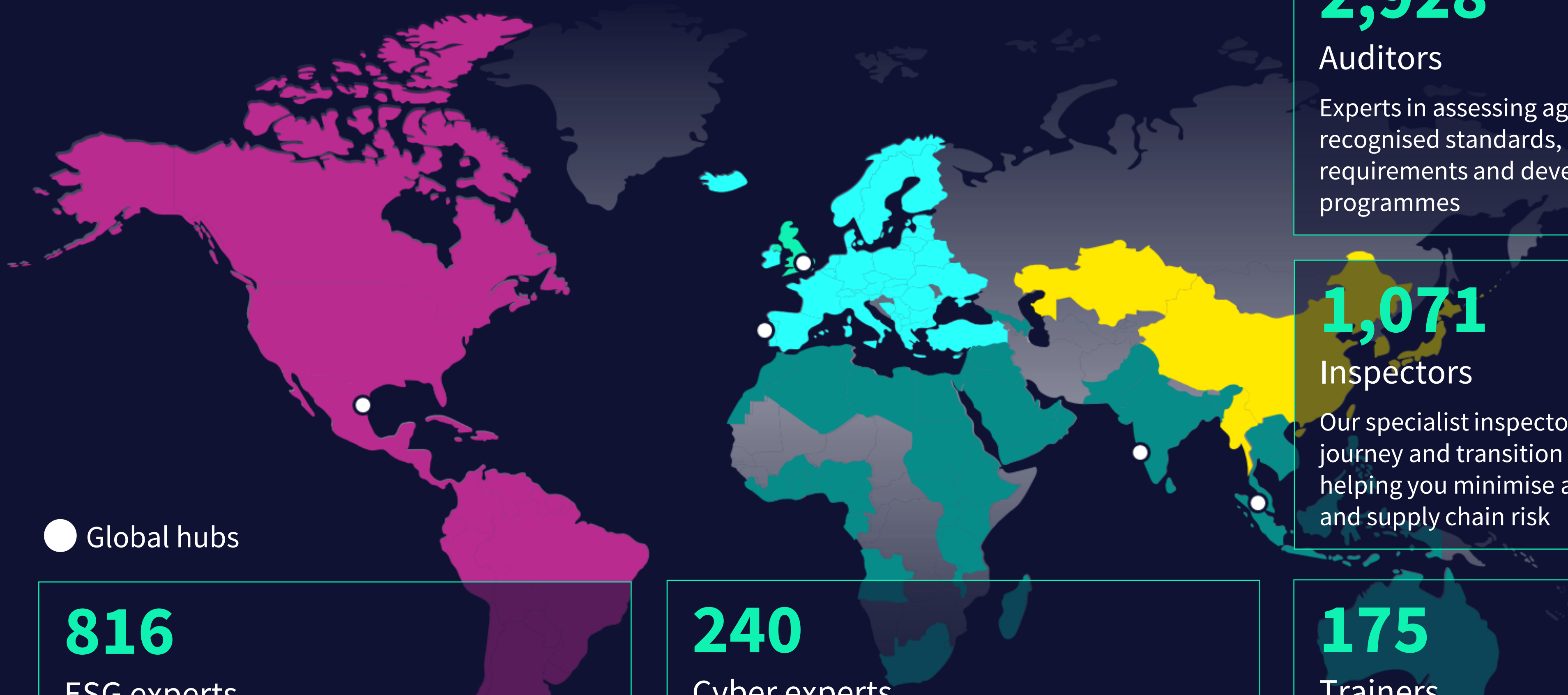
Hydrogen

Your energy transition partner

DD/MM/YYYY| [Name- Job Title | **Client**

We are **everywhere** you are



2,928

Auditors

Experts in assessing against internationally recognised standards, aligning with the latest requirements and developing bespoke audit programmes

1,071

Inspectors

Our specialist inspectors support your compliance journey and transition to cleaner energy – helping you minimise asset, equipment and supply chain risk

816

ESG experts

Trusted specialists helping you navigate sustainability regulations and expectations, from your carbon footprint to your supply chain

240

Cyber experts

Our skilled experts help you identify and manage cyber risks, building your resilience to combat the ever-evolving threat landscape

175

Trainers

Industry specialists aligned to your business needs to deliver effective and robust training

From small manufacturers to the world's leading brands

LRQA has supported a wide range of organisations with experience in:

14 countries

With hydrogen projects completed in:

Australia, China, France, Germany, India, Japan, Malaysia, Netherlands, Saudi Arabia, South Korea, UAE, UK, USA, Vietnam

Hydrogen end-use and transportation

Including:

