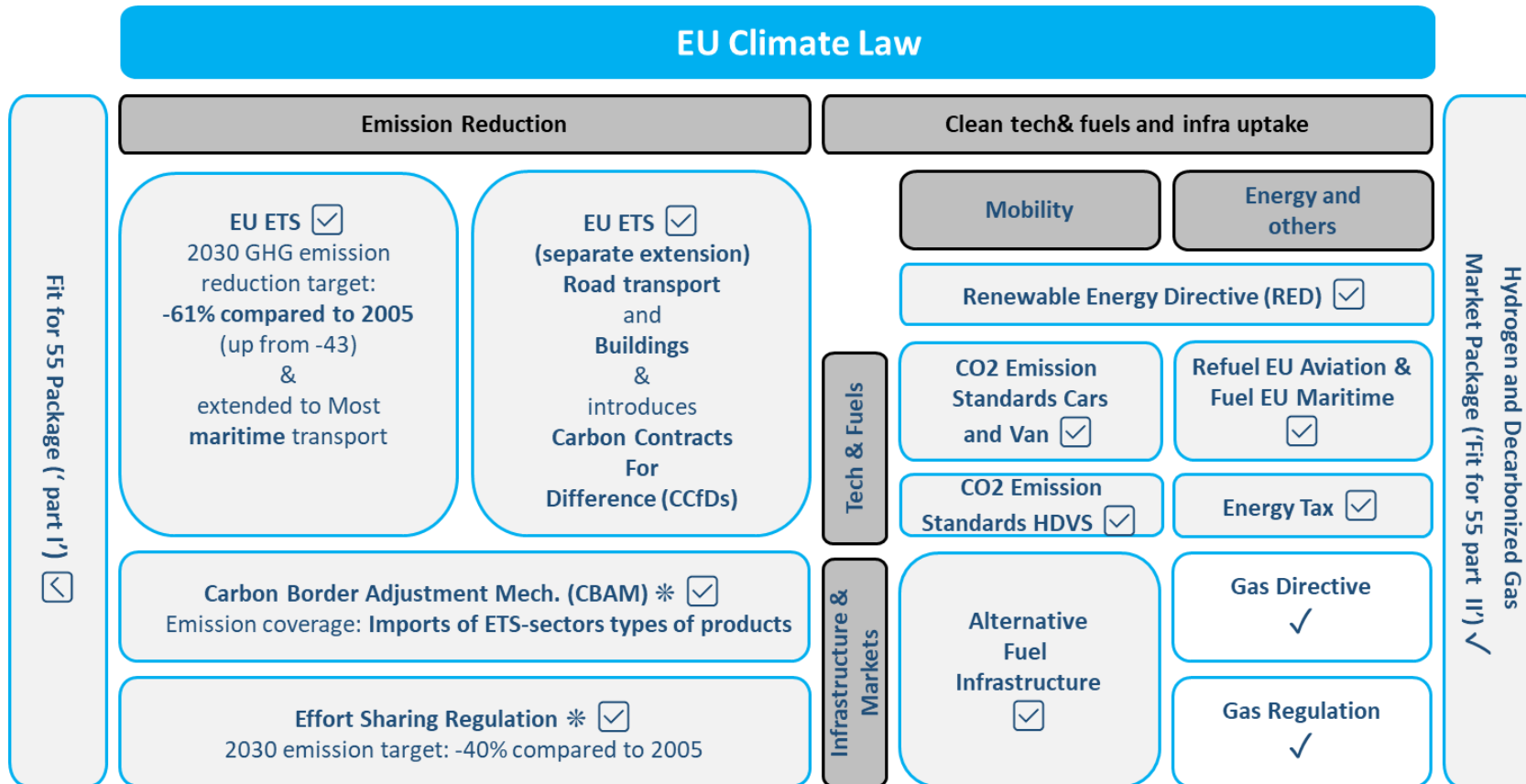# Universal I-REC Certification Scheme for Hydrogen and Derivatives

Wael Almazeedi
Avance Labs

30 September 2022

Europe is not a leader for hydrogen, only leading in complexity

EU Climate Law

Fit for 55 Package ('part I') ☒

Emission Reduction

EU ETS ☑
2030 GHG emission reduction target:
-61% compared to 2005
(up from -43)
&
extended to Most
maritime transport

EU ETS ☑
(separate extension)
Road transport
and
Buildings
&
introduces
Carbon Contracts
For
Difference (CCfDs)

Carbon Border Adjustment Mech. (CBAM) ✳ ☑
Emission coverage: **Imports of ETS-sectors types of products**

Effort Sharing Regulation ✳ ☑
2030 emission target: -40% compared to 2005

Clean tech& fuels and infra uptake

Mobility

Energy and others

Renewable Energy Directive (RED) ☑

Tech & Fuels

CO2 Emission Standards Cars and Van ☑

Refuel EU Aviation & Fuel EU Maritime ☑

CO2 Emission Standards HDVS ☑

Energy Tax ☑

Infrastructure & Markets

Alternative Fuel Infrastructure ☑

Gas Directive ✓

Gas Regulation ✓

Hydrogen and Decarbonized Gas Market Package ('Fit for 55 part II') ✓

Source: Jan Braun, Ad van Wijk, and Kirsten Westphal

The Renewable Energy Directive - History

- Originally passed in 2009, and recast in 2018 as REDII, to promote of the use of energy from renewable sources.

