TEACHING FUEL CELL AND HYDROGEN SCIENCE AND ENGINEERING ACROSS EUROPE

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1 author:

Iordache Ioan
National Research and Development Institute for Cryogenic and Isotopic Technologies ICIT, Rm. Valcea
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Ioan Iordache

[1] *The National R&D Institute for Cryogenic and Isotopic Technologies – ICSI, no. 4 Uzinei Str., Rm. Valcea, Romania*
[2] *University POLITEHNICA of Bucharest, Faculty of Power Engineering, no.313 Independenţei Str., Bucharest, Romania*

TUBA World Conference on
Energy Science and Technology
(TUBA WCEST-2021) August 8-12, 2021 / Online

TeacHy is a project funded by the Horizon 2020 program through FCH JU.

The offers its network partners access to its educational material and the use of the MSc course modules available on the TeacHy web site.

There are **12 partners** from **11** European **countries.** Until this moment the partners contributed together to the realization of 20 didactical modules.

Partners

UNIVERSITY OF BIRMINGHAM

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

UNIVERSITY OF CHEMISTRY AND TECHNOLOGY PRAGUE

Technical University of Denmark

The project, entitled: *Teaching Fuel Cell and Hydrogen Science and Engineering Across Europe within Horizon 2020*, acronym *TeacHy*, **is addressed to universities that have master's courses** covering elements related to hydrogen economics and the benefits that will be obtained by implementing it. Also, the **deliverables** generated by the project are intended to be **useful tools for teachers** in various European universities, which deal with the implementation of hydrogen in the renewable energy and alternative fuels, so that **the number of students, PhD students and specialists** with up-to-date knowledge in this field, to be **bigger and bigger**.

The partners have prepared:

- 7 compulsory (mandatary) modules,
- 11 optional modules, and
- 2 additional modules.

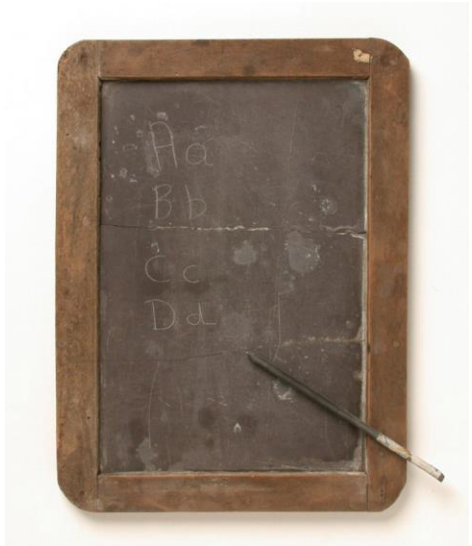
Compulsory modules:

1. Thermodynamics, electrochemistry, chemistry (KIT)
2. Characterisation methods (EPFL)
3. Introduction to fuel cells (UBHAM)
4. Fuel cell modelling tools (POLITO, Grenoble INP) and control (TUD)
5. Hydrogen (production, storage, handling), fuels (P2G, P2X) (UPB), electrolysers (UCTP, Grenoble INP)
6. Labs (POLITO)
7. Hydrogen safety (UU)

Optional modules:

1. Environmental analysis, life cycle analysis (UBHAM)
2. Low temperature fuel cells (materials, stacks, thermodynamics, electrochemistry, chemistry) (Grenoble INP, UCTP, DTU)
3. High temperature fuel cells (materials, stacks, thermodynamics, electrochemistry, chemistry) (TUD, KPI)
4. Low temperature systems (DTU)
5. High temperature systems (UBHAM)
6. Advanced characterisation (EPFL)
7. High temperature chemistry for SOFCs/SOEs (TUD, KPI)
8. Fuel cell electric vehicles (UBHAM)
9. Politics, markets, regulation, codes and standards (UBHAM, ULB)
10. Energy system and storage (UPB)
11. Advanced modelling (POLITO, Grenoble INP)

In order to create a didactic content you must understand and know the evolution of the didactic tools.



... is about the evolution from **tablet** to **tablet**

creating online content

it seem simple ….