- Refuelling stations
- Engines
- Fuel cells
- Pipeline – new and existing upgrades

Hydrogen-specific production equipment

Including:

- Raw material
- Bullets
- Electrolysers (inc component parts)
- Compressor
- Condenser
- Coolers
- Cyclones
- Cylinder
- Economiser
- Generation unit
- Heat Exchangers
- Measuring skid
- Pressure vessel
- Reactors
- Reformer tubes
- Storage vessel/tanks
- Storage skids
- Valves

Production, storage, handling and transportation lifecycles

Including:

- Onshore and offshore pilot plants
- Hydrogen production facilities >10 MW
- Hydrogen fuelled power stations
- Ammonia plants

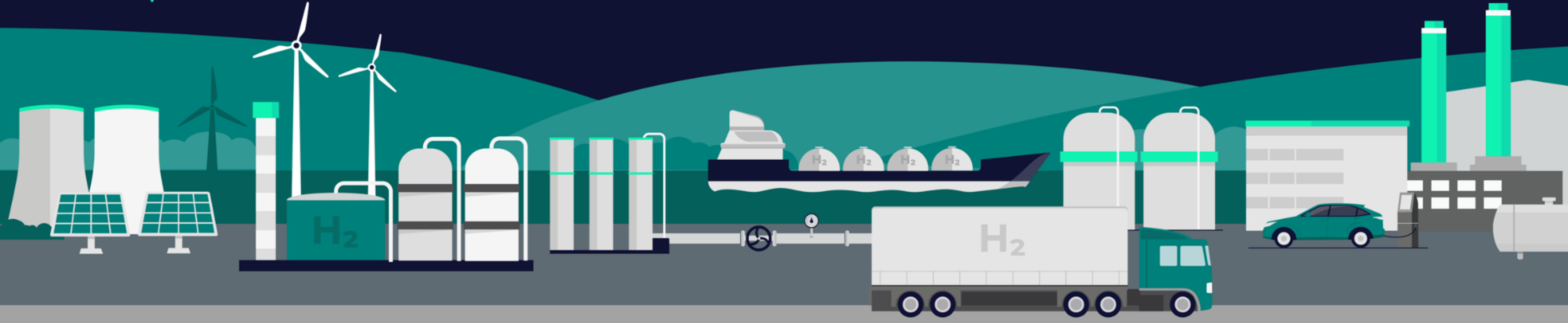
The hydrogen sector continues to grow, but challenges exist...

1,064
Hydrogen projects are projected to be completed by 2040

40%
growth in number of projected projects over the last 12 months

But, only
6%
of projects >10MW reached Final Investment Decision (FID)

Supply chain
response has been slower than expected, leading to fewer projects reaching construction



Source: LRQA Consulting Analysis, IEA, Hydrogen council

There's a strong need for education, innovation and stability throughout the hydrogen sector

Assurance, access to the right technical expertise and a quality-focused approach provide a solution

Market challenges

Technology & supply chain

- Hydrogen production isn't new – the scale and required cost point is new and requires innovation
- Diversified & new supply chains carry risk
- Plants are in less common locations – leading to personnel challenges and skills gaps

Regulations & standards

- Regulations and standards are needed to cover:
  - Production
  - Storage
  - Transportation
  - Fuelling and distribution
- Holistic regulations and standards are currently limited in scope
- Minimal marketplace knowledge relating to best practices

Social licence to operate

- Hydrogen projects will have a public impact – consider gas blending and fuel stations
- Previous disasters cause negative perceptions
- Lessons learnt from the "Not in my backyard" effect and low public acceptance

Competency gap

- Limited specific expertise
- Lack of knowledge of standard/ regulations
- Demand across sectors still high
- Hydrogen simplest molecule but differences need to be respected

Potential impacts

- Lack of trust could prevent scale-up leading to
  - Delays
  - Supply chain risks & additional costs
  - First-mover disadvantage
- Lack of clarity around regulations delays development
  - Delays
  - Highly complex regulatory landscape
  - Reduced cross-region/border training
  - Increased costs
- Poor public perception of hydrogen projects
  - Delays
  - Additional costs
  - Corporate reputation could be damaged

Meeting **high expectations** is challenging

How do I...

Avoid unnecessary **costs** and **make savings?**

Keep operating no matter what, with minimal disruption?

Keep up with changing **social** and **environmental regulation?**

What is the regulatory requirements for a specific country?

Boost long-term business **resilience** and **sustainable growth?**

Make sure my **workers on site and around the supply chain** are **healthy, safe and happy?**

Meet **customer expectations** and **maintain** good brand **reputation?**

Ensure quality throughout my supply chain?

