



International Perspectives and Analysis on Implementation and Uptake of Hydrogen Technologies

6th RD20 Conference

Technical Session addressing Barriers to Hydrogen Implementation

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Context of H₂ deployment

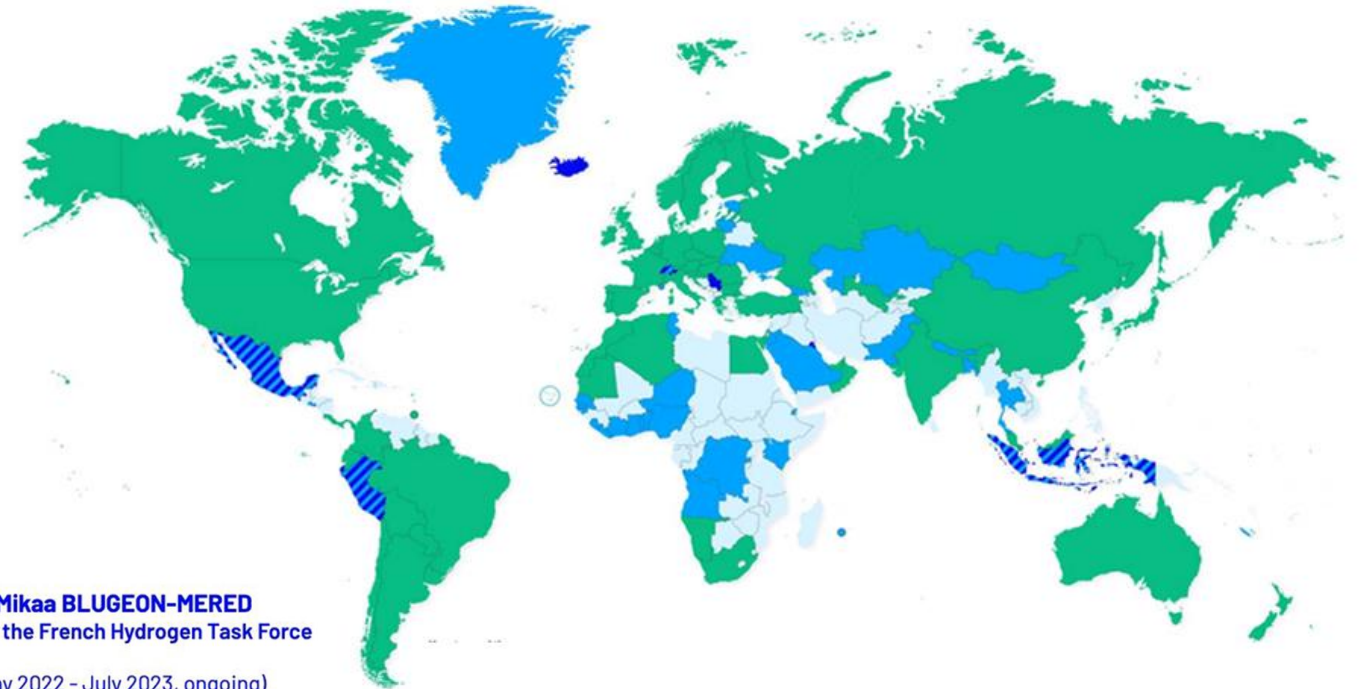
Hydrogen is considered worldwide as an important energy carrier for decarbonisation

More and more countries (83 + 28 in development) have national H₂ strategies:

- For industry decarbonisation (as feedstock in the process or to produce heat in replacement of natural gas in petrochemical, steel, cement, manufacturing...)
- For transport sector for **heavy transport** and **long distances**, via direct (**Fuel cells**) or indirect (**synfuels**) electrification




Worldmap of National Hydrogen Strategies & Roadmaps v.3.9, as of July 23rd 2023





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for the French Hydrogen Task Force


(May 2022 - July 2023, ongoing)
www.taskforcehydrogene.fr


How to read the map:

 At least one hydrogen strategic planning document prepared and officially adopted by the national (or local autonomous) government. (e.g. strategy, roadmap, action plan, hydrogen law,...).

