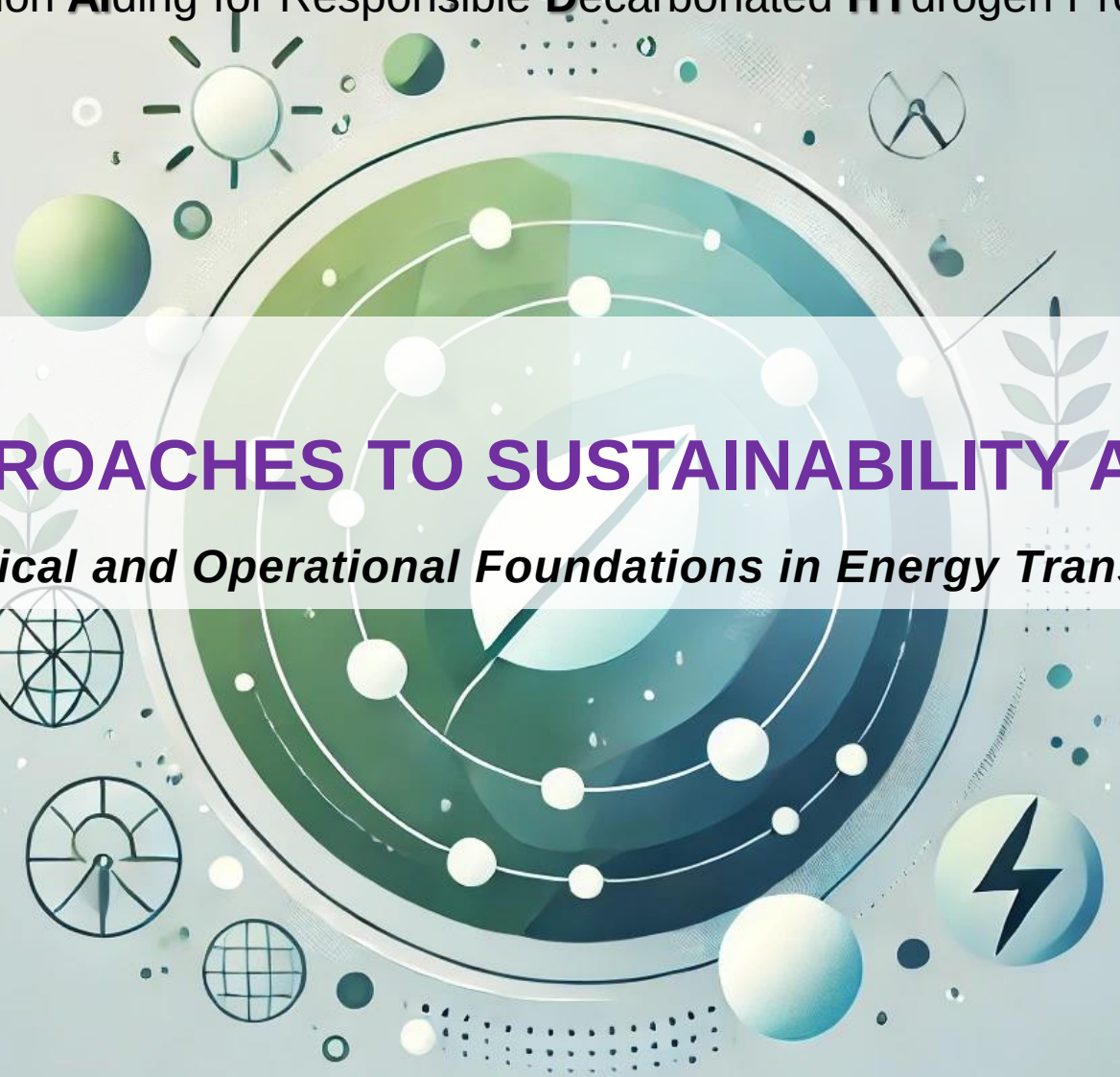
AIDHY (ANR-22-PEHY-0019)

