A vision for hydrogen in the Tees Valley

ARUP

bp

kellas MIDSTREAM

Northern Gas Networks

TEES VALLEY COMBINED AUTHORITY

TEES VALLEY MAYOR

Foreword

Hydrogen presents an unparalleled opportunity to the Tees Valley, and the UK as a whole, to unlock decades of low-carbon prosperity – but only if we act now. We can secure our future fuel supply and the future of our industrial clusters but, most importantly, we can create tens of thousands of jobs in the cleaner, healthier and safer industries of the future.

Our region is at the forefront of the UK's clean energy ambitions, to reach carbon net zero by 2050, and we're on track to become one of the world's first decarbonised industrial clusters by 2040, with transformative projects secured in the low carbon and offshore sectors. The scale of opportunity at sites like Teesworks, and those coming thanks to the Teesside Freeport, the UK's biggest and first to be operational Freeport, is huge.

To reach net zero, our places, industries and transport systems must transition from fossil fuels towards cleaner alternatives, like hydrogen.

We already produce around half of the UK's hydrogen, so we're well-placed to become a leading force and 'SuperPlace' in the production, storage, distribution and use of hydrogen, and for green projects of global significance.

bp, which is leading on Net Zero Teesside, will establish two large-scale hydrogen production facilities - HyGreen Teesside producing green hydrogen, H2Teesside producing blue - and Kellas Midstream is also establishing its own blue hydrogen facility - H2NorthEast - in the region. Current chemical feedstock production will need to adopt a low-carbon, likely CCUS enabled, pathway, while EDF and Protium will develop their own green hydrogen schemes.

The proposed hydrogen production projects by private organisations in the Tees Valley could see up to 2.5GW of hydrogen production capacity by 2030. This represents a quarter of the government's ambition for 10GW.

This landmark study sets out how this will happen; how the Tees Valley will become a globally significant centre for the production, consumption, and export of hydrogen, and how this will bring the well-paid, high-quality jobs of the future to Teesside, Darlington and Hartlepool as our green economy continues to grow.

The aim is to work with hydrogen project developers, funders, the local supply chain and consumers across sectors to make this vision a reality. It will be a complex process. That's why we have set out a strategic route map for achieving this world-beating hydrogen transformation.

If we seize the opportunity that stands before us today, the Tees Valley can be to hydrogen in the 21st century what it was to steel and chemicals in the 19th and 20th.

Ben Houchen, Mayor of Tees Valley.

A vision for hydrogen in the Tees Valley

01 Initial development of large scale blue hydrogen (CCUS enabled) facilities, facilitated by the Northern Endurance Partnership's subsea saline aquifers. Green hydrogen (electrolytic) grows significantly over time, drawing on increasing access to offshore wind available near Teesside.

02 Supply of low carbon hydrogen into the gas distribution network, initially to decrease the carbon intensity of the natural gas grid serving homes and buildings via blending.

03 Supply of hydrogen into the gas distribution grid (building on the hydrogen village trial at Redcar hydrogen community), first via blending to 20%, later with 100% hydrogen.

04 Export of increasing volumes of hydrogen to meet demand. South to the Humber region and west to Cumbria (via East Coast hydrogen), north to Scotland, and east via ship to Europe.

05 Running of hydrogen trains on the Tees Valley line and then further afield.

06 Production of sustainable aviation fuels (SAF) for use at Teesside International Airport and exported nationally and internationally.

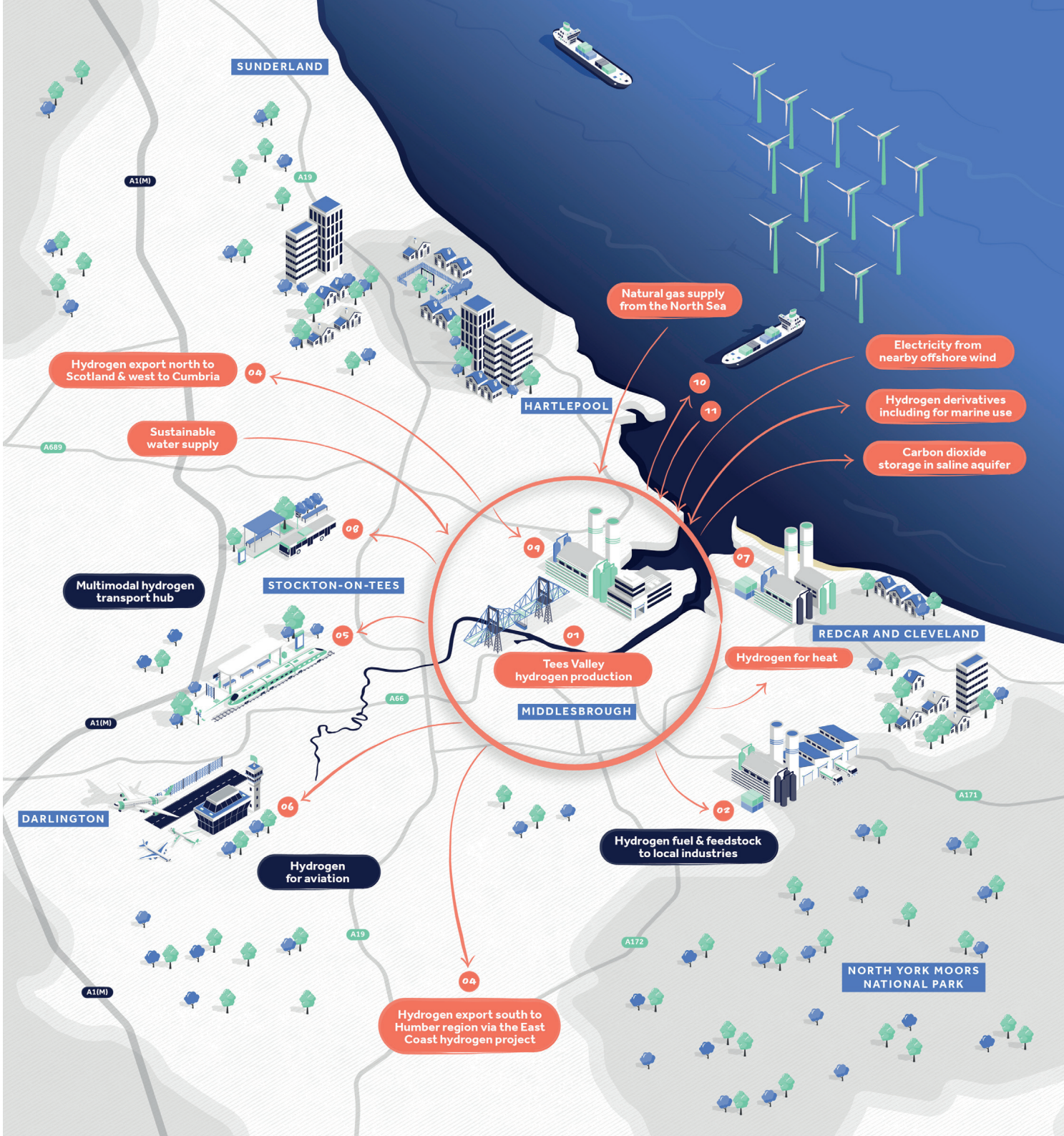
07 Recycling of scrap steel into green steel using hydrogen.