- In July 2021, the Commission proposed amendments as part of the European Green Deal.

- In May 2022, the Commission proposed (i) further amendments as part of its RePower EU Communication, and (ii) Delegated Acts under RED pursuant to statutory authority.

- In July 2022, the Council adopted its position on REDII.

- In Sept. 2022, the Parliament adopted its position on REDII.

The Open Question for Hydrogen in REDII

- What are the requirements to count electricity as fully renewable when used for hydrogen production (so that such hydrogen counts as "renewable hydrogen", and any derivative renewable fuels of non-biological origin are counted towards the overall share of renewable energy of a Member State and potentially eligible for financial support by public authorities)?

The Commission view on "renewable hydrogen"

- Article 27(3) empowered the Commission to adopt a Delegated Act setting out detailed rules on counting electricity used to produce RFNBOs as fully renewable.

- The DA proposed by the Commission (May 2022) contained stringent additionality requirements, including:
  - For directly-connected projects, no more than 36 months between first operation of the RE project and the H2 project
  - For grid connected projects, hourly temporal correlation from 2027 (on a monthly basis in a transitional phase)
  - For grid connected projects, geographical correlation on a bidding zone basis
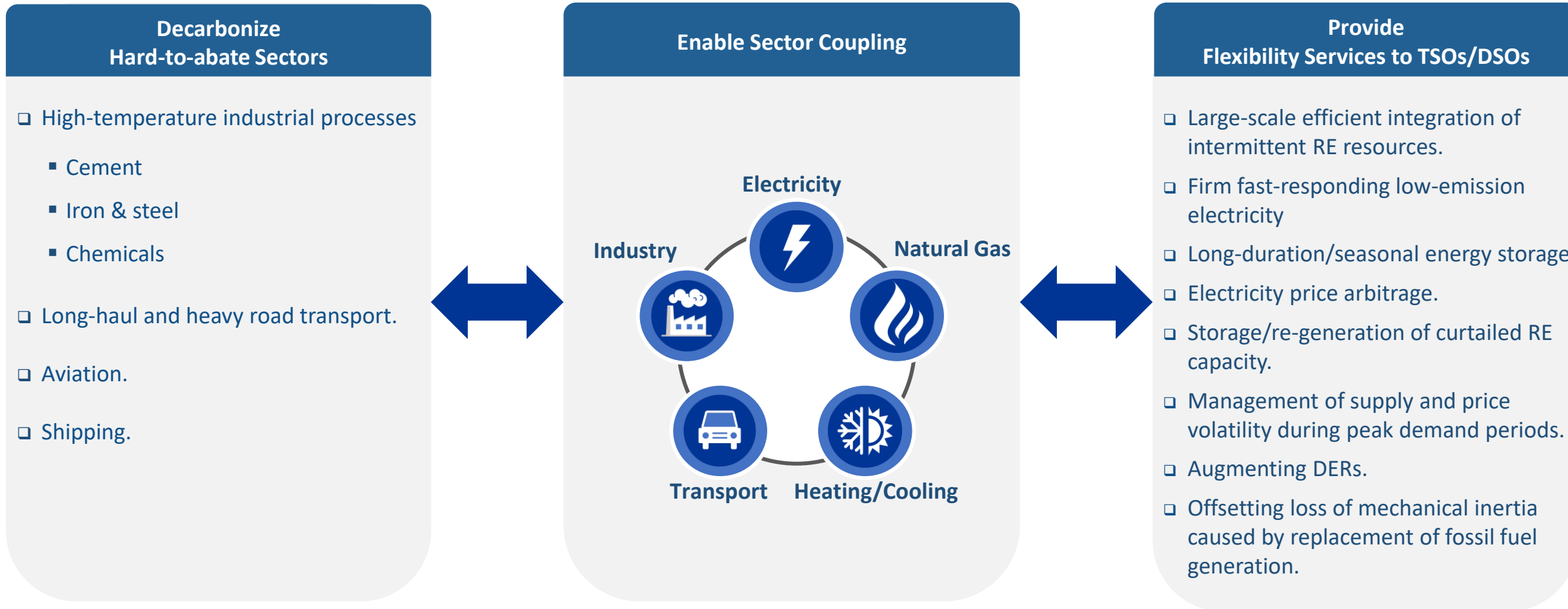
The Parliament view on "renewable hydrogen"

- Revokes the power of the Commission to enact a Delegated Act with respect to renewable electricity properties for H2.

- Directly-connected projects may count all electricity as fully renewable; there is no operational in-service restriction.

- Grid-connected projects may count electricity as fully renewable if:
  - Renewable electricity claimed only once in one end-use sector
  - Temporal correlation on a calendar quarterly basis until 2030 (thereafter on a yearly, quarterly or monthly basis)
  - Geographical correlation within country or neighboring country

What's Next?

- *Trilogue* negotiations between the Parliament, the Council and the Commission to come to an informal provisional agreement on the amendments to REDII.

- In the Council, the provisional agreement is first formally approved by the Committee of Permanent Representatives and then by full Council of the EU.