Decision **AI**ding for Responsible **D**ecarbonated **HY**drogen Projects



INTEGRATED APPROACHES TO SUSTAINABILITY AND RESILIENCE

Philosophical and Operational Foundations in Energy Transition Research

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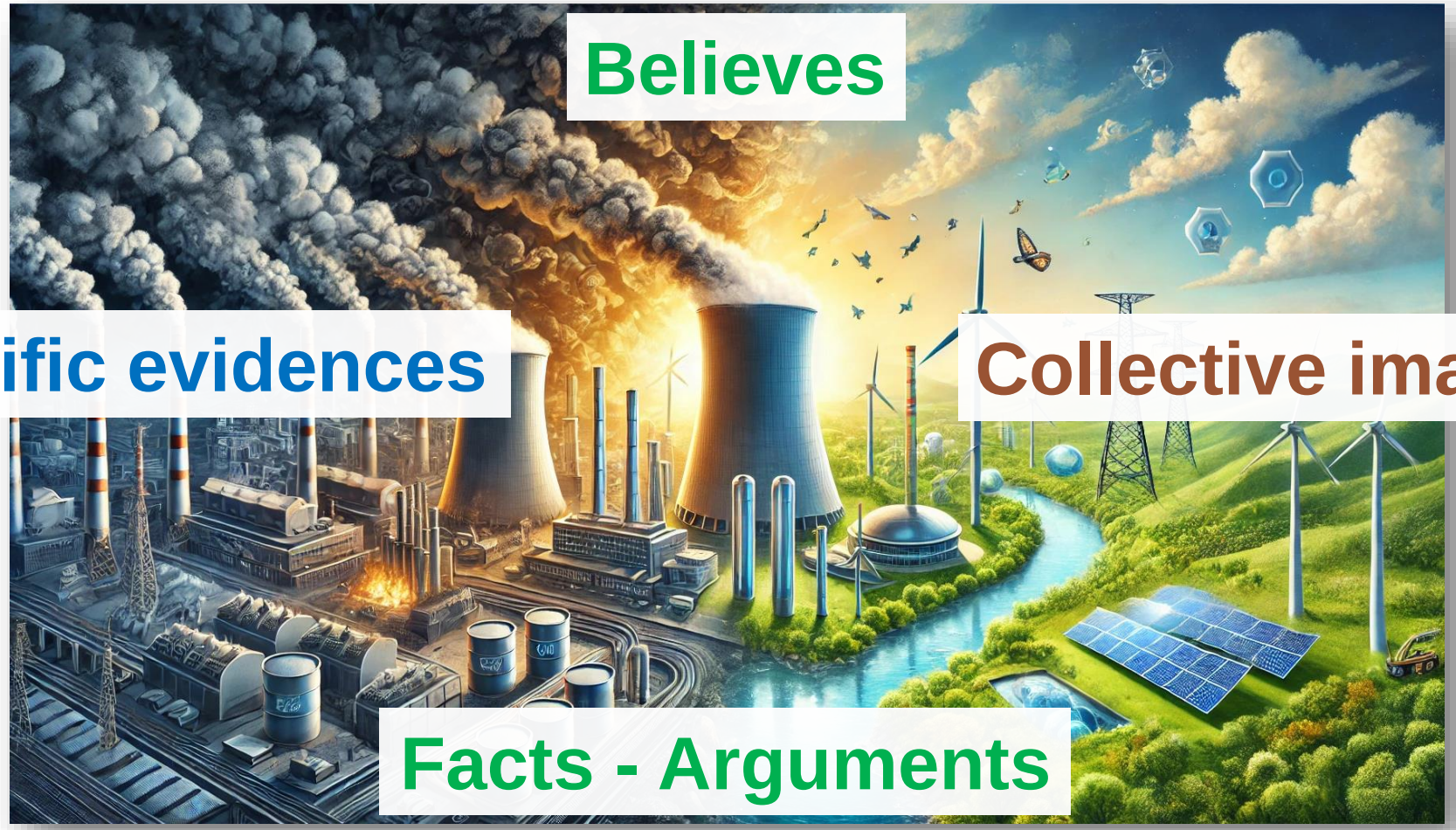
Energy transition



FRANCE 2030 PROGRAMME DE RECHERCHE HYDROGÈNE

BELIEVES

Belief n°1: There is one way to transition!