 No hydrogen strategic planning document prepared nor published by the national (or local autonomous) government, but a supranational hydrogen strategy applies. (e.g. EU H2 Strategy)

 Hydrogen strategic planning document currently in preparation or considered by the national (or local autonomous) government or by a regional intergovernmental body in the name of several national governments. (e.g. CEDEAO)

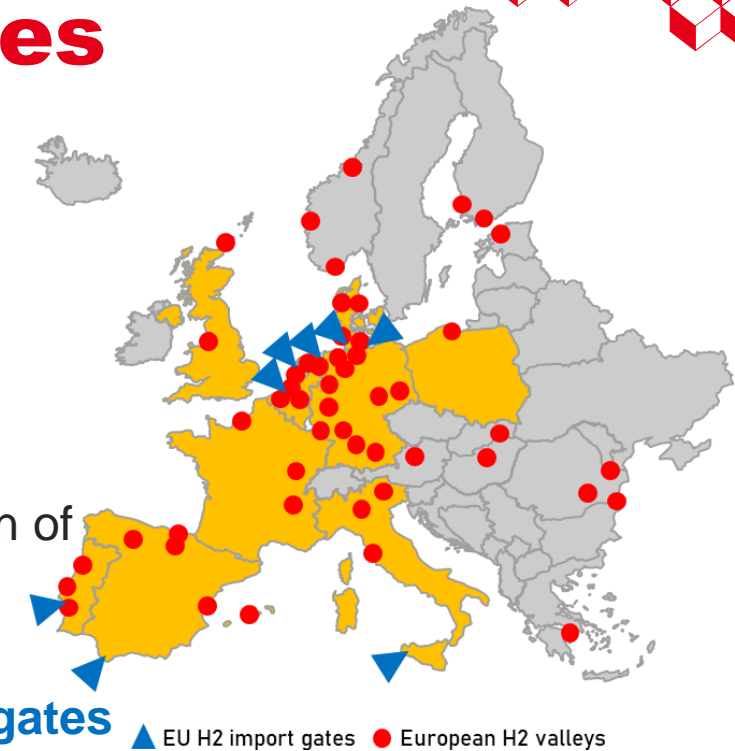
 Industrial hydrogen strategy or roadmap prepared and published by a recognized national industry organisation and/or leading academic institution with no endorsement by the national government, and no known national governmental hydrogen strategy or roadmap currently in preparation.

 Industrial hydrogen strategy or roadmap prepared and published by a recognized national industry organisation and/or leading academic institution, while an official hydrogen strategy or roadmap is being prepared or considered by the national (or local autonomous) government.

Various H2 roadmaps in EU countries

National strategies rather well defined:

- Belgium: Ports as **import gates** & transport network
- Denmark: **Production from renewables** & Power-to-X
- France: **Production from nuclear and renewables**, decarbonisation of industry and heavy mobility
- Germany: H₂ technologies provider and **large imports** for decarbonisation of industry, transport and heat market
- Italy: **H₂ corridor** thanks to gas transport infrastructure
- Netherland: **Wind-to-H₂** & decarbonisation of industry – Ports as **import gates**
- Poland: decarbonisation of power and heating sectors and of industry
- Portugal: **Production from renewables** to substitute natural gas imports and focus on transport and industry decarbonisation
- Spain: **Production from renewables**, decarbonisation of industry and transport and **H₂ corridor**
- United Kingdom: **Wind-to-H₂** & decarbonisation of industry, power, heat in buildings and transport sectors



Hydrogen initiatives across Europe and countries analyzed

Mapping the Landscape for International Collaboration on Hydrogen

BREAKTHROUGH AGENDA

Initiative	Long-term vision & action plans	Demand creation & management	Infrastructure & supply chains	Finance & investment	Research & innovation	Market Structures	Standards & certification	Trade conditions	Knowledge, Capability & Skills	Social engagement & impact	Landscape co-ordination
Clean Energy Ministerial's Hydrogen Initiative (CEM H2I)	●	●	●			●		●	●		
Green Hydrogen Organisation (GH2)	●	●		●			●		●		
Hydrogen Council	●	●					●	●	●		
IEA Hydrogen Technology Collaboration Programme (Hydrogen TCP)					●		●				
Industrial Transition Accelerator (ITA)				●			●				
International Partnership for Hydrogen and fuel cells in the Economy (IPHE)	●	●				●	●	●	●	●	●
IRENA and its Collaborative Framework Green Hydrogen	●	●	●	●	●	●	●	●	●	●	
The Alliance for Industry Decarbonization					●		●		●		
Mission Innovation's Clean Hydrogen Mission	●	●	●		●				●		
OECD's Clean Energy Finance and Investment Mobilisation (CEFIM)				●							
RMI's Green Hydrogen Catapult		●		●	●						
UNIDO's Global Programme for Hydrogen in Industry		●	●	●		●	●	●	●	●	
World Business Council for Sustainable Development (WBCSD)						●					
World Bank's Hydrogen for Development Partnership (H4D)		●		●					●		
The Alliance for Industry Decarbonization		●	●								