- In the Parliament, the text of the provisional agreement has to be approved by a vote in the Industry, Research and Energy committee after which it is voted on in the plenary assembly.

Hydrogen's Role in Energy Transition

Hydrogen will complement the role of renewable electricity in the energy transition

Decarbonize Hard-to-abate Sectors

- High-temperature industrial processes
  - Cement
  - Iron & steel
  - Chemicals
- Long-haul and heavy road transport.
- Aviation.
- Shipping.

Enable Sector Coupling

Electricity

Industry

Natural Gas

Transport

Heating/Cooling

Provide Flexibility Services to TSOs/DSOs

- Large-scale efficient integration of intermittent RE resources.
- Firm fast-responding low-emission electricity
- Long-duration/seasonal energy storage
- Electricity price arbitrage.
- Storage/re-generation of curtailed RE capacity.
- Management of supply and price volatility during peak demand periods.
- Augmenting DERs.
- Offsetting loss of mechanical inertia caused by replacement of fossil fuel generation.
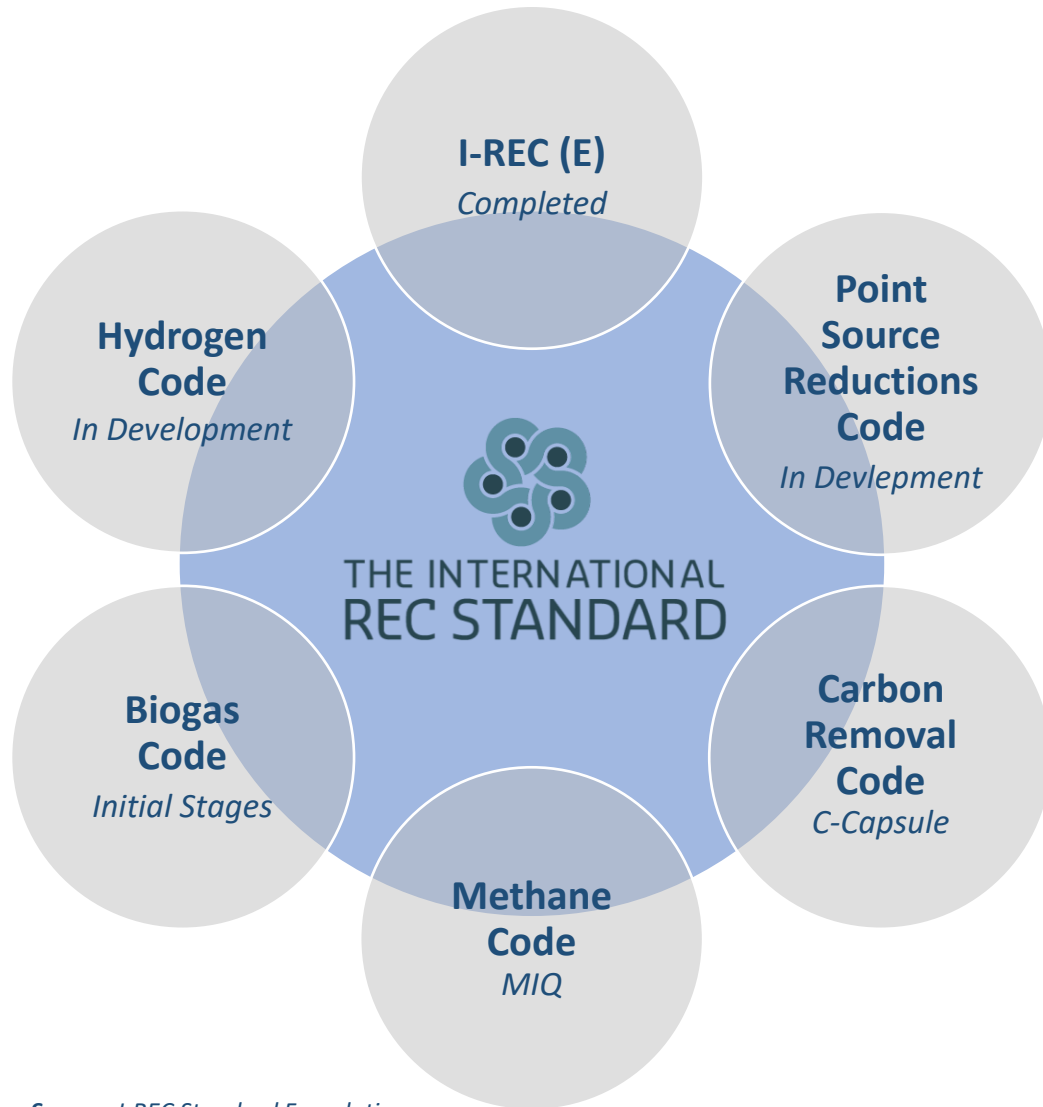
Legend: *RE: Renewable Energy / CCGT: Combined Cycle Gas Turbine / DER: Distributed Energy Resources / TSO: Transmission System Operator / DSO : Distributed System Operator*

Source: *Avance Labs*

Strong Synergies with Electricity

❑ Parallels between the hydrogen industry of today and the solar and wind industries of the early 2000s.

❑ Hydrogen will act as a complement to renewable electricity in the energy transition.