08 Deployment of fleets of hydrogen buses, public sector vehicles and other hard to decarbonise vehicles.

09 Production of green ammonia and other green chemical products.

10 Supporting the development of Teesside freeport as a green port hub with decarbonised shipping, hydrogen infrastructure and the export of hydrogen internationally.

11 Attraction into the Tees Valley region of new global industries and organisations seeking to secure sources of low and zero carbon energy, leading to further growth in hydrogen production and investment.



A vision for hydrogen in the Tees Valley

This vision reflects the combined efforts of a coalition of partners: Tees Valley Combined Authority (TVCA), bp, Kellas Midstream, Northern Gas Networks (NGN) and Arup. We are grateful to the many Industrial stakeholder who have spoken with us and attended our engagement events, and now we present our vision as an invitation to go further and faster on hydrogen in the Tees Valley.

Our vision is for the Tees Valley to be one of the UK's first hydrogen SuperPlaces:

It will produce over a quarter of the government's 2030 hydrogen production target of 10GW.

It can become one of the world's first net zero industrial clusters by 2040.

It will accelerate the UK's overarching 2050 net zero goal.

It will rebalance the economy of the north, whilst supporting up to 3,000 jobs in key existing industries.

Hydrogen 'SuperPlaces' are industrial regions supporting the production, storage, distribution and end use of hydrogen. They see indigenous and new industries adapt, grow and thrive on clean, cost-effective energy. They are hubs where low carbon hydrogen, and products made using it, can be exported domestically and internationally. They are not solely reliant on outside supplies of energy.

Hydrogen provides a platform that accelerates the Tees Valley's current growth into new industries, giving the region the opportunity to rebalance the economic future of the north, especially the East Coast. Abroad it will be a catalyst for industrial decarbonisation and good green growth displacing fossil fuels. At home, the Tees Valley's SuperPlace status will see it become a showcase for economic regeneration, inward investment, and the creation of secure, high-value jobs in a hydrogen economy.

The Tees Valley has long held a central position in the energy economy of the UK. Around 66 major industrial businesses are located within a cluster, centred around the mouth of the river Tees, that includes deep-water port facilities. The Tees Valley's industry already has experience of the production and use of hydrogen, employing it as a feedstock. It is transported by an infrastructure of pipelines running from the north bank to the south bank of the Tees River, supported by underground storage connected to industrial end users .

The region's transport links and position in the UK's gas and power grids makes it an attractive place to deploy hydrogen at scale and at speed. The Tees Valley's strategic location on the east coast links it not only to the Humber region but also to Scotland and across the North Sea to mainland Europe. Natural gas, an important feedstock and fuel to make CCUS enabled hydrogen, is brought ashore locally. The expansion of offshore wind off the north east coast will also be a key source of electrolytic hydrogen.

In summary, hydrogen in the Tees Valley already has multiple end uses. Low carbon hydrogen should be deployed alongside other interventions including energy conservation, electrification, carbon capture and green house gas removal to ensure a resilient, cost effective transition to meet the net zero target of 2040.

Figure 2 - The industrial cluster in the Tees Valley; a future 'SuperPlace' for hydrogen, industrial decarbonisation and industrial regeneration.

What it means, in real terms

We see the Tees Valley producing low carbon hydrogen that will not only provide fuel and feedstocks for industry, but also power transport and heat buildings and homes regionally and across the UK. In effect, the Tees Valley will become part of the UK's net zero energy engine room, powering a transformation on a scale similar to both the industrial revolution and electrification over the last century.

The steps needed to make that vision a reality, and to reach carbon net zero, extend beyond the Tees Valley. Hydrogen has been identified as critical to achieving net zero by the UK Government. It has particular benefit in certain sectors which are hard to move away from fossil fuels. It also has a wider range of potential applications in transport and heat. Buildings used by various sectors across the UK will have to be retrofitted, and changes in behaviour around how heat and transport are used also play a huge part. Collaboration across sectors and across geographies, especially to the Humber region, will be essential.

