**Hydrogen R&D Value Chain – Key Elements and Research Focus Areas**

**Production**: research focus areas include

Biological hydrogen production

Biomass and waste conversion

Direct hydrogen carrier production

Electrolysis

Fossil fuel conversion

Natural hydrogen

Photochemical and photocatalytic processes

Thermal water splitting

**Storage**: research focus areas include

*Compression and liquefaction*

Compressed gas

Cold/cryo compressed

Liquid hydrogen

Underground storage

Pipeline storage

*Chemical storage*

Ammonia

Hydrides

Liquid organic carriers

Synthetic fuels and chemicals

Adsorbents

Proton Batteries

**Distribution and supply:** research focus areas include

Pipeline materials and performance

Pipeline design and integrity management

Pipeline and network operations

Hydrogen embrittlement

Non-pipeline non-export supply technologies

**Cross-cutting**: research focus areas include

*Environment*

Water use and treatment

Land use and ecological impacts

Emissions and atmospheric impacts

Materials and waste management

*Social Licence*

Social licence

Socio-technical risks

Local communities

Indigenous culture and communities

Communication and engagement

*Safety and standards*

Safety and standards

*Techno-economic evaluation*

Techno-economic evaluation

*Modelling*

Geographical modelling

Computational modelling

Materials modelling

*Systems integration and markets*

Energy systems integration

Sector coupling

Supply chain integration

Hydrogen market development

*Policy and regulation*

Policy

Regulations

Hydrogen certification schemes

*Ancillary technology and services*

Separation materials and technologies

Specialised components and devices

Advanced manufacturing

Technology integration process improvement

Nanomaterials

*Skills and labour market*

Skills and labour market

**Utilisation**: research focus areas include

Electricity

Export potential

Gas networks and appliances

Heat storage

Industrial heat processes

Industrial feedstock processes

Mobility

**Whole Chain:** whereresearch covers all key elements of the value chain