Invest in **safe** and **legitimate technologies?**

Take control of your risk profile

We help you:

- Have confidence in your projects & planning
- Comply with codes, regulations & standards
- Trust your supply chain, end-to-end
- Optimise your equipment & operational performance

Hydrogen Lifecycle Solutions

GUARANTEE OF ORIGIN

- There is a current market need for closed loop certification of Hydrogen origin to prove its green credentials.
- LRQA has an established and strong market share in carbon verification. This can be adapted to establish a scheme specific for the hydrogen sector expanding from verification to product certification

01

FEASIBILITY & COMMERCIAL

- Risk and safety studies
- Technical Due diligence of pre-owned plants / equipment
- Vendor assessment
- Design Review
- Approval in Principle

02

PRODUCTION

- Design, procurement, site quality support and assurance
- Supply chain assessment

03

STORAGE

- Experecine with Projects in compressed hydrogen gas and liquefied hydrogen and alternative storage media as ammonia and methanol
- Pipeline re-lifeing studies and inspection

TRANSPORTATION

- Experience with pipelines, transport and shipping of hydrogen

USAGE

- Hydrogen filling stations certification
- Fuel cells compliance and inspection

04

EMISSIONS VERIFICATION

- Transparency - verification of emissions – leading to “green” H2 certification
- Responsible Steel certification

REGULATORY FRAMEWORK

- Advise and training on relevant standards and regulations
- Support in adoption of global best practise - development of frameworks

Approval In Principle (AIP)

LRQA can provide robust technical review and assurance mechanisms - to show compliance to codes and standards or where they do not exist suitability for use in Hydrogen sector

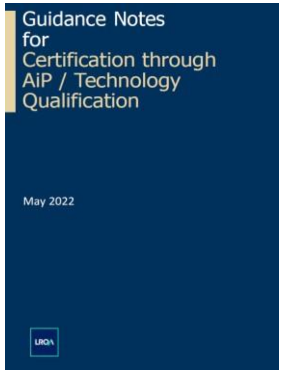
Benefits of AIP are:

- Help manufacturer to obtain Finance and insurance
- Use AIP certificate as Marketing tool
- Aid route to market
- EPCs and Operators benefit by reducing risk in the supply chain

Compliance Review for Hydrogen Products to market

Disciplines Involved

- Process Safety
- Fire
- Technical safety
- Pressure Systems
- Rotary equipment
- Civil
- NDE
- Electrical and C&I
- Materials


Guidance Notes for Certification through AiP / Technology Qualification

May 2022

1 RISK REVIEW – Hazard and Failure Mode Identification and QRA

- Identification hazards and failure modes applicable to the plant along with support information demonstrating the control of these hazards and failure modes is proved to be feasible
- Workshop and review

2 DEFINE CODES AND STANDARDS – Code and Standard Selection

- Confirm applied Codes and Standards, Specifications and Practices that has been selected for the design and construction of this type of equipment are suitable

3 CONCEPT DESIGN REVIEW – Concept Design Review

- Review Design Philosophies, Design basis, System and functional details such as functional flow block diagram, process flow diagrams, Piping and Instrumentation Diagrams, Interfaces

AIP CERTIFICATE – Deliverable

- Approval In Principal (AIP) Certificate to be used for marketing purposes
  - ❑ Include caveats on required including
    - Required Testing
    - Additional details for detailed design
    - Regulatory

4 APPROVAL FOR USE/ TYPE APPROVAL – Approval for use / Type approval

- Similar process to above now investigating
  - ❑ Detailed design and testing for specific market use
  - ❑ Regulatory review

We give you the confidence to make informed decisions

Economic viability and opportunities

- Does the product meet the required certification?
- Are the energy yield estimates realistic?
- Which components are covered in cost estimates?
- What are potential operation and maintenance issues?

Threats, asset integrity and liability avoidance

- Is the design feasible?
- Is the site prone to natural disasters?
- What is the local community's opinion?