Hydrogen also provides an option to achieve seasonal energy storage in large quantities, providing a substantial benefit for industries and domestic consumers that have relied on fossil fuels that now need to decarbonise. Hydrogen can become a year-round, on demand energy source for industry, heat and transport, powering new growth.

A hydrogen vision for the Tees Valley

This ambitious vision for the Tees Valley to become a hydrogen SuperPlace will not materialise without strong leadership, purposeful action, and sustained effort.

The UK Government has published its hydrogen strategy and is currently developing the business models and low carbon hydrogen standards that will set the strategic direction for the growth of hydrogen use in the UK. A swift conclusion to this work, with funding to support the first movers in production and use of hydrogen, will be a positive first step on the journey to net zero. A number of funding routes are already available for projects at a range of scales, via the UK Government's Net Zero Hydrogen Fund (NZHF) and Net Zero Innovation Portfolio (NZIP).

Industry partners can move forward with projects, providing secure supplies of hydrogen. In turn, industrial customers will support these projects, entering into supply agreements and converting their processes for hydrogen, whilst reducing the growing burden of carbon emissions.

Growing the industrial demand of hydrogen, will lead to an expansion of other hydrogen-enabled demand networks, like transport and domestic heating. Improved pipelines and infrastructure will boost Tees Valley's producers' ability to export to customers and industrial users across the country and beyond.

This ambitious vision for the Tees Valley to become a centre for hydrogen use and supply in the UK will not come to be without strong leadership, purposeful action, and sustained effort.

Hydrogen production will see even more growth as personal and business users begin to take advantage of the lower cost of converting their traditional heating systems. Because of the work being done in the Tees Valley, energy customers in the UK and Europe will start to look to the region as a beacon of low-cost clean energy.

The Tees Valley's location gives it great access to supplies of gas and electricity and to a suitable site to dispose of carbon. Industrial demand exists to take advantage of the sustainable benefits of hydrogen use. Transport and infrastructure links provide access to wider markets. With all these critical components already in place, the Tees Valley is ideally placed to transform rapidly into a world-class exemplar of a low carbon hydrogen SuperPlace .

Read on to see how it can be done, and what it will mean to the region.

Hydrogen - the power of its potential

It is quickly becoming clear that hydrogen, the most abundant element in the universe (and the element that powers our sun), is also a key component of a future energy system that takes us to net zero to meet the challenge of climate change.

With hydrogen, sectors that have been traditionally challenging to electrify (like heavy transport, and those industries that rely on high-grade heat) can be more easily decarbonised with the creation of more flexible, resilient, and better integrated energy systems. The effect that will have on decarbonising the global energy system in turn will be huge, accelerating the case for renewable energy, decreasing emissions and increasing resilience.

In order to make that future a reality, governments and industries need to decide how and where hydrogen will be used in the long term. The technology is still developing, and in order for it to thrive, commercialisation pathways need to be worked out. That means understanding economic impacts, technological development, and user requirements, as well as building evidence of the benefits of hydrogen with early projects. The Tees Valley represents an ideal location to develop this understanding and begin the large-scale use of hydrogen as a fuel and industrial feedstock.

Whole system planning and coordination, and establishing a regional hydrogen economy are key for hydrogen to play the fullest role in achieving net zero by 2040. This is where the Tees Valley can rise to the challenge.

The Tees Valley currently uses a mix of electricity and natural gas to power its industry and domestic heating, with diesel and petrol powering most road transportation. Prior to 2025 the focus will be on putting the fundamentals in place for planning, business models, and design.

It is unlikely that large scale deployment can be achieved by the private sector alone, partly due to the timescales required for development and construction. Government signalling and support for hydrogen is key to enabling the rigorous pre-FEED and FEED studies which must be started. Government revenue support is critical so that hydrogen prices can be made competitive next to natural gas or other fossil fuels.

Hydrogen for domestic heat will be deployed in Teeside, alongside other measures. Initial funding has been granted to the Redcar Community Hydrogen Project, one of two hydrogen village trials in the UK with aims to substitute natural gas for 100% low carbon hydrogen in 2000 homes and businesses and be up and running by 2025.

Driving demand for hydrogen in the Tees Valley to 2035

It is after 2025 that hydrogen demand is predicted to take off. Even by 2030, the Tees Valley will be known as a hydrogen 'SuperPlace' with over 2.5GW of new hydrogen production capacity adding to the current feedstock hydrogen production. This existing feedstock production will need to decarbonise, making use of new CCUS infrastructure, through reliable offsets, or through switching to the electrolytic method. Driving demand will require government support, guidance and regulations in end-use applications. Government is actively developing what this support entails, but it is assumed that any government support will enable hydrogen to be cost competitive with high carbon fuels for industrial customers. Ensuring cost competitiveness would remove a barrier to industries adopting hydrogen, especially where capital costs of conversion can be met from reduced costs (and risks) for carbon emissions under the Emissions Trading Scheme.

At home, the use of hydrogen in Teesside will begin to grow as it is blended into existing gas pipelines. Following the planned implementation of the Redcar hydrogen village trial in 2025, the case for 100% hydrogen will grow also. At present however, the evidence for hydrogen for heat is still being gathered by government. The case for 20% hydrogen blending with natural gas into the gas network (where most downstream appliances can remain in place) is being evaluated with a decision to be made during 2023. The case for repurposing some of the gas networks with 100% hydrogen (where replacement of all downstream appliances will be required) is set for 2026. This will require a mixture of new, repurposed, decommissioned and temporary pipelines. The scenarios are currently being investigated at a national scale based on value for money compared to other options for decarbonising heat. Of particular relevance to Teesside, the East Coast Hydrogen project is currently investigating the repurposing of gas network between Teesside and the Humber with implementation dates between 2025-35. Despite the current uncertainty around the national strategy for decarbonising heat, proximity to hydrogen production means the Tees Valley is likely to see hydrogen for heat during this period.