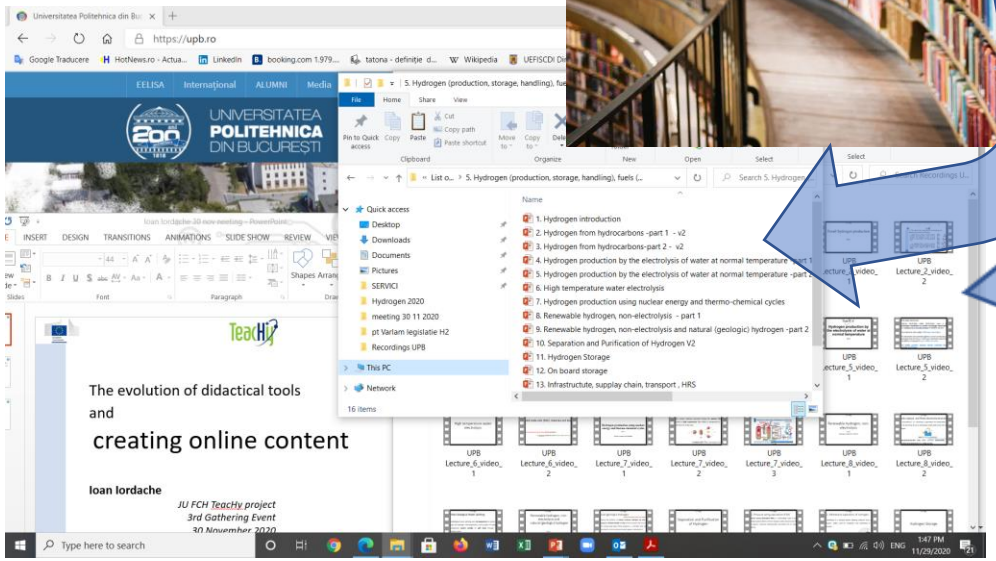
you document yourself

….upload data in

……your laptop

classic

internet



… the course is ready!

Examples of didactical content:

1. Steam reforming for hydrogen production

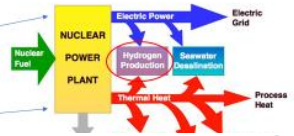
- Steam methane reforming (SMR) - is the most common method of producing commercial bulk hydrogen.
- Hydrogen is an important raw material for the **chemical**, **petrochemical** or **agrochemical** industry, with the big chances to become an **energy carrier alongside electricity** in the near future.



3. Hydrogen production with nuclear energy

There are two main **energy source** that can be used from **nuclear power** plants to produce hydrogen:

- **electricity** and
- **heat**.



Renewable hydrogen, non-electrolysis and natural (geologic) hydrogen

Part 2

- Hydrogen production methods –summary
- Natural (geologic) hydrogen

Renewable hydrogen, non-electrolysis

1

2. Theory of water electrolysis. Thermodynamics

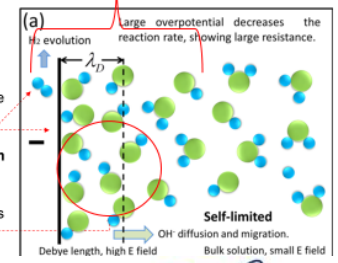
- The water electrolysis reactions are:

(1) **heterogeneous**,

(2) taking place at the **boundary between** the electrode and the electrolyte with

(3) the aqueous boundary layer subject to **concentration and electrical potential gradients** with

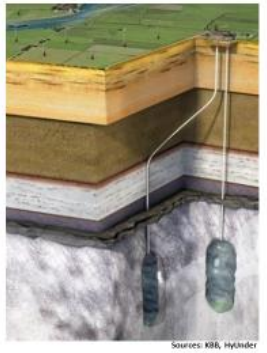
(4) the presence of the **generated gaseous** nanobubbles and microbubbles.



03/08/2021

Hydrogen underground storage

- Hydrogen as a mean to store energy.
- Increasing production of fluctuating renewable energy intensifies the **need for energy storage** to ensure network reliability and flexibility.