Place of RD20 within those initiatives

Unique Identity

- International forum of Researchers
- Focus on Scientific and Technological collaborations, exchanges and training
- Main achievements regarding H2 (TS → TF → WS)
 - yearly Technical Sessions
 - 2022 - H2 LCA & TEA
 - 2023 - H2 for decarbonization Energy & Industry sectors
 - 2024 - H2 Barriers towards massive deployment)
 - Several Task Forces and Workshops
 - 2023: TF on sharing and disseminating LCSA practices
 - 2023: Common WS with H2 GIGATONS
 - 2024: Round Robin exercise for assessing H2 cost calculations and optimisations → techno-economic analysis Workshop



Several ongoing collaborative studies between RD20 partners to facilitate massive H2 deployment

- France-Australia-Japan symposium on renewable hydrogen organized in Sept. 23 by the French Embassy in Japan to promote scientific and industrial projects concerning renewable hydrogen projects.
- Downer Group (AUS), H²potential (AUS), University of Sydney, University of Adelaide, and CEA (FRA) are collaborating with the Franco-Australian Centre for Energy Transition (FACET) on a pre-FEED (front end engineering design) study, to construct a commercial-scale demonstration plant in Australia, producing synthetic fuels (eFuels) for the maritime and aviation sectors.



- Sisyphe study on European Trends for demand of low carbon hydrogen until 2040

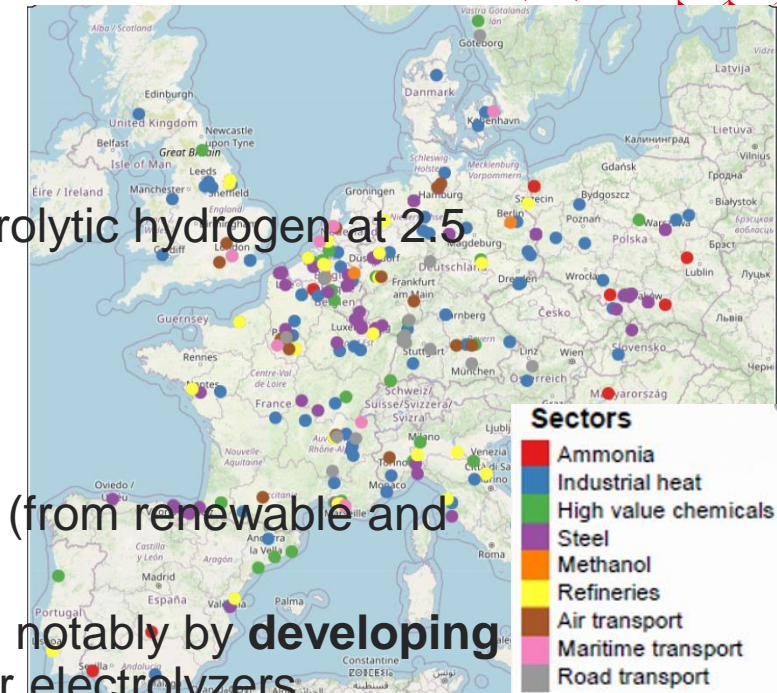


- Just-Green AFH₂ICA Study on low carbon H₂ import/export potential between African Union and EU and promote a just transition to green Hydrogen in Africa