As for transport, the demand within the Tees Valley will focus on heavy-duty municipal and port fleets locally. There will be an increased demand for hydrogen from heavy goods vehicles tackling longer distance cross-country routes, where the Tees Valley is one of a number of strategic refuelling hubs. Another source of demand in the local area is the Redcar Community Hydrogen Project, which aims to substitute domestic natural gas use with low carbon hydrogen. Another opportunity is for rail lines which have not been electrified to harness clean hydrogen instead.

Figure 3 - On both sides of the River Tees hydrogen production is likely to be a major employer. Picture shows CATS terminal on the Seal Sands where Kellas Midstream are planning a new hydrogen production facility.

Nationally the demand for hydrogen powered transport is expected to grow significantly including in the marine and aviation sectors. For the Tees Valley, that growth will lead to opportunities outside the local region, with high-purity, low carbon hydrogen exported for low emission transport across the UK.

Driving demand for hydrogen in the Tees Valley to 2045

In the decade between 2035 and 2045, demand for hydrogen will be driven through subsidies, carbon pricing, regulations and policy. This will happen steadily, starting with subsidies and grants but increasingly carbon pricing and carbon allowances focused on emissions. Policy such as the proposed commitment to phase out unabated electricity generation from natural gas by 2035 will be key.

By 2045, with the UK wide target of hitting net zero by 2050 rapidly approaching, hydrogen will be almost exclusively fuelling all non-electrified energy consumption and remaining fossil fuel uses will be linked to robust greenhouse gas removal mechanisms.

A 100% hydrogen gas distribution network delivers to residential areas, and transport and industries unable to electrify have made the switch to hydrogen. Teeside is exporting hydrogen through the gas network in the north of England and via ship overseas.

By this point in time, we expect to see hydrogen penetrating new markets, such as aviation fuel, and supplanting long-standing fuels in others. A prime example of this would be fuel for shipping, where fuel-oil and diesel have dominated for decades. Hydrogen or hydrogen derived fuels can replace these directly after modifications have been made. This not only provides a route to decarbonisation for marine traffic, but another route for international hydrogen export from the Tees Valley.

Hydrogen supply – from the Tees Valley to the world

There are many reasons why the Tees Valley is an attractive region to produce hydrogen at scale, and for international export. The fundamental components for a hydrogen SuperPlace are already intrinsic to the Tees Valley, and it has the capability to generate most types of hydrogen, but especially green (electrolytic) and blue (CCUS enabled) hydrogen. So if Tees Valley is not a hydrogen SuperPlace, then where is?

Blue hydrogen is produced using natural gas, something that the Tees Valley has in abundance thanks to its proximity to the North Sea offshore gas fields. Green hydrogen, meanwhile, is made with renewable energy and a process known as electrolysis, where water is split into oxygen and hydrogen. The Tees Valley already boasts excellent access to freshwater resources and a central location in the power grid, so with plans for connection to large wind projects in the North Sea, it is primed to produce green hydrogen too.

The Tees Valley already produces approximately 140kt of grey hydrogen (carbon dioxide is not captured and stored) per year for chemical feedstock. These sites provide a significant source of hydrogen technical expertise, but are also sources of emissions. A rigorous decarbonisatoin programme for this existing grey hydrogen production, likely to be centered around carbon capture, is essential.

Regardless of whether the Tees Valley supplies more blue or green hydrogen one thing is sure - a rapid growth in production at competitive prices will lead to a boom in consumption to match.

