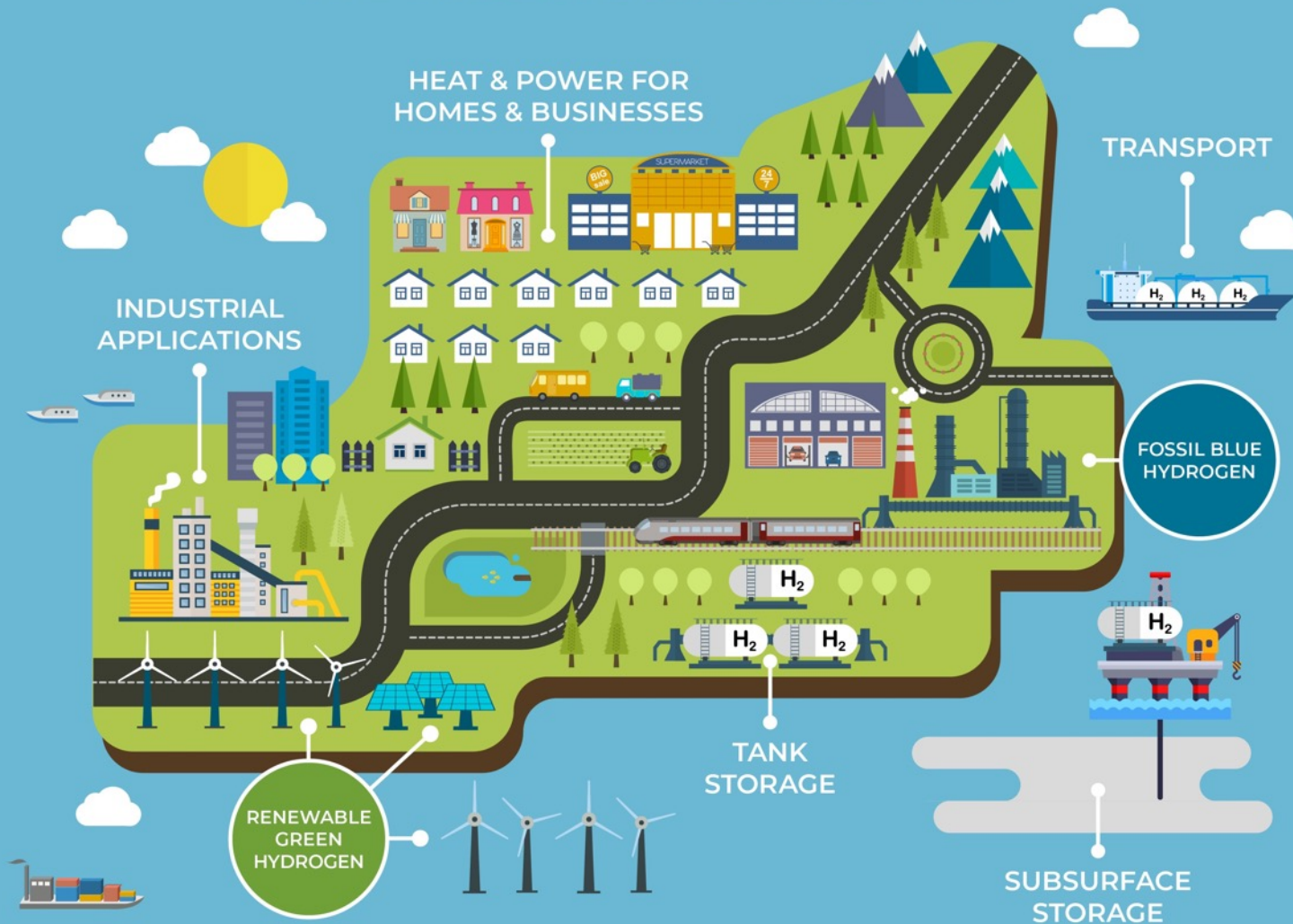
# Implications for geological storage of hydrogen

- Virtually nothing on hydrogen storage – need for industry and governments to communicate more on how hydrogen will be stored?
- Importance of illustrating how geological storage will enable hydrogen applications across the whole energy system;
- Public more likely to engage with controversy or polarised debates (even if not underpinned by the best science...) – how can researchers, industry and governments be ready to react to these?