….. Energy Transition Modalities

- **Definition**

  Energy transitions vary by speed, risks, and impacts.

- **Key Modalities**
  - **Radical:** Fast and disruptive.
  - **Substitutive:** Gradual replacement.
  - **Incremental:** Slow improvements.
  - **Hybrid:** Mixed old and new systems.
  - **Regenerative:** Ecosystem restoration + energy shift.
  - **Cataclysmic:** Disaster-driven changes.
  - **Planned:** Coordinated policies.
  - **Spontaneous**: Local, unplanned.
- **Phases**

  Emergence → Diffusion → Domination → Obsolescence.

Socio-Political and Territorial Dimensions of transition

•Radical

•**Socio-political**: Requires strong political leadership and public acceptance.
•**Territorial**: Best suited for small, controlled environments (e.g., islands or autonomous regions).

•Substitutive

•**Socio-political**: Minimal resistance due to gradual change.
•**Territorial**: Effective in areas with existing infrastructure (e.g., gas pipelines replacing coal facilities).

•Incremental

•**Socio-political**: Low resistance, as changes are small and steady.
•**Territorial**: Common in cities with complex systems requiring step-by-step upgrades.

•Hybrid

•**Socio-political**: Requires negotiation between stakeholders to manage mixed systems.
•**Territorial**: Demands regional collaboration to integrate old and new technologies.

•Regenerative

•**Socio-political**: Inclusive governance to balance environmental, economic, and social goals.
•**Territorial**: Rural/agricultural areas benefit most from combined energy and ecosystem solutions.

•Cataclysmic

•**Socio-political**: High public pressure, but reactive rather than planned.
•**Territorial**: Uneven impacts—vulnerable areas may face more challenges.

•Planned

•**Socio-political**: Multi-level governance is key for aligning global and local policies.
•**Territorial**: Broadly applicable but needs adaptation to local contexts.

•Spontaneous

•**Socio-political**: Driven by local communities or innovators with limited external support.
•**Territorial**: High impact in off-grid or underserved regions; scalability remains a challenge.

Risks and Resilience in Energy Transitions

•Risks

- **Rapid transitions:** Social/economic instability.
- **Delays in incremental changes:** Climate risks.
- **Fragmentation:** Spontaneous efforts lack coordination.

•Resilience Factors

- **Flexibility**: Adapting systems to uncertainties.
- **Inclusiveness**: Engaging diverse stakeholders.
- **Capacity Building**: Training and resources.
- **Regional Adaptation**: Tailoring solutions to local needs.

... Other believes

- **Sustainability consists in the reduction of CO_2 emissions as a virtue for technological projects.**

- **Controversies mainly revolve around environmental impacts.**
  - **Life Cycle Assessment (LCA) is often used to demonstrate sustainability, viability, and responsibility in projects.**

- **Information serves as a means to educate, pacify, and align stakeholders.**
  - **Social acceptability: A way to measure the impact of information and training.**

What lies at the root of these BELIEFS?