Scenarios and modelling of the ramp up between today and 2050

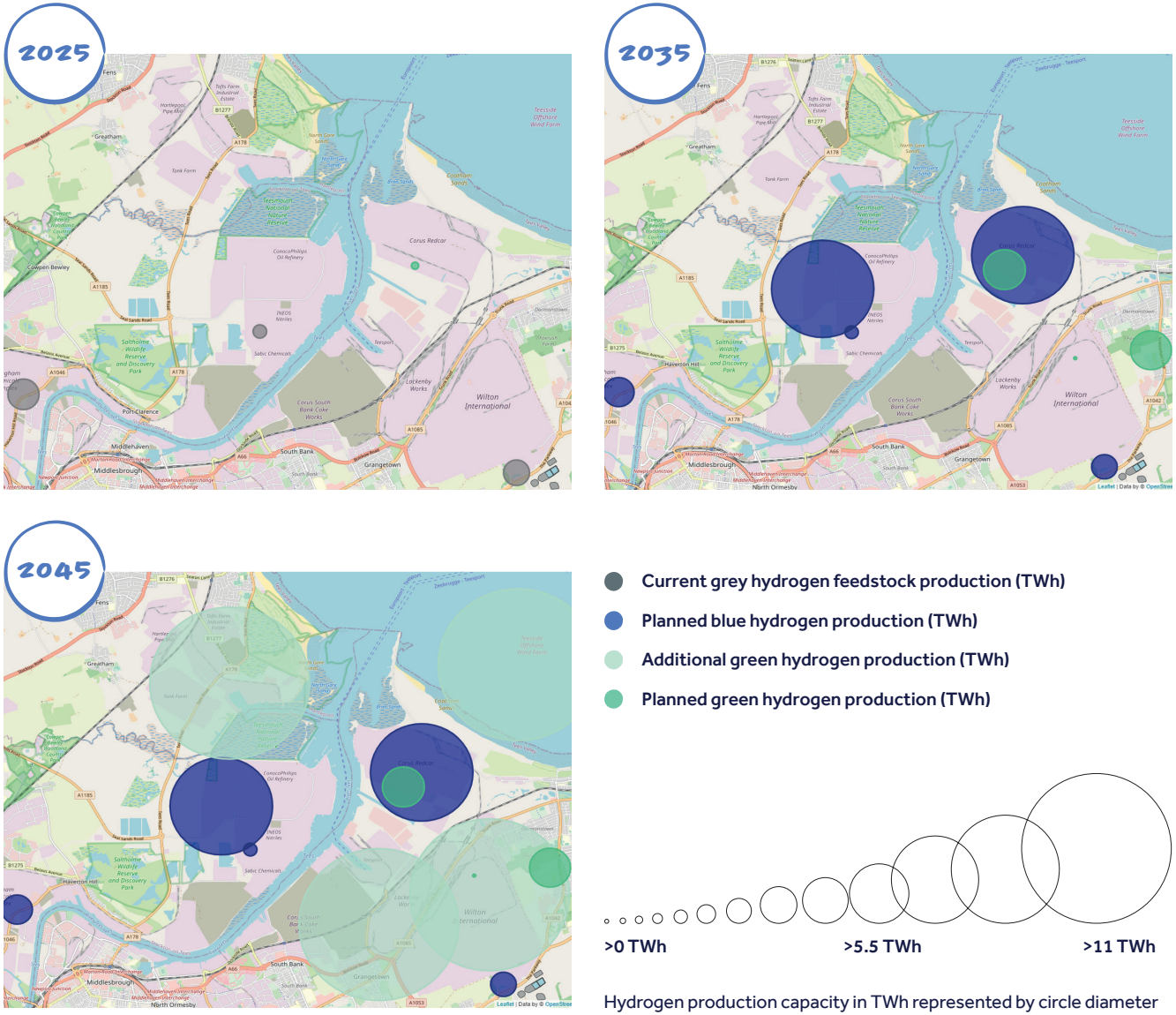


Figure 4 - Snapshots of hydrogen supply in 2025, 2035, and 2045. The locations shown are conceptual.

The Tees Valley's hydrogen SuperPlace status will see hydrogen demand grow ahead of the national rate, but supplies of the fuel, infrastructure, and expertise will all be in place to support it. When it comes to the Tees Valley, we believe that hydrogen use will massively outstrip the government's national projections, bringing new projects and benefits with it.

To date Teesside has five significant proposed hydrogen projects. These are:

bp - 500MW leading to 1GW blue hydrogen.

bp - 80MWe leading up to 500MWe green hydrogen.

Kellas Midstream - 355MW leading to 1GW blue HYdrogen.

EDF - 30 to 50MWe and then to 500MWe green hydrogen.

Protium - 40MWe green hydrogen.

Hydrogen supply - looking ahead to 2035, 2045 and beyond

By 2035 we expect the Tees Valley to be leading the way on hydrogen production nationally. The Tees Valley will be attracting new industry to use this low carbon hydrogen. It will also be exporting hydrogen within the UK and could export internationally.

By 2040 hydrogen will have played a role, alongside CCUS, energy efficiency, greenhouse gas removals and offsets in making the Tees Valley one of the world's first net zero industrial clusters. The initial growth in blue hydrogen will have paved the way for an increase in ambition and then deployment of the Tees Valley current green hydrogen projects.

By 2045, support mechanisms for early hydrogen production plants are anticipated to have ended or will be ending this decade. Early built plants will have paid off their investment and will still be operational and producing hydrogen. Factors like market competition, costs of feedstocks and energy, tightening emission targets and carbon taxes, however, will drive the ratio of the demand of blue and green hydrogen by consumers and hence that of production.

By 2045, there will need to be significantly more hydrogen produced than is currently projected. We see the Tees Valley aiming to supply at least 20% of the UK's hydrogen demand. We chose 20%, rather than a much larger number, given the need for a geographic spread of hydrogen production across the UK: ensuring a resilient and secure energy system. Our analysis indicates that if the Tees Valley were to produce 20% of the UK's hydrogen demand, it would need between a two and fourfold increase from the almost 3GW capacity of currently proposed projects. The exact level depends on which of the Committee for Climate Change (CCC) consumption scenarios is used for reference.

Whilst there is uncertainty over the exact picture in 2045, what is clear is how the ambition needs to be increased and the pace of change accelerated. The following three graphs give a visual demonstration of the descriptions above. They are the outputs of our modelling on the future of hydrogen in the Tees Valley.