# **FOCUS: Hydrogen in the net-zero energy mix: stakeholder workshops**



## HYDROGEN & STORAGE MIX



## HYDROGEN AND ITS STORAGE AS PART OF THE MIX

Diverse views on the role/weight/importance of hydrogen from different stakeholders;

H<sub>2</sub> preferred for industry and transport rather than domestic: perception readiness is closer for industry than for aviation, and even further for home usage;

Concern: cost of H<sub>2</sub> compared to electrification, especially investment and scale-up;

H<sub>2</sub> storage – and energy storage in general – not discussed in great depth. An area of limited knowledge, even for informed stakeholders?



*“the debate has moved to deep decarbonisation and net zero rather than 80% decarbonisation, I think that’s greatly favoured the prospects for hydrogen, because hydrogen is all about the last 20%. Steel manufacture, aviation, the really difficult to do things where if you’re forced to pay, the willingness to pay would be high. There’s much more money in steel manufacture decarbonisation than electricity decarbonisation, and that’s enough money to make hydrogen happen.”*

*“hydrogen storage [...] with, it’s all going to be part of this cluster dynamic, I would have thought, in which case there’s £100 million problem with your storage facility and a £2 billion problem onshore about the industrial cluster”*

*“Maybe one aspect has changed, and it’s domestic heating. Maybe two years ago I would be big fan, I would be telling you yeah, it’s definitely good for domestic heating and we can back all this big energy consumption sector. Today I’m not sure, I’m not sure whether we should be going this way. If we cannot have gas, I would rather see maybe electrified than hydrogen”*



## SUCCESSION OF TECHNOLOGIES AND TIMELINE

Idea of monopoly of one type of energy is risky. Need for opening to different technologies such as H<sub>2</sub>, rather than just electrification, to meet targets within the timeline;

Emphasis on readiness, and succession of technologies: some H<sub>2</sub> applications are ready now, some in 10 years. Which to prioritize? How about transition from 'blue' to 'green' H<sub>2</sub>?

Reduced hope and expectation for H<sub>2</sub> due to perception other technologies already work, e.g. wind and solar.



*“We know hydrogen to a certain extent and how to deal with that. However, it has always been used in industrial environments and industrial fields and for industrial purposes. Now we are talking about a shift to public, and even to the houses, and I think that this shift cannot be done abruptly.”*

*“my current understanding, is none of these actual quite official reports by these quite prestigious bodies actually see a significant expansion of hydrogen in the future, which I think is really quite interesting.”*

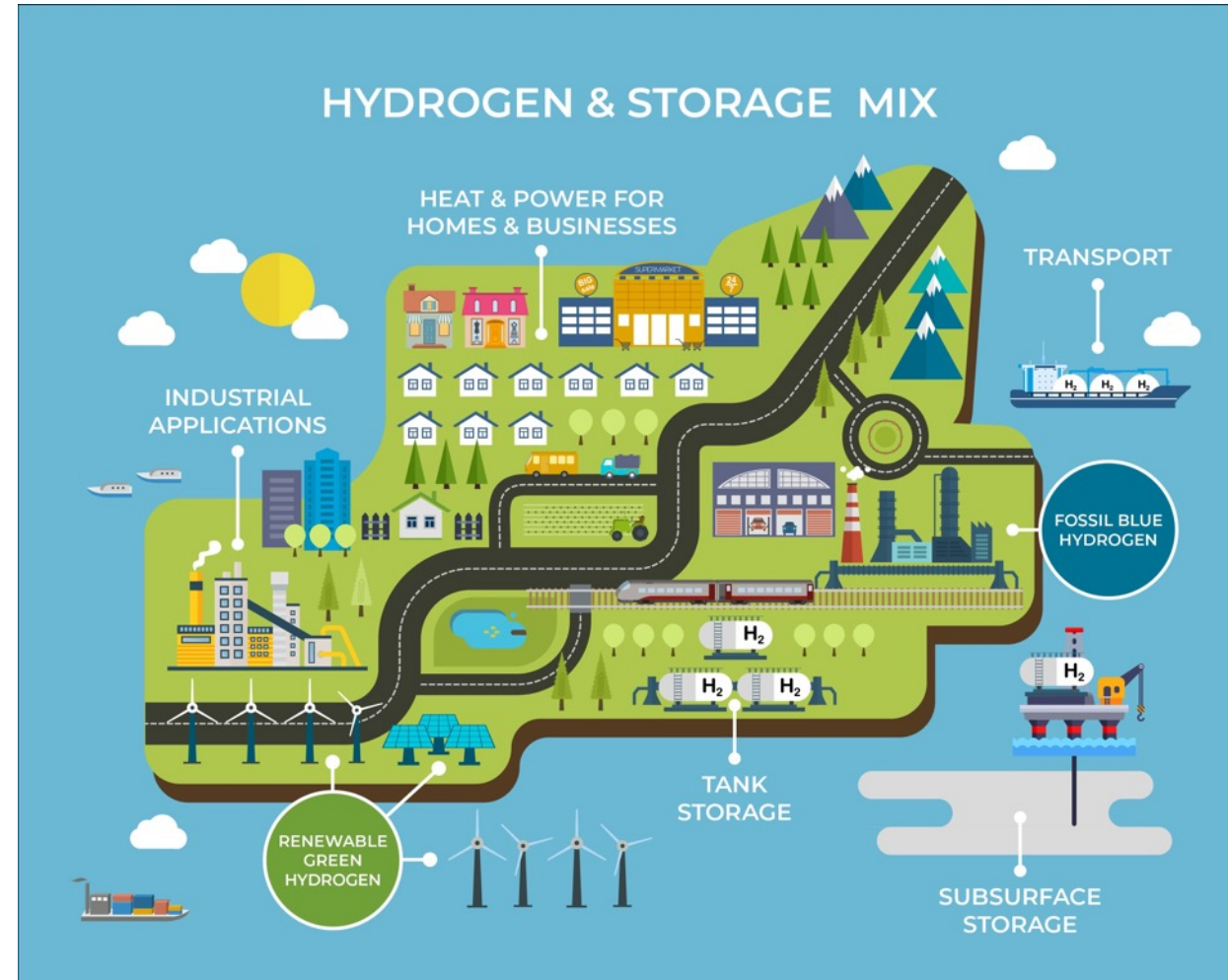
*“it seems that even if it was feasible to use hydrogen in the planes on the technical side, from what I understand listening to some of those stakeholders, they’re going to be wrapped up in 15-20 years’ worth of all the regulation side and safety and so on, so it just seems that this would be such a long backlog to get into what you’ve suggested now, for the more commercial sectors, potentially residential, which has again a big question mark over it to be honest. “*