❑ Electricity is a primary source and a key energy input for all hydrogen production pathways.

❑ Hydrogen expected to retain some of the electricity industry's features and to benefit from its innovations:

- Demand aggregation platforms
- Virtual supply contracts
- Distributed hydrogen
- P2X

➢ Energy attribute certificates ("EACs") for electricity and hydrogen would need to be integrated.

I-REC Product Codes

I-REC (E)
Completed

Point Source Reductions Code
In Devlepment

Hydrogen Code
In Development

Biogas Code
Initial Stages

Carbon Removal Code
C-Capsule

Methane Code
MIQ

THE INTERNATIONAL
REC STANDARD

I-REC (E) in Türkiye

300 Facility Devices registered

I-REC Product Codes

Fact-based, ex-post, and interoperable energy attribute certificates accredited by I-REC Standard Foundation

Source: I-REC Standard Foundation

❑ Linked more closely to electricity.

❑ Structured from top to bottom rather than from left to right with hydrogen consumers sending **P**rice and **Q**uality signals to producers who would need to adapt to evolving market requirements.

❑ Demand-driven with energy consumers playing an equal, if not greater, role than that of other industry stakeholders.

Evolving Hydrogen Supply Chain
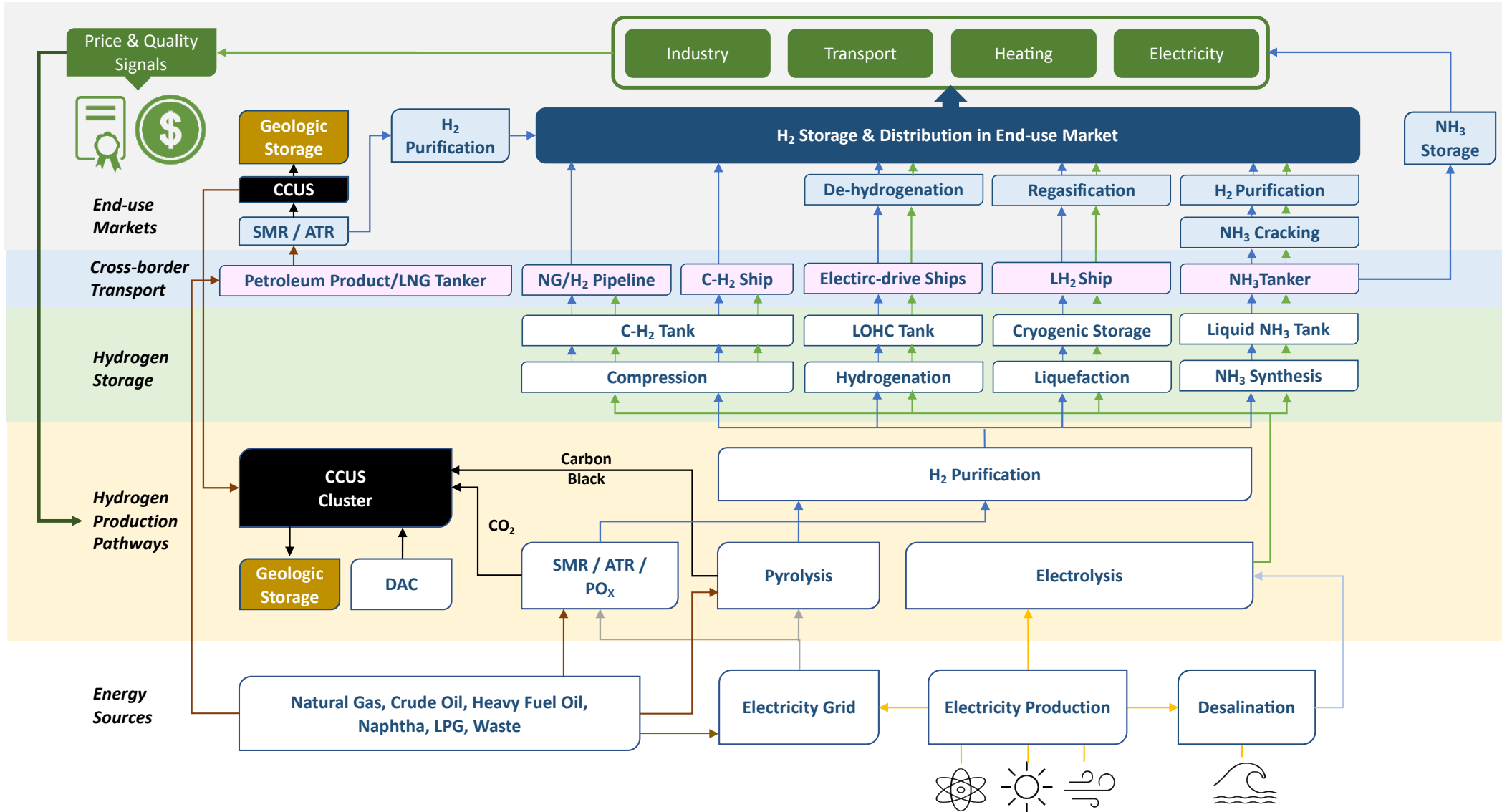
Legend: ATR: Autothermal Reforming / PO$_X$ Partial Oxidation / SMR: Steam Methane Reforming / CCUS: Carbon Capture, Utilization & Storage / DAC: Direct Air Capture / LOHC: Liquid Organic Hydrogen Carriers
Source: Avance Labs