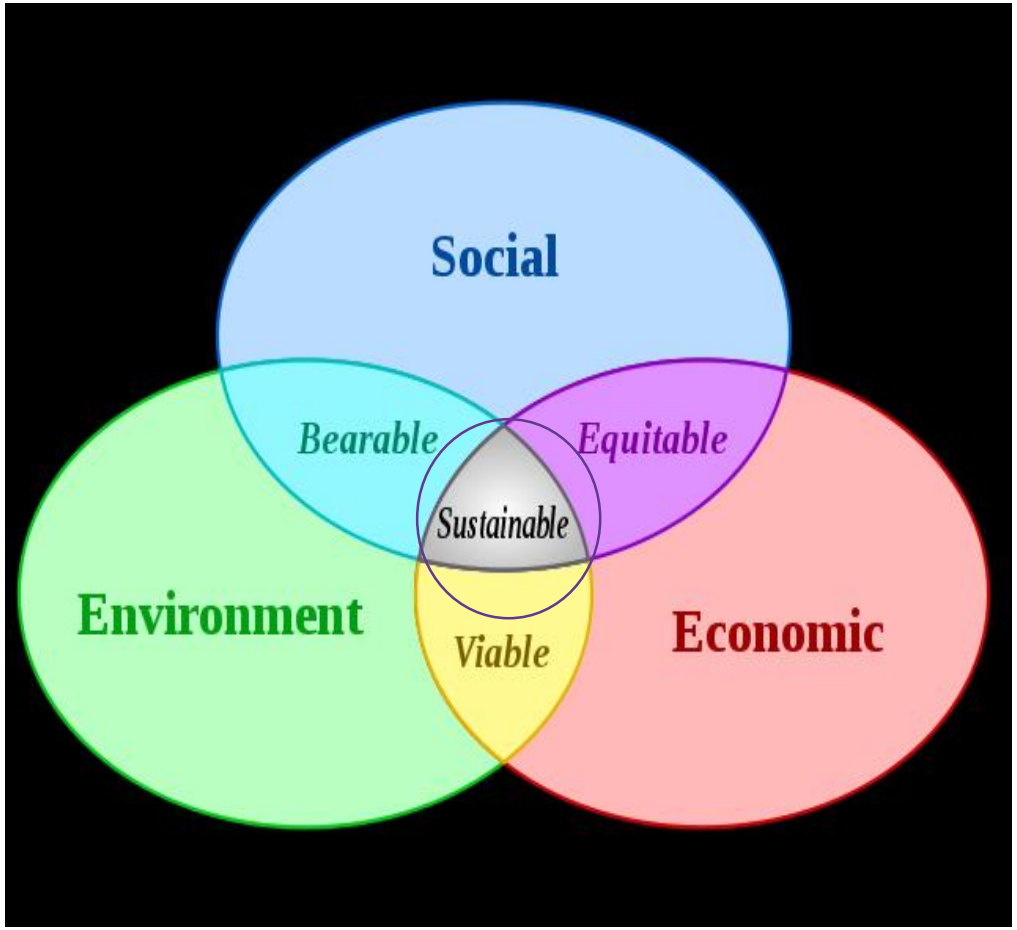
- **Different Views on the Concepts**
  - **Regulatory and Normative Framework**
  - **Ethical Dimension**
- **Sacralization of tools**
  - **Life Cycle Assessment (LCA)**
  - **The Nature of Controversies**

Sustainability, Viability, and Corporate Social Responsibility: Similarities and Differences

- **Sustainability:** Meeting present needs without compromising future generations. Defined directly in French, European, and international frameworks.
- **Viability:** Long-term management of ecological resources, often indirectly linked to sustainability and natural resources.
- **Corporate Social Responsibility (CSR):** Voluntary integration of social, environmental, and ethical concerns in organizational practices. Defined directly in various frameworks.