## SYNERGIES AND TRADE-OFFS

H<sub>2</sub> for gas seen as a bad idea due to mixing with natural gas, changes to appliances, insurance;

Industrial clusters: necessity of CCS and H<sub>2</sub> is questionable if we manage to decarbonise clusters?

Synergy between biogas and hydrogen and CCS, repurposing potential but also limitation due to gas properties?



*“when we are talking for example in underground energy storage, any energy; it doesn't have to be hydrogen: it could be CO2, it could be compressed gas, it could be any energy, because the know how that has been built within last decades related to underground is held by oil and by gas energy, and <laughs> so everything that we know basically on permeability, porosity and multiphase flow, everything has been developed by oil and gas, and the petroleum industry. “*

*“in terms of the more pragmatic side of things then yeah, there may be some blue hydrogen in the short term, projects are emerging, they are being developed – but the good thing about that is that the infrastructure of blue hydrogen is pretty much the same as for green hydrogen, the molecule is the same regardless of colour, so we should move forward quickly with the infrastructure – the pipes, the ports, the storage, in order to basically ... the resource is over there somewhere, the demand is here, so we need to match them together.”*

“I think there's been lots of speculation, lots of lobbying around hydrogen, lots of silly suggestions made, for example, in terms of hydrogen for example, playing an important role in the existing gas networks for example.”

## SOCIETAL CONTEXT

Change in behaviours associated with new technologies to succeed with decarbonisation. The demand side and behavioural aspect is as important as the supply side. Demand side and consuming less should be a priority policy;

Variation in knowledge, awareness and understanding from the public of energy use, capacity etc;

Creation of local and high qualification jobs or import of technologies which create jobs in other countries?



*"I hope that we'll see more energy communities, I think where people have a bit more control about the energy that they use and they generate themselves. But in terms of the wider thing, I think we need a bit of everything. Of course ideally we need to scale back on the gas and oil or the carbon element, but I don't see how it's going to be possible."*

*"the energy problem we tend to say is why a really interesting topic in social science now: we have to change our behaviour of use energy. We have to change, adapt, because all the technology can ... if we want the decarbonisation, we cannot say OK, we just want to switch on the power we use."*

*"I cannot see huge new jobs opportunities created by hydrogen economy either, unless we do not own technology and do not produce anything that could be as we provided. The know-how is fine, but it's still very limited."*

## KEY MESSAGES

There is stakeholder support for hydrogen in the net-zero energy mix: but the rationale for its use needs to be clearly articulated;

Question over the timeframes for which hydrogen is being deployed, and how that relates not just to the energy systems we will have but also the kind of society we have;

Still very challenging to have discussions with non-technical stakeholders about hydrogen storage.



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