SISYPHE study

- 70 interviews / 9 sectors (industry, mobility / European coverage)
- **A gap** between European Targets and Estimated demand evaluated for electrolytic hydrogen at 2.5 million tons in 2030 and 9 million tons in 2040
- **3 main barriers** : Price, Regulation and availability of Electrolytic Hydrogen
- **3 levers** to activate for
 - ✓ Accelerating the development of low-carbon electricity production capacity (from renewable and nuclear sources) in Europe
 - ✓ Scaling up hydrogen and hydrogen-derived molecules production facilities, notably by **developing applied R&D** to accelerate the reliability and industrialization of high-power electrolyzers.
 - ✓ Simplifying and stabilizing support mechanisms compensating over cost vs Fossil process
- **The question of Hydrogen production location**
 - ✓ addresses a risk of lead to relocating outside Europe not only of the production of hydrogen and derivative molecules, but also of certain 'final' products (nitrogen fertilizers, steel, etc.) that are easier to transport
 - ✓ Implies a major infrastructure development challenge for EU countries with a more limited renewable energy potential (Central and Eastern Europe)
 - ✓ Local hydrogen production for countries with low-carbon electricity and/or high renewable energy potential (Nordic countries, France, Iberian Peninsula).



Large European demand for low carbon H₂ imports

«Fit for 55» & «RePowerEU» plans : 10 Mt of imported H₂ in 2030 (on top of 10 Mt of domestic production)

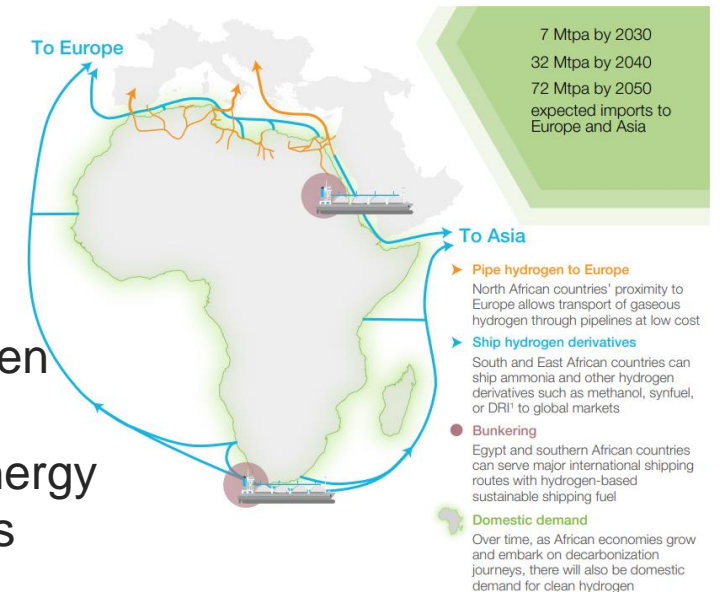
Unique African Hydrogen Value Proposition

- Huge Renewable Potential (number of RES power plants with capacity not fully exploited) → **LCOH can be as low as 1.5-2.7 €/kg**
- Presence of Gas Infrastructure in the North of the continent → **Cost of transport: 0.2-0.25 €/kg**
- African focal position in many shipping routes
- Presence of «hard to abate» industries (chemical industry to produce ammonia for fertilisers; refining of fossil fuels)
- Presence of Natural Hydrogen Reservoirs (still to be technologically explored)



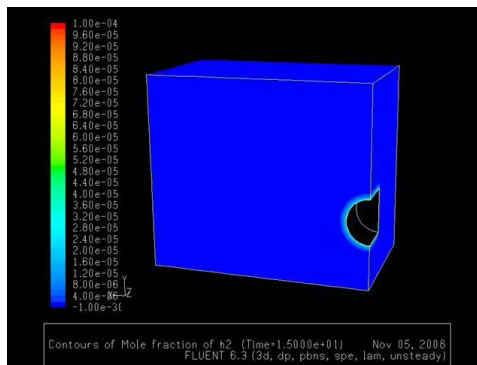
OVERALL OBJECTIVE

Develop mutual benefit joint green hydrogen roadmaps
To bridge EU 2030-2050 Clean Energy Goals and 2063 AU aspirations