Sustainable energy– A Vocabulary under Constraints

ISO 26000: Social Responsibility of Organizations



Synthesis of Concepts: France and International

Notion	Text	Year	Purpose	Code	Definition	Type of Definition	Criteria	Nature of Criteria	Time Vision	Regulatory Tools
Viability (France)	Grenelle II Law	2010	Ecological and energy transition	Environmental Code	Long-term ecological resource management	Indirect	Environmental, economic	Carbon footprint, GHG reduction	Long term	Carbon footprint, energy audits, impact assessments
Viability (EU)	European Green Deal, Regulation EU 2021/1119	2021	Carbon neutrality and decarbonized economy goals	EU Regulation	Sustainable natural resource management	Indirect	Environmental, economic	Emission limitation, resource protection	Long term	Green taxonomy, sustainability reports
Sustainability (France)	Environmental Charter	2005	Protecting resources for future generations	Constitution	Meeting present needs without compromising the future	Indirect	Environmental, social, economic	Resource management, social inclusion	Long term	Environmental assessments, sustainable planning
Sustainability (EU)	CSRD Directive, Paris Agreement	2021	Sustainable development goals	EU Regulation	Long-term responsible resource management	Direct	Environmental, social, economic	Environmental, social, economic sustainability	Long term	Sustainability reports, ESG standards
CSR (France)	NRE Law (New Economic Regulations)	2001	Non-financial reporting on corporate impacts	Commercial Code	Addressing social and environmental impacts	Direct	Environmental, social, ethical	Transparency, equality, governance	Short to medium term	Vigilance plan, CSR reports
CSR (EU)	CSRD Directive	2023	Transparency on ESG practices	EU Regulation	Corporate responsibility for social and environmental issues	Direct	Environmental, social, ethical	Carbon footprint, working conditions, transparency	Short to medium term	ESG reports, vigilance plans

Normative Framework

Notion	Norm/Standard	Year	Purpose	Organization	Definition	Type of Definition	Criteria	Nature of Criteria	Time Vision	Regulatory Tools
Sustainability	ISO 26000, GRI, SDG	2010	Integration of sustainable development principles	ISO, GRI, UN	Holistic approach to sustainable resource management	Direct	Environmental, social, economic	Resource management, reduction of ecological impacts	Medium to long term	GRI reporting, internal audit, ESG integration
Viability	GRI, SASB, SDG	2015	Measurement and management of economic, environmental, and social impacts	GRI, SASB, UN	Ability to meet current needs without compromising the future	Direct	Environmental, social, economic	ESG performance, social inclusion, resource preservation	Short to long term	GRI, SASB standards, SDG indicators
Corporate Social Responsibility	ISO 26000	2010	Voluntary integration of social and environmental concerns	ISO	Consideration of impacts on society and the environment	Direct	Environmental, social, ethical	Transparency, respect for human rights, good governance practices	Short to medium term	Internal audit, sustainability reports, stakeholder engagement

What lies at the heart of our ethical concerns?

Principals approaches to ethics

Ethical Approach	Key Figure	Key Principles	References
Deontology	Immanuel Kant	Actions are judged based on adherence to universal rules.	Kant, E. (1785). *Groundwork of the Metaphysics of Morals*.
Consequentialism	John Stuart Mill	Actions are evaluated based on their consequences (utilitarianism).	Mill, J.S. (1863). *Utilitarianism*.
Virtue Ethics	Aristotle	Focuses on developing virtues and moral character.	Aristotle. (350 BCE). *Nicomachean Ethics*.
Care Ethics	Carol Gilligan	Values empathy and human relationships in ethical decision-making.	Gilligan, C. (1982). *In a Different Voice*.
Justice Ethics	John Rawls	Focuses on justice and fairness, introducing the "veil of ignorance."	Rawls, J. (1971). *A Theory of Justice*.
Pragmatic Ethics	William James, John Dewey	Evaluates actions based on practical effectiveness in specific contexts.	Dewey, J. (1922). *Human Nature and Conduct*.
Relativist Ethics	Various thinkers	Moral norms are relative to cultures or individuals, with no universal standards.	Appiah, K.A. (2006). *Cosmopolitanism: Ethics in a World of Strangers*.
Descriptive Ethics	-	Studies moral beliefs and practices without making judgments.	Rachels, J. (1999). *The Elements of Moral Philosophy*.
Normative Ethics	-	Prescribes moral norms and principles to guide actions.	Kantorowicz, H. (2003). *Morals and Ethics: Principles and Problems*.