Tees Valley hydrogen vision

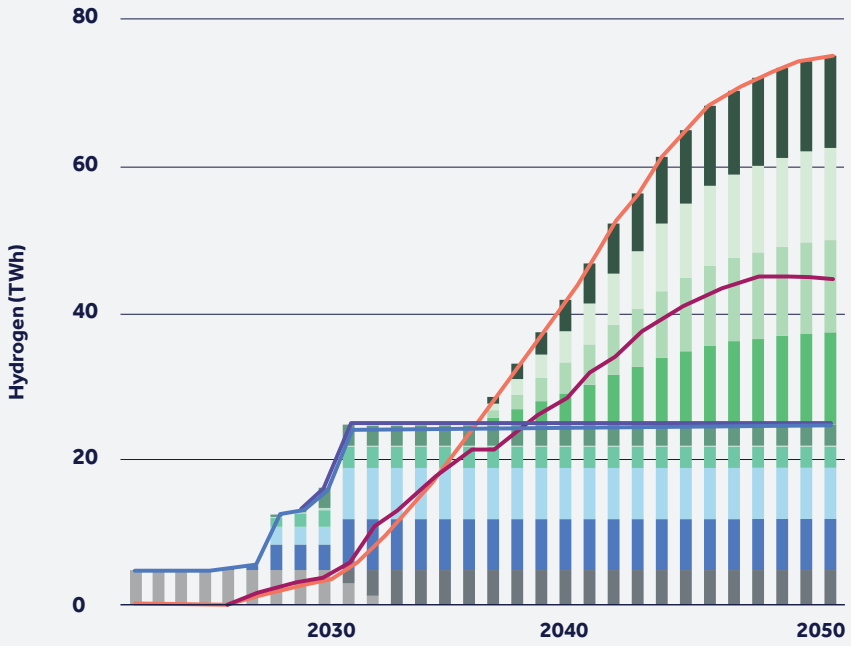
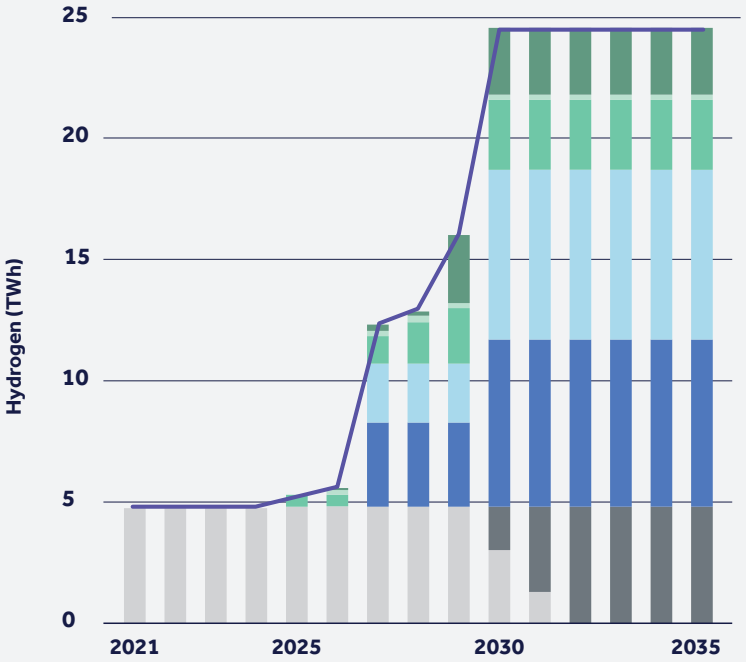


Figure 5 - Our vision outlines how the currently proposed projects will provide the initial impetus but between 2 and 4 times more hydrogen will be required by 2050 if Teesside is to meet 20% of national demand.

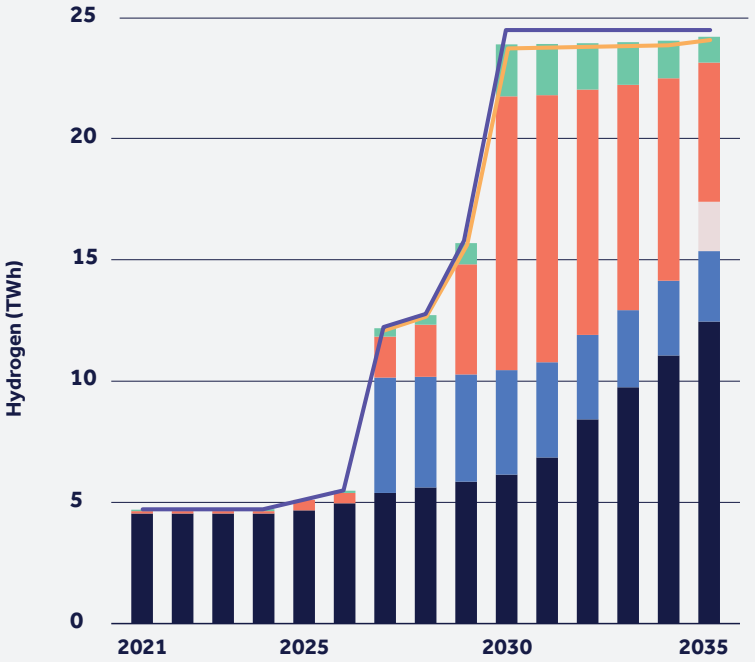
Production from current projects



- EDF Tees green hydrogen
- Protium energy
- bp HyGreen Teesside
- H2 North East
- Chemical feedstock production (grey)
- Chemical feedstock production (blue)
- bp H2Teesside
- Currently proposed supply

Figure 6 - Teesside already produces approximately 5 TWh of grey hydrogen annually. However, it will see a significant ramp up in this production, reaching 25 TWh by 2035. The decarbonisation of current grey hydrogen production is an important part of the vision, the transition dates and pathway shown are indicative.

Potential demand from current projects



- Accelerated hydrogen for transport
- Blending into gas network, national export or additional inward investment
- New steel recycling, SAF production, and novel chemical processing
- Early industrial adopters
- Expected underlying growth
- Currently proposed supply
- Local full utilisation demand

Figure 7 - This graph indicates how we expect hydrogen from currently proposed production projects to be used in existing industries, new industries, blending into the gas networks, and in accelerating hydrogen for transport.

Distributing hydrogen

In order for The Tees Valley to reach its potential as a hydrogen SuperPlace, it is essential that gas network infrastructure is in place that will allow distribution across the Tees Valley region, and for export domestically and internationally. Distribution will also be using compressed hydrogen by road or rail tanker. Whilst this is less efficient than pipeline distribution, it allows for greater flexibility.