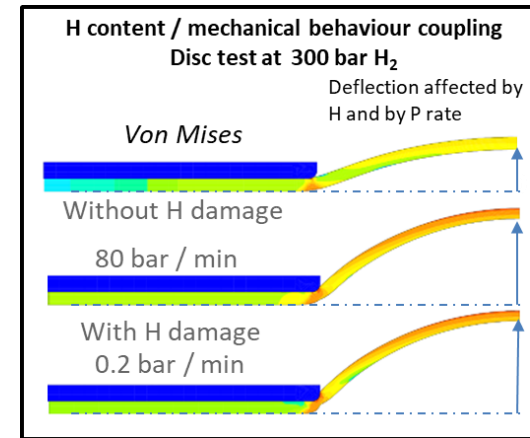


Pending questions (1/2)

- Common practices, standards/regulation, testing protocols, Scaling-up are necessary for cost effectiveness
 - Use potential RD20 TFs ?
 - How reinforced/Extended collaboration ?
 - Contributing to database (ie H2 incident and Accident from JRC or DOE) ?
 - R&D Support



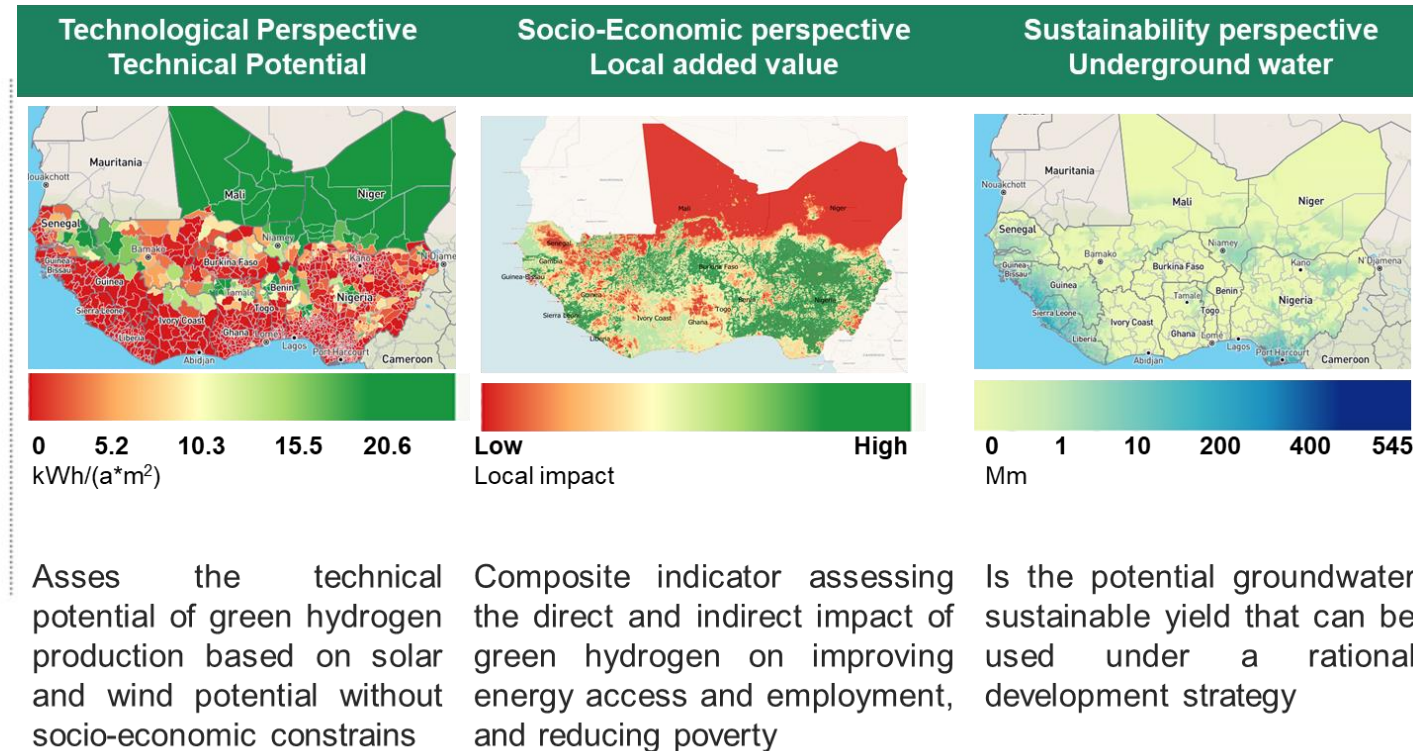
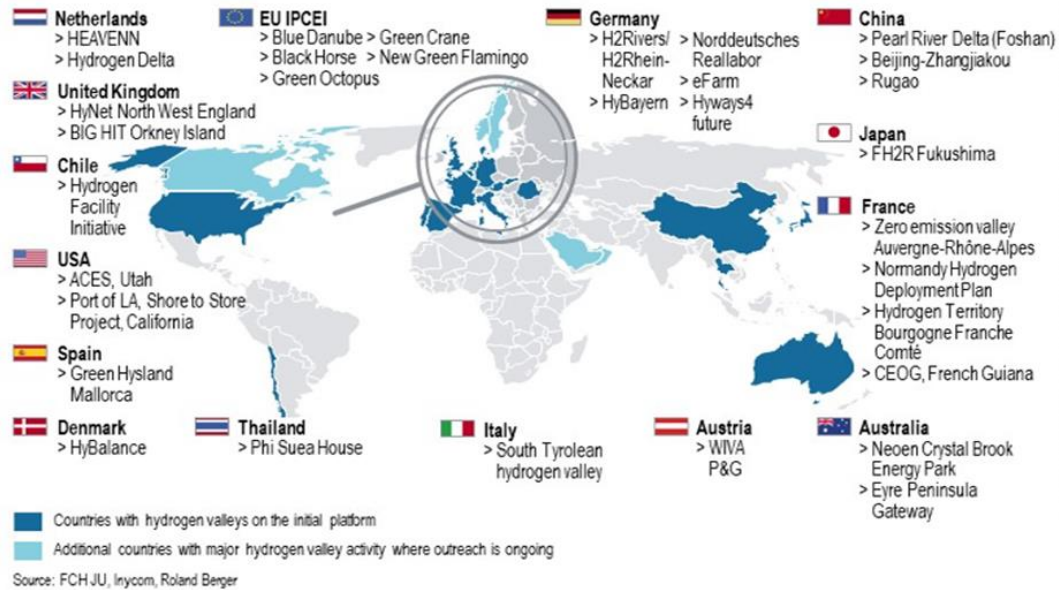
Sensor position
Leakage cell
Embrittlement test