Regulatory framework

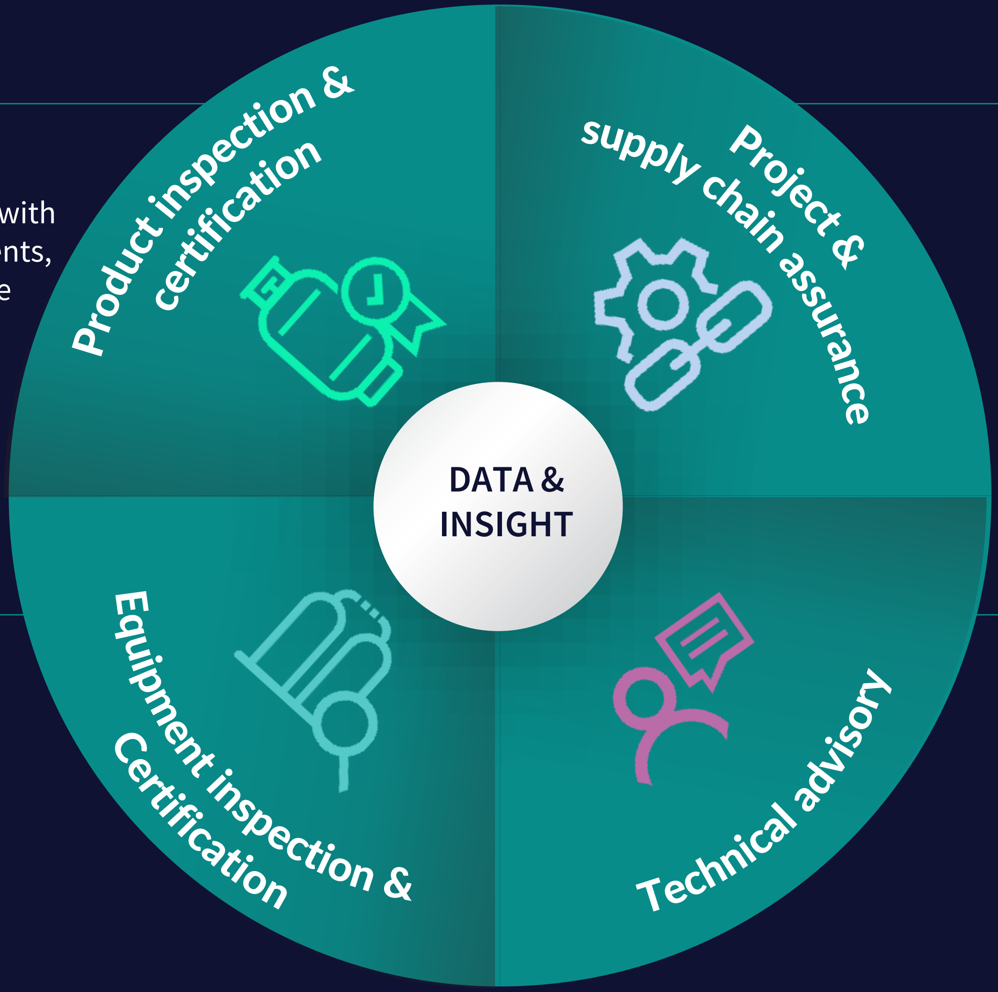
- What are the minimum regulatory requirements and timeframe?
- What's the current state of permitting?
- Will recent changes in legal requirements impact the project?
- What are the penalties and sanctions if permits are not obtained in time?
- How does the use of Hydrogen affect the use of existing standards?

Tailored solutions to manage risk throughout your hydrogen projects

Gain assurance around equipment adaptation, stay one step ahead of the regulatory landscape, and address facility challenges for safe hydrogen production, storage, and distribution.

Product inspection & certification

Ensure that the hydrogen you produce complies with standards, regulations, GHG reporting requirements, and recognised best practices before entering the market.



Project & supply chain Assurance

Maintain the integrity of your hydrogen supply chain through site inspections and vendor assessments that ensure quality and safety throughout your projects.

Equipment inspection & certification

Ensure your equipment adheres to all relevant regulations and international standards, regardless of your export or usage location.

Technical advisory

Maximise the success of your hydrogen projects with specialised insight, regulatory advice, training and support at every stage.

CASE STUDY Inspection Services

Certifying design innovation in green hydrogen storage

Challenge

Combining plastics with a carbon fibre shell, Emano's innovative approach to hydrogen storage delivers weight and price advantages, as well as improved risk performance. As Germany's hydrogen economy booms, Emano is working to build confidence in the technology and reassure customers that there is no compromise on safety or quality.

Solution

End-to-end certification across design, product and manufacturing, against international best practice including European Pressure Equipment Directive (PED) and American Society of Mechanical Engineers (ASME) standards. Certification was achieved not just to PED Module B and Module F, but also ASME Class I, Section 10, which focuses on fibre reinforced pressure vessels.

Benefits

- Emano's innovative storage tanks have been successfully delivered and installed for one of its major customers - Apex Energy - as it builds a ground-breaking green hydrogen energy plant.
- Certification across European and US standards means that Emano is able to target valuable export markets, as well as future applications for the technology, including domestic storage.

Your Future, Our Focus

Any questions?

Fraser.morris@lrqa.com