Customer-centred Hydrogen Supply Chain

Price & Quality Signals

Energy Customers

| Industry | Mobility | Electricity | Heating/ Cooling |

Hydrogen End-use Applications

System Boundaries

Hydrogen Transport & Distribution

Hydrogen Conversion & Storage

Carbon Reduction & Removal

Hydrogen Production

Energy Production

Policy & Regulations

- ❑ Hydrogen Strategies
- ❑ Support Mechanisms
- ❑ Technological Mandates
- ❑ Market Creation
- ❑ R&D
- ❑ Carbon Pricing

Energy Attributes Certification

- ❑ Factual Information
- ❑ GHG Emissions Criteria
- ❑ Sustainability Criteria

Source: Avance Labs

I-REC Hydrogen Product Code Architecture

Physical Assets

- End of Life
- Hydrogen End-use Applications
- Hydrogen Transport & Distribution
- Hydrogen Conversion & Storage
- Carbon Reduction & Removal
- Hydrogen Production
- Energy Production

Point-of-use

Well

System Boundaries

Sensors

Digital Twin

Data

Analytics Engine

GHG Emissions Grading System

Zero-carbon
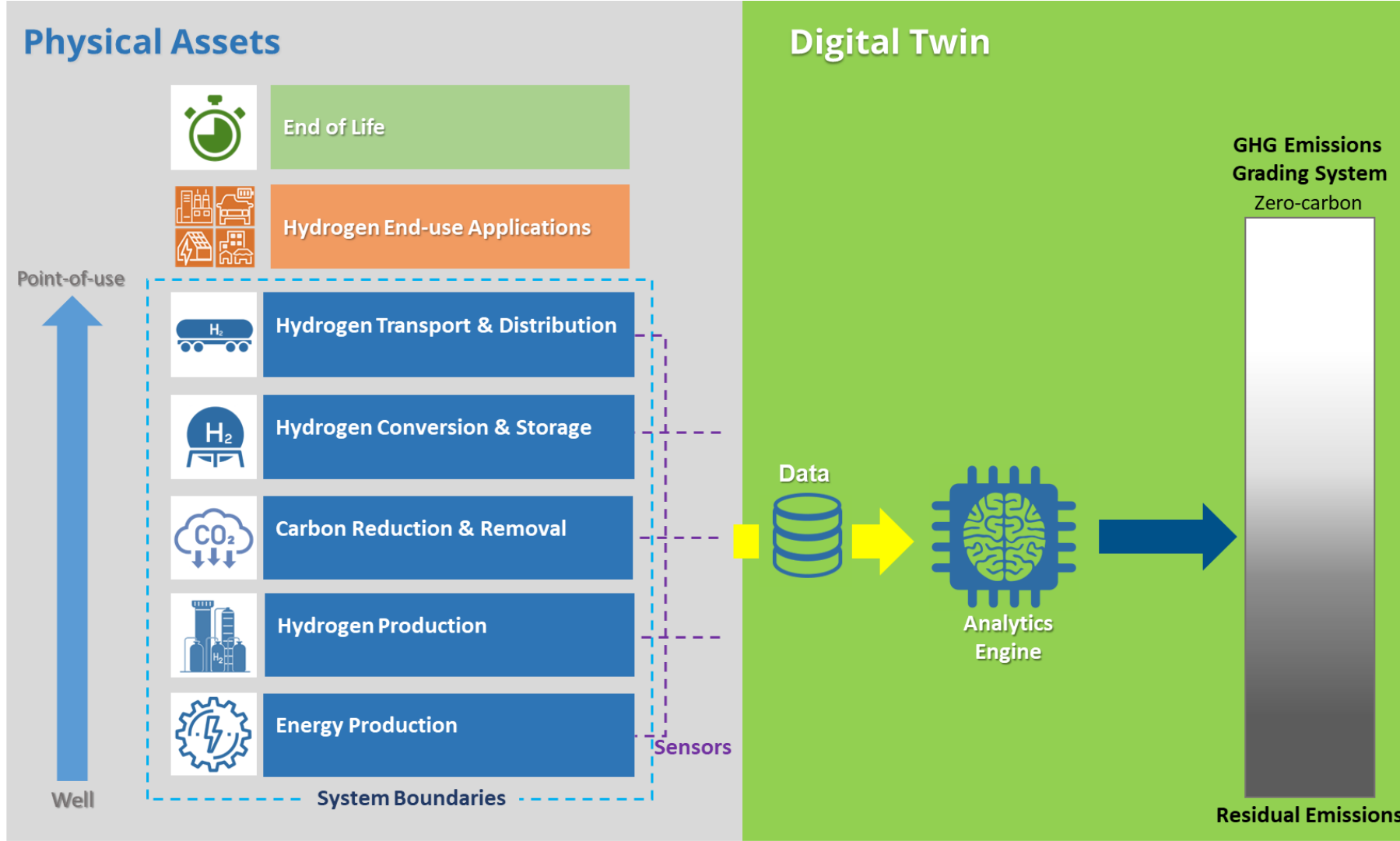
Residual Emissions

One-stop certification solution for hydrogen and derivatives

- Agnostic
- Fact-based
- Ex-post
- Flexible boundaries (Cradle-to-Cradle)
- Inclusive (all hydrogen production pathways)
- Hybrid chain of custody
- Interoperability with other product codes within I-REC ecosystem

Source: Avance Labs

Certification: A Risk Management Tool

❑ Hydrogen projects need bankable offtake agreements to attract limited recource project financing.