Ethics' Criteria in Regulatory Texts

Notion	Regulation / Standard	Dimension	Criteria	Tools
Viability	Grenelle II Law, European Green Deal	Respect for ecological limits, intergenerational responsibility	Resource respect, climate equity	Environmental audit, sustainability reports
Sustainability	CSRD Directive, SDGs	Transparency, social inclusion, inequality reduction	Transparent practices, stakeholder inclusion	GRI reports, SDG indicators
CSR	ISO 26000, Duty of Vigilance (France)	Ethical governance, human rights, transparency	Respect for human rights, anti-corruption	Vigilance plan, stakeholder consultation

Considering Ethics in Sustainability, Viability, and CSR

Notion	Standard	Dimension	Criteria	Tools
Viability	ISO 26000, SDGs	Respect for ecological limits, preservation of future generations' rights	Intergenerational equity, resource protection	Internal audits, stakeholder engagement, environmental reporting
Sustainability	GRI, SASB, SDGs	Reducing inequalities, social inclusion	Social equity, stakeholder inclusion	GRI, SASB reports, SDG indicators
CSR	ISO 26000, GRI	Transparency, human rights, fair business practices	Ethical governance, human rights, anti-corruption	Vigilance plan, CSR reports, stakeholders' engagement

Analysis of Differences and Similarities

- **Regulatory Frameworks:** In France and the EU, regulatory frameworks directly address sustainability, viability, and CSR with obligations for transparency and annual reporting.

- **Normative Frameworks:** Standards like ISO 26000 and GRI provide guidelines for ethical and sustainable corporate practices without direct legal constraints.

- **Similarities and Differences:** Both frameworks share ethical principles such as transparency and respect for human rights, but regulatory frameworks impose stricter obligations.

Facts - Arguments

Life Cycle Assessment (LCA)

- **French Regulation:** LCA is promoted as a tool to measure the ecological footprint of products and services, thus reinforcing the viability of economic activities.
- **European Framework:** LCA is integral to European initiatives such as the Green Deal, acting as a key tool for assessing product sustainability.
- **International Recognition:** ISO 14040 and 14044 standards ensure LCA uniformity worldwide, aligning with Paris Agreement goals.
- **Normative Framework:** In the CSR context, LCA evaluates environmental impacts, aligning with ISO standards and ESG criteria.

Synthesis: LCA and the Normative and Regulatory Frameworks

Framework	LCA Use	Year	Links to Sustainability, Viability, and CSR	Related Tools	Output
French Regulation	Promoted by Grenelle II Law, Low Carbon Strategy	2010	Measures environmental impacts, supports ecological transition	Carbon footprint measures, GHG reduction tools	Sustainability reports, environmental certifications
European Regulation	Integrated in Green Deal, Taxonomy Regulation	2020	Key to circular economy, green taxonomy	Sustainability impact evaluations	Compliance reports, environmental audits
International Framework	ISO 14040/14044, Paris Agreement principles	1997/2006 (ISO), 2015 (Paris Agreement)	Standardized tool to measure environmental impacts	Emission reduction, international comparability	Life cycle assessments, compliance evaluations
Normative Framework	ISO 26000 Standards, GRI	2010	Used in CSR reporting and managing societal and environmental impacts	ESG Reporting, Environmental Audits	CSR Reports, Environmental Impact Assessments

Complementary Methods for LCA

How to go beyond?

- **S-LCA (Social Life Cycle Assessment):** Assesses social impacts, including worker rights, health, safety, and community impacts.
- **Life Cycle Costing (LCC):** Evaluates the economic costs of a product or service throughout its lifecycle, factoring in externalities such as pollution and resource consumption.
- **ESG (Environmental, Social, Governance):** Measures overall corporate performance by integrating governance, ethical practices, and human rights beyond environmental impacts.
- **Multi-Criteria Decision Analysis (MCDA):** A decision-aiding tool that balances different factors (economic, social, environmental) to provide a comprehensive view of sustainability.