- H2 Cost/environmental benefit/Social awareness/ business models vs fossil society
 - Is Hydrogen Valley approach transferable Everywhere ?

Pending questions (2/2)

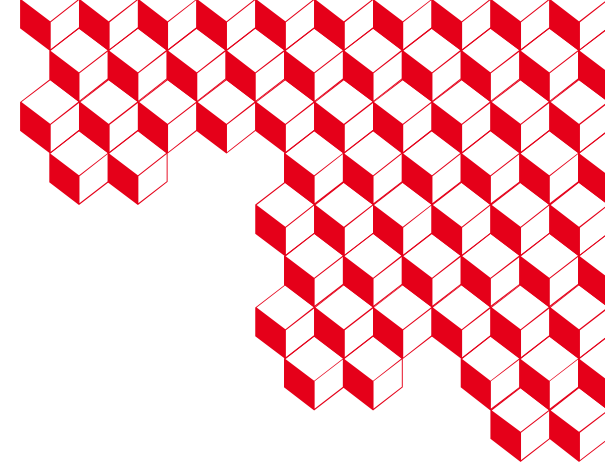
- Hydrogen Valleys have become a global phenomenon, with integrated project emerging all around the World (>30 Valleys from 18 countries)
 - Is Hydrogen Valley approach transferable Everywhere ?
 - How aggregate H2 Cost/environmental benefit/Social awareness/ business models vs fossil society competitiveness ? (Regional feasibility, experiences from www.H2Atlas.de)



Conclusions & Perspectives

- Significant Scientific, technological and political activities on H2 deployment at International level
- Strong need for common matrix and shared normative approaches
- Relevance of organizing H2 deployment through a HUB/Hot Spot/Valleys heuristic approach
- Outcomes from RD20 works are comforted
 - Needs common metrics and harmonized methodologies to evaluate Carbon Content of H₂ or H₂ based molecules and risks/benefits other than economics
 - Focus on questions on how to scale up electrolyzer capacities to GW/TW
 - LCSA should incorporate sustainability, social acceptance, safety aspects, recycling possibilities and consider local specificities and environmental justice





Thank You for your attention

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