❑ However, development of commercially viable agreements for producers and end-users will be a key challnge

- ▪ Absence of a merchant market (hydrogen is primarily used in captive industrial markets, where production feeds an industrial process without third-party commercial agreement or price)

- ▪ Significant regulatory and demand uncertainty.

❑ Certificationcan can be used as a flexible mechanism to de-risk long-term offtake contracts.

Certification: A Risk Management Tool

Sale and Purchase (Offtake) Contracts

Price   **Volume**   **Credit Risk**   **Quality**

Background

❑ Buyers and sellers agree on a price for hydrogen to be delivered.

❑ Levelized cost of hydrogen (LCOH) as a pricing component.

Application

❑ Premiums and/or discounts to LCOH to reflect price of reconfigured energy attributes.

Background

❑ Buyers and sellers agree on a specified hydrogen quality to be delivered.

❑ A certification system informs end-users of the origin, quality and lifecycle GHG emissions of hydrogen.

Application

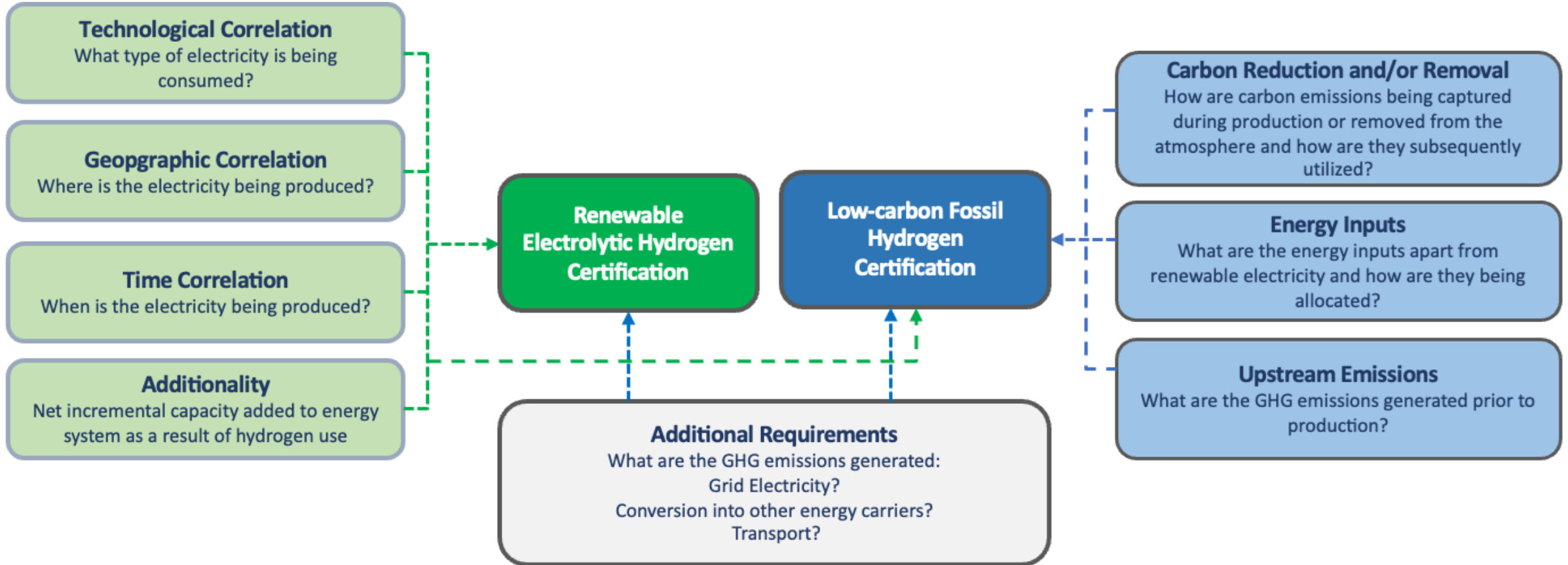❑ Re-certification of reconfigured energy attributes to meet new regulatory and market requirements.