A local hydrogen pipeline network within and between the industries of the Tees Valley is an obvious step, growing in parallel to road transport and to an ambitious timetable for construction. Outside of the industrial estate, hydrogen will be blended into the National Grid Gas Transportation System and the local gas distribution network operated by Northern Gas Networks. Blending will only be up to 20% hydrogen as levels above 20% require the replacement of consumer downstream appliances. The East Coast hydrogen project is a collaboration between National Grid, NGN and Cadent to accelerate the plans for a 100% hydrogen gas distribution along the East Coast of England. Initially this will link the Tees Valley and Humber regions. The East Coast hydrogen project proposes that a 100% hydrogen Tees Valley to Humber link will be connected between 2027 - 2030, though detailed studies have not yet been carried out. These studies are key to deployment, as is support from government.

Export of hydrogen by sea to mainland Europe is likely to be a key component of demand, though much depends on the global prices of hydrogen in years to come. A number of liquid chemicals that contain hydrogen are being investigated by producers for both export and import of hydrogen. These avoid the need for compression or cryogenics, providing a denser and cost-effective means of transporting hydrogen by sea.

Storage solutions

Storage of significant quantities of hydrogen enables the ability to cater for seasonal swings (between summer and winter) of energy required for domestic and commercial heating. Having sufficient storage when generating energy from offshore wind farms avoids curtailment, a situation where wind farm output is restricted, and enables better use of the electricity grid. Storage is essential also for operational resilience and energy security.

Hydrogen can be stored in overground tanks, either as compressed hydrogen or converted to liquid ammonia. At a much larger scale, hydrogen can also be stored in underground salt caverns, salt having the right properties to avoid hydrogen leakage. With 0.32 million cubic meters of salt formations under the Tees Valley, and the potential to expand to cover increased local use, capacity for hydrogen storage is significant. Utilising the 100% hydrogen pipelines proposed by East Coast hydrogen project means there is also the chance to make use of the large salt-cavity stores in Yorkshire, which currently house natural gas.

Energising the economy

Adopting and growing a hydrogen economy will bring demand for new skills and business growth to the region, as industries diversify, and a hydrogen supply chain is created. Fresh growth means new jobs in existing and newly established businesses, and a socioeconomic boost for the Tees Valley. To understand properly what that boost will look like, it is important to look at how gross value added (GVA) is affected - will the region generate products and services with a greater financial impact than any that have been displaced to make room for the hydrogen economy?

Figure 8 - Route of the high pressure gas main between the Tees Valley and Humber Region along which is significant potential for the underground storage of hydrogen in salt caverns.

The opportunities in the Tees Valley

A socioeconomic view - jobs

The Tees Valley is already a major industrial hub, so it will be reasonably straightforward to find, develop, and retain talented individuals for roles within the hydrogen economy thanks to existing and transferable skills. Creating and maintaining industry supply chains within the Tees Valley will also have a positive impact on job numbers and security.

As consumers start to demand low carbon products, the hydrogen industry can begin to safeguard energy intensive jobs as the new economy takes hold. With the shift towards low carbon manufacturing speeding up (some car manufacturers are already specifying that all new vehicles must be made with low carbon steel or aluminium), there is a chance for new businesses to take over from those that find it hard to decarbonise and can't adapt to survive. We can expect to see more of this happening due to the Government's legally binding pledge to reach net zero carbon emissions by 2050.

The good news is that this shift in the availability and use of hydrogen has the potential to protect up to 2,400 jobs in the manufacturing industry (£190m GVA per annum) and 400 jobs in transport and other industries (£15m GVA). New jobs in the Tees Valley will also be a feature of a hydrogen SuperPlace. The ability to produce both green and blue hydrogen in one area gives the Tees Valley an opportunity to attract investment from the private sector to create innovative and sustainable employment.

Meanwhile, large businesses that are making the shift into low carbon products would have an incentive to move to the Tees Valley, where their hydrogen demands can be easily met. With the creation of high-value employment opportunities, the Tees Valley would have a major role in contributing to the UK Levelling Up agenda.

Building a hydrogen 'SuperPlace'

In order to create a hydrogen SuperPlace in the Tees Valley, facilities and infrastructure will need to be developed. That means a sizeable increase in work for local construction firms and supply chains.

To give an indication of what that increase looks like, five significant hydrogen production sites are already in the pipeline to be built. Combined, the sites will have a capacity of almost 3GW, and will support up to 6,300 workers during a three-year construction period. That breaks down to 3,500 construction workers, 2,100 supply chain workers, and 700 others in work thanks to growth of indirect jobs. In terms of the GVA, it could reach up to £440m per annum.

Yet more jobs will come from the need for large-scale seasonal storage. An estimated £300m+ is needed to make this investment plan a reality, but this investment will directly support up to 1,350 jobs annually for three years. That's 750 construction workers, 450 workers in associated industries and 150 workers in the wider economy, and a combined GVA of up to £100m per annum.

The skills of the construction industry will be called on again to create a dedicated pipeline network. This network will be used to link the Tees Valley's hydrogen production sites to demand clusters and will support up to 100 deployment and maintenance workers up to 2050, with a GVA of up to £7m per annum.

Call to action

Looking ahead to 2040 and Teesside as one of the world's first net zero industrial clusters, it is easy to envisage a region which is a thriving hub of clean industry with a global impact.

At this moment, however, stakeholders across the Tees Valley need to come together behind a shared vision of a hydrogen-powered industrial regeneration of the region. Only by working together can the regulations, policies, investments and actions be unlocked, opening the door to achieving the ambitious hydrogen production decarbonisation targets set out by the TVCA and national government. This coming together has already started with work on the Teesside Cluster Plan and Net Zero Leadership Group, but more must be done.