Sources: KBB, HyUnder

Hydrogen Infrastructure

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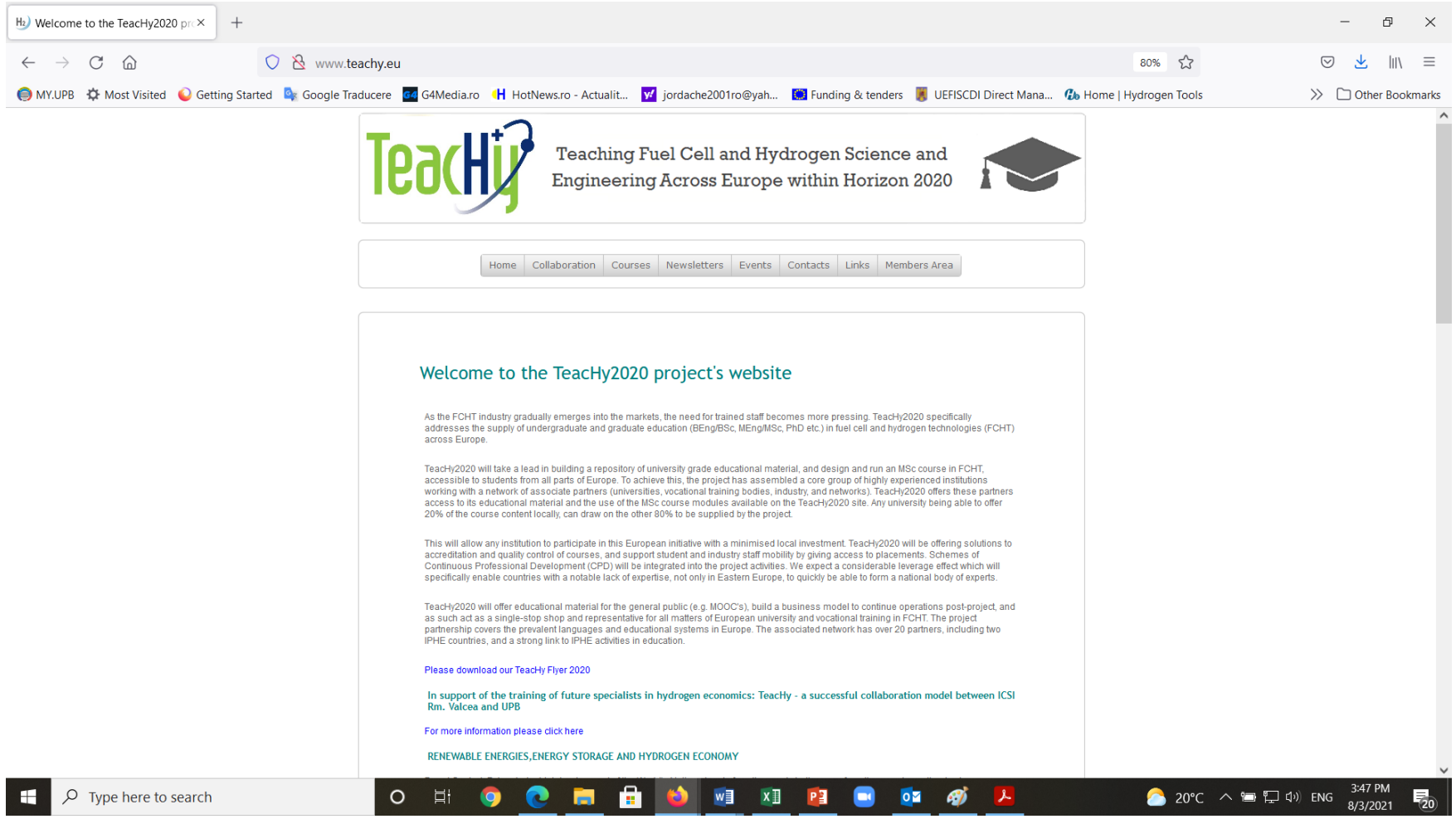
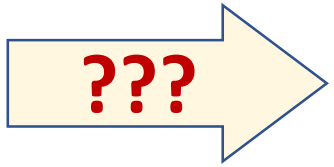
More on

http://www.teachy.eu



Our role as professors does not change!

….**but** the <u>digitalization means a lot more</u>, instead of assistants or PhD students, we would rather need actors, someone(or more) with a pleasant voice, TV operators, ... … finally a full TV team from Discovery!



What is a pen, notebook or pencil box?

Yes, our generation know!

Thank you for your attention!

…. but how many of us know how to use a quill pen?