I-REC Hydrogen Product Code Development

- **Hydrogen Code to become operational in Q3 2023 with Alpha version of the Code applied to pilot projects in Q4 2022**

- **Stakeholders Platform for Pilot Projects to enable industry stakeholders to play a consultative role during development phase and potentially a governance role thereafter**
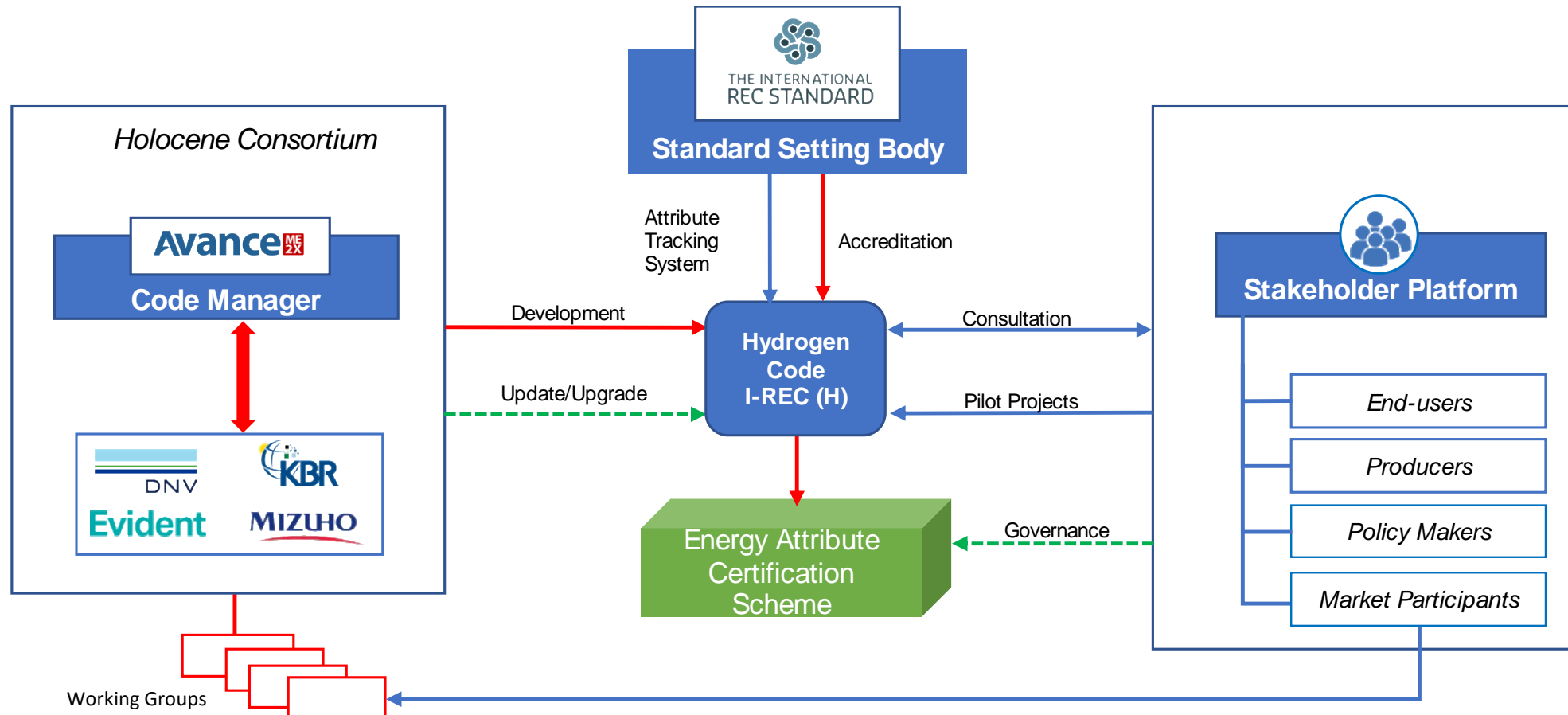
Hydrogen Tracking Requirements (Illustrative)

Technological Correlation
What type of electricity is being consumed?

Geopgraphic Correlation
Where is the electricity being produced?

Time Correlation
When is the electricity being produced?

Additionality
Net incremental capacity added to energy system as a result of hydrogen use

Renewable Electrolytic Hydrogen Certification

Low-carbon Fossil Hydrogen Certification

Carbon Reduction and/or Removal
How are carbon emissions being captured during production or removed from the atmosphere and how are they subsequently utilized?

Energy Inputs
What are the energy inputs apart from renewable electricity and how are they being allocated?

Upstream Emissions
What are the GHG emissions generated prior to production?

Additional Requirements
What are the GHG emissions generated:
Grid Electricity?
Conversion into other energy carriers?
Transport?