There stands before the people and industries of the Tees Valley a once in a generation opportunity. A chance to create a sustainable, low carbon future with significant economic benefits and global importance, a future as a hydrogen SuperPlace. The Tees Valley Hydrogen Vision is within reach and is a collaborative future worth fighting for.

Present day

- The seeds of the hydrogen revolution are being planted right now. Government is putting in place the regulations and financial support to make this happen.
- Government's plans are attracting the interest of businesses looking to play a part in the hydrogen future. Potential producers are starting to develop hydrogen projects to produce hydrogen for fuel at large-scale and consumers are looking to the future, advancing plans to move to low carbon energy.
- Hydrogen is currently produced in the Tees Valley for use as a chemical feedstock.

2022 Regulations in place to build hydrogen industry.

Early steps

- With a regulatory framework and business support in place, confidence in a hydrogen future grows. Carbon capture utilisation and storage (CCUS) projects continue to develop.
- Large-scale hydrogen projects begin construction, moving from the drawing board into reality. Some smaller-scale green hydrogen projects already commencing production.
- Consumers and businesses have the confidence to contract for hydrogen supply and convert their processes to consume it.
- Hydrogen for home heating trials are successful, pointing the way forward for widespread adoption. Hydrogen for transport is ramping up across transport fleets, especially heavy duty transport.

2025 Hydrogen projects begin construction.

Production accelerates

- Momentum grows, decarbonisation is becoming a reality as offshore wind, CCUS and hydrogen production are now operating at large scale.
- More hydrogen capacity under construction, and current feedstock production decarbonises.
- With experience in producing and selling hydrogen, businesses plan for expansion and the next stage in their growth.
- Scale-up of green hydrogen capacity continues as costs fall and hydrogen demand increases.
- Businesses can clearly see the advantages of moving to hydrogen and more seek to convert to maintain competition.
- People can see the advantages of hydrogen for heat and transport, creating significant demand.

2030 Hydrogen production at scale.

Green growth

- Building on their experience and falling construction costs, hydrogen businesses expand hydrogen production.
- Infrastructure is now in place to store and distribute hydrogen, and business, industry and consumers become low carbon energy and fuels.
- Hydrogen is playing a major role in the Tees Valley Industrial Cluster's overall decarbonisation plan.

2035 Green hydrogen production expands capacity.

Net zero Tees Valley

- Tees Valley achieves the status of one of the world's first net zero industrial clusters, supported by the deployment of low-carbon hydrogen.
- The Government's focus on radically reducing all GHG emissions has been achieved in Teesside 10 years early. The few remaining unabated emissions face a regime of rising taxes and restrictions in operation.
- The renewable electricity and green hydrogen industries march forward in lock step, working to deliver demand for low carbon energy.
- Existing energy intensive industries thrive and others are attracted back to the Tees Valley, owing to the availability of clean fuel and feedstocks.
- Hydrogen vehicles are commonplace and the natural gas network moves to deliver 100% hydrogen across the country to buildings and industry.

2040 One of the world's first net zero industrial clusters.

Destination zero

- Five years ahead of the UK's 2050 net zero target, Teesside has not only achieved net zero but is also, along with other industrial clusters, helping the rest of the country achieve this goal.
- The Tees Valley's position as a global location for low carbon industry is secured as businesses meet consumer and regulatory demands for sustainability.
- Teesside International Airport runs scheduled zero emissions flights based on locally produced hydrogen and sustainable aviation fuels.

2045 The Tees Valley accelerates the UK's net zero target.

Summary action plan

In order to achieve the Tees Valley hydrogen vision, the following action plan is recommended.

Leadership actions

2022
TVCA's re- energized net zero Leadership group, established to drive the vision forward and synergise with other Teesside initiatives including the Cluster Plan.

Stakeholders: TVCA , bp, Kellas, NGN and others

Demand actions

Now – 2030
Incentivise existing and new industrial consumers to switch to H_2.

Stakeholders: TVCA, BEIS, HM Government

Now – 2030
Build out H_2 transportation hubs across all modes (road, rail, shipping and aviation).

Stakeholders: DfT, TVCA, Energy and Transport Providers

2025
Deploy the H_2 village at Redcar, then deploy H_2 for heating across the Tees Valley where appropriate.

Stakeholders: DLUHC, BEIS, NGN

Supply actions

2023
Explore hydrogen export within UK and to Europe.

Stakeholders: Hydrogen Producers

2025 – 2030
Deliver the 5 proposed H_2 production projects , begin the decarbonisation of current feedstock production, and seek to expand.

Stakeholders: Hydrogen producers

2025 – 2030
Expand North Sea offshore wind capability with H_2 as an energy vector.

Stakeholders: BEIS, Energy Industry and Crown Estates

Distribution and storage

2035 Onwards
Teesside to play a key role in the repurposing of the gas network across the UK.

Stakeholders: BEIS, Offgem, National Grid, NGN

2025
Deployment of local distribution network for H_2 within the cluster.

Stakeholders: NGN, Hydrogen Producers

2025 – 2030
Build the east coast hydrogen project and associated seasonal H_2 storage.

Stakeholders: National Grid, NGN, Cadent

Socio economics

Now – 2030
Incentivise new industries to Teesside prioritising local jobs where possible.

Stakeholders: TVCA, HM Government

Now – 2030
Establish centres of excellence for hydrogen research and skills development.

Stakeholders: TVCA, Local Authorities, Teesside University, Durham University, Local Colleges, Employment support providers

Now – 2030
Accelerate STEM activities (including hydrogen related technologies) in local schools.

Stakeholders: TVCA, Local Authorities

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