Synthesis on How to Go Beyond Classic LCA

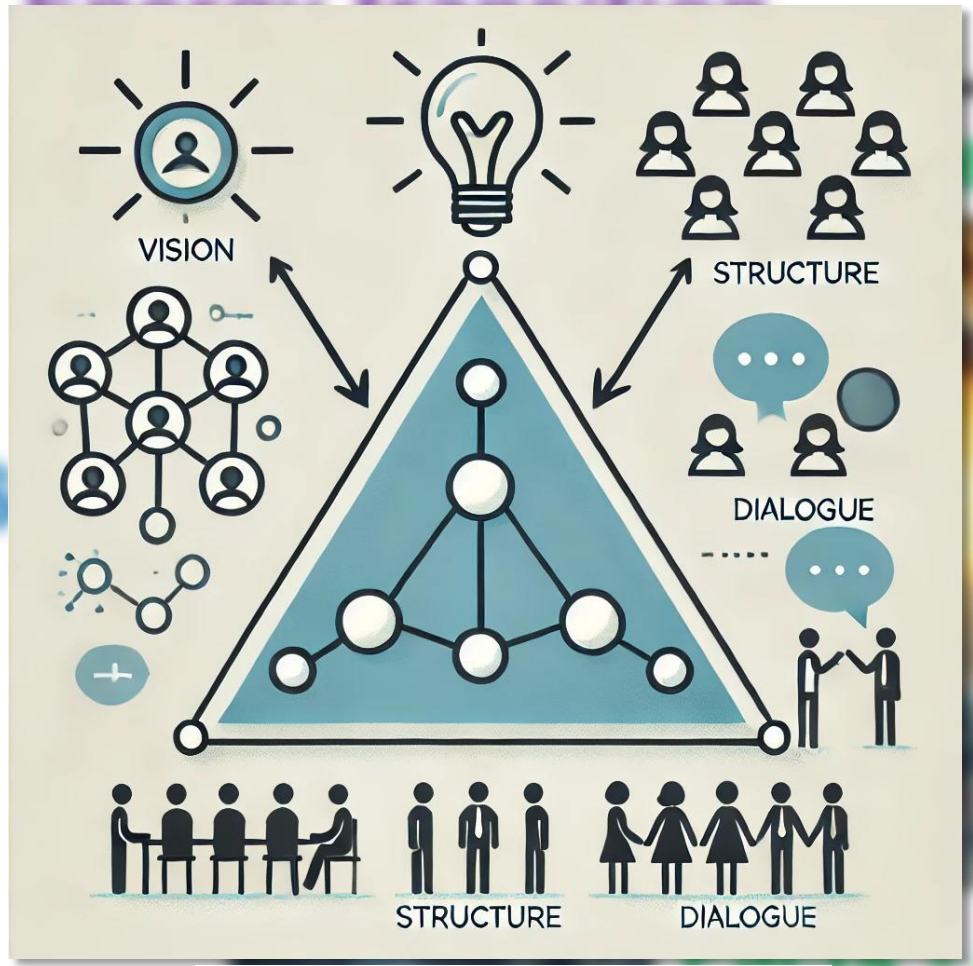
Criterion	Consideration in LCA	LCA Limitations	Complementary Methods	Output
Viability	Environmental impact, CO_2 reduction	Does not cover social and economic aspects	S-LCA, LCC, ISO 26000, MCDA	Social, economic, and environmental impact reports
Sustainability	Environmental impacts (short/medium term)	Excludes social justice, economic stability	LCC, ESG, MCDA, SDGs	Multi-criteria analyses, ESG assessments
CSR	Reducing the ecological footprint	Governance, human rights, transparency not covered	ISO 26000, GRI, ESG, MCDA	CSR reports, environmental and social impact assessments

What are the links between controversies and sustainability?