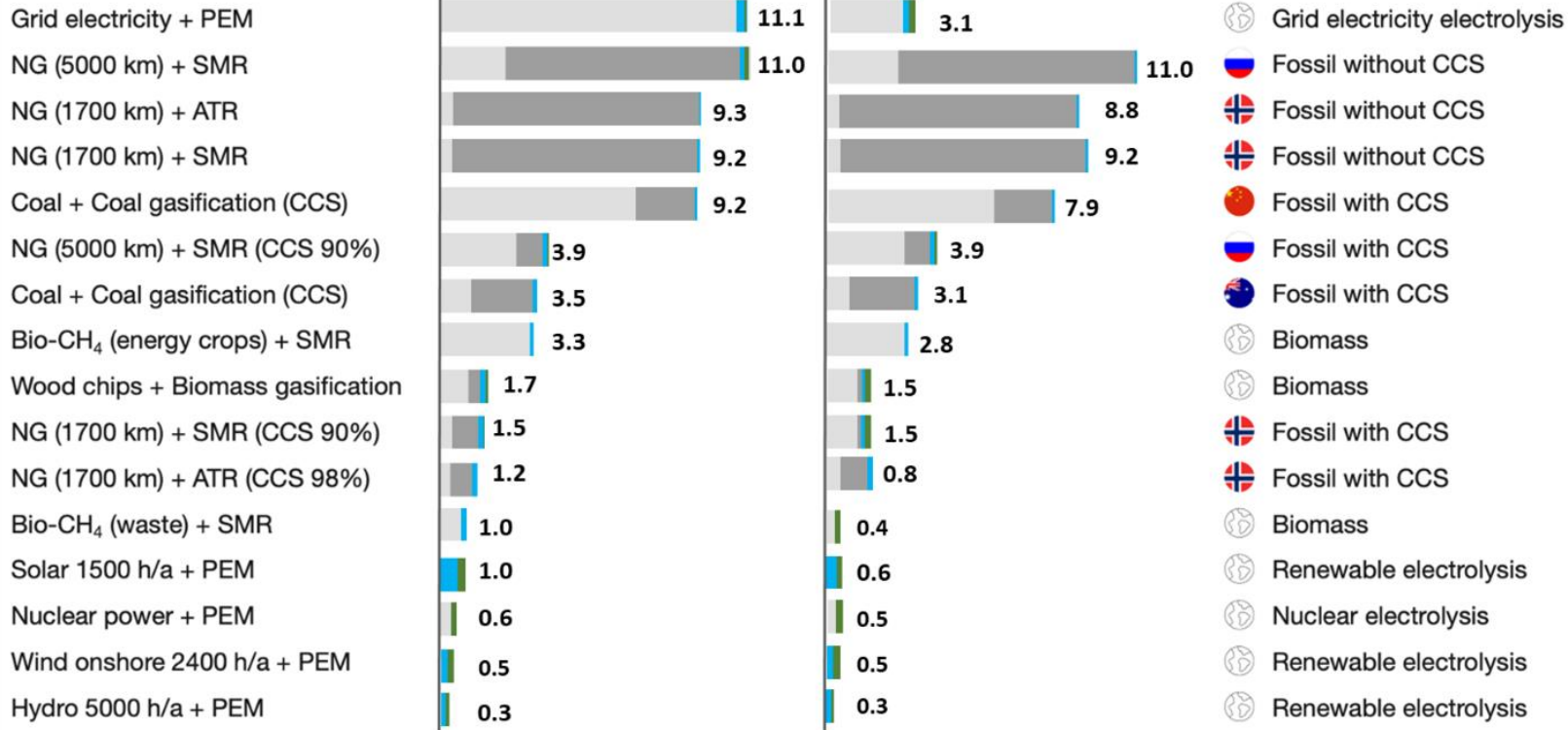**Source:** IRENA Coalition for Action 2022 and Avance Labs

Carbon-equivalent Emissions Intensities

Legend:
- + capex-related emissions - virgin materials
- + capex-related emissions - recycled materials
- H2 production
- Energy production

GHG emissions, kg/kg$_{H2, LHV}$

	2030	2050	
Grid electricity + PEM	11.1	3.1	Grid electricity electrolysis
NG (5000 km) + SMR	11.0	11.0	Fossil without CCS
NG (1700 km) + ATR	9.3	8.8	Fossil without CCS
NG (1700 km) + SMR	9.2	9.2	Fossil without CCS
Coal + Coal gasification (CCS)	9.2	7.9	Fossil with CCS
NG (5000 km) + SMR (CCS 90%)	3.9	3.9	Fossil with CCS
Coal + Coal gasification (CCS)	3.5	3.1	Fossil with CCS
Bio-CH$_4$ (energy crops) + SMR	3.3	2.8	Biomass
Wood chips + Biomass gasification	1.7	1.5	Biomass
NG (1700 km) + SMR (CCS 90%)	1.5	1.5	Fossil with CCS
NG (1700 km) + ATR (CCS 98%)	1.2	0.8	Fossil with CCS
Bio-CH$_4$ (waste) + SMR	1.0	0.4	Biomass
Solar 1500 h/a + PEM	1.0	0.6	Renewable electrolysis
Nuclear power + PEM	0.6	0.5	Nuclear electrolysis
Wind onshore 2400 h/a + PEM	0.5	0.5	Renewable electrolysis
Hydro 5000 h/a + PEM	0.3	0.3	Renewable electrolysis

- ✓ Hydrogen production, transport and distribution have a highly variable GHG emissions footprint.

- ✓ Hydrogen production alone has a GHG emissions intensity ranging from 0.3 – 11.0 kg CO$_2$ Eq./kg H$_2$

- ✓ Neither renewable nor low-carbon hydrogen production pathways are completely net-zero" in terms of GHG emissions over their lifecycle.

Note: *Energy production refers to GHG emissions from the supply of the main input into the H2 plant (natural gas, coal, electricity), while H2 production refers to direct GHG emission of H2 plant, including from plant auxiliary electricity use*
Legend: *NG: Natural gas / PEM: Polymer Electrolyte Membrane Electrolysis / SMR: Steam Methane Reforming / ATR: Autothermal Reforming / CCS: Carbon Capture & Storage*

Source: *Hydrogen Council, Ludwig-Bölkow-Systemtechni (LBST)*