Controversy Topic	Nature of Concern (ISO 26000)	Category of Actors	Details of the Controversy and Arguments Presented	Relevant Projects in France
Environmental Impact	Environment	Environmental associations, citizens	Concerns about the ecological footprint of hydrogen production, especially regarding excessive water and energy consumption for electrolysis. Associations highlight risks to ecosystems and significant gray energy use.	H2V59 (Production and electrolysis in Dunkirk)
Infrastructure Safety	Human rights / Workplace safety	Local authorities, safety experts	Risks related to the safety of hydrogen transport and storage infrastructure (explosions, leaks). Safety experts point to the lack of adequate regulation and industrial risks to nearby communities.	DHUNE
Cost and Financing	Governance	Policymakers, economists, NGOs	The high costs of setting up hydrogen infrastructure and transport raise concerns, with doubts about long-term profitability. Economists and NGOs question the viability of such investments compared to alternatives like direct electrification.	HyAMMED (Hydrogen mobility, PACA region)
Social Acceptability	Community relations and local development	Local communities, elected officials	Local communities fear negative impacts on quality of life, exclusion from decision-making processes. Local officials aim to balance economic benefits with social and environmental impacts.	HySeine (Production and distribution, Paris region)
Energy Sovereignty	Fair operational practices	Economists, policymakers	Concerns about dependence on foreign hydrogen suppliers or technologies. Economists and policymakers emphasize the need to maintain national energy sovereignty while developing hydrogen.	Masshylia (Solar hydrogen production, Fos-sur-Mer)
Local Employment Impact	Employment and labor relations	Unions, professional associations	Unions and professional associations are worried about rapid industrial changes, fearing job losses in traditional sectors in favor of hydrogen jobs, which may be fewer or more specialized.	Hydrogen at Carling Saint-Avold (Industrial transformation)
Intergenerational Equity	Human rights	Younger generations, NGOs	Younger generations and NGOs raise concerns about passing costly infrastructure or unsustainable technologies to future generations, locking them into imposed technological paths.	Project Jupiter 1000 (Power-to-Gas, Marseille)
Technological Innovation	Sustainable consumption practices	Industry, research laboratories	Industrial and research actors argue that hydrogen is an emerging technology worth further investment, while critics call for prioritizing more mature solutions.	Zero Emission Valley (Auvergne-Rhône-Alpes)

What Should Be Concluded?

Participation and deliberation engineering



Organizational

Formal methodology

What Should Be Concluded?

1. **REGULATORY AND NORMATIVE**

- **Framework:** France: Grenelle II Law (2010), Duty of Vigilance (2017)Obligations for transparency, reduction of environmental and social impacts.
- **European Union:** CSRD Directive, European Green Deal (2020)Company transparency, goals for environmental sustainability, green taxonomy.
- **International:** ISO standards (26000, 14040), Sustainable Development Goals (SDGs)Frameworks to integrate sustainability into corporate governance.

2. **ETHICAL DIMENSION:**

- **Key principles:** Transparency, respect for human rights, ethical governance (ISO 26000).
- **Human rights and stakeholder involvement strengthened by the Duty of Vigilance** in France.

3. **LIFE CYCLE ASSESSMENT (LCA):**

- **Strengths:** A key tool for measuring environmental impacts (GHG reduction, ecological footprint).
- **Limitations:** Does not cover social, economic, and governance aspects.

Implications for Assessing the Sustainability of the Decarbonized Hydrogen Sector/projects/Fields/Scenarios

1. MULTI-STAKEHOLDER AND MULTI-CRITERIA METHODOLOGY

- **Integrated Approach:** Combine LCA (Life Cycle Assessment) with social tools (S-LCA), economic analyses (LCC), and ESG frameworks to evaluate all impacts.
- **Engage Stakeholders:** Foster collaboration between businesses, local communities, and governments to ensure a holistic vision.

2. KEY CRITERIA CONSIDERATIONS

- **Environmental:** Reduction of CO_2 emissions, transition to decarbonized energy sources.
- **Social:** Job creation, ensuring workers' rights and social equity.
- **Economic:** Long-term profitability, optimization of total cost of ownership.

3. TOOLS TO INTEGRATE

- S-LCA (Social Life Cycle Assessment): Evaluate social impacts.
- LCC (Life Cycle Costing): Analyze economic costs over the entire lifecycle.
- ESG (Environmental, Social, Governance): Ensure ethical governance and transparency.

4. GOVERNANCE

- **ISO 26000, GRI Standards:** Integrate social responsibility at every stage of the hydrogen value chain.