NANOINNOVATION 2021 (Rome, 21 - 24 September 2021)

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WORKSHOP 22 Sept. 2021

TT.III.H The energy hubs and districts in Italy: a showcase for nanotech

https://www.nanoinnovation2021.eu/home/index.php/daily-schedule/plan-22-september

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Co-organized with University of Messina & INSTM

Energy hubs and districts plays a crucial role to implement the energy transition and defossilization of the society, and to empower its key components such as a hydrogen economy, the development of solar fuels and artificial leaf, the technologies for the closure of carbon cycles and the electrification of production, the realization of green ports or hydrogen valleys.

Energy hubs and districts represent a relevant showcase of nanotech technologies and their modalities of integration into smart and innovative energy communities and grids. Nanotechnologies (nanotech) provide the potential to enhance energy efficiency across all branches of renewable energy production, transformation, transport, distribution, and use, and to economically leverage renewable energy through new and optimized technological solutions.

Nanotech innovations impact each part of the value-added chain in the energy sector and find in energy hubs and district the way to enlighten their crucial role providing a blueprint for industries and governments to energy transition and decarbonization. Nanotech Energy Hubs workshop will discuss relevant case examples of innovative nanotech solutions which can play a relevant role to realize new models of energy hubs and districts in Italy.

22 SEPTEMBER Part 1: 14:00- 15:30

Nr. lecture	*Presenter and Institution*	*Photo*	*In presence (P) or remote (R)*
TT.III.H.1 SY.VIII.1.1	Frederic CHANDEZON CEA-Fundamental Research Division/IRIG, Grenoble, France SUNERGY a European large scale initiative on fossil free free fuels and chemicals)		P
TT.III.H.2 SY.VIII.1.2	Antonio LUCCI RINA Hydrogen storage & transport challenges		R
TT.III.H.3 SY.VIII.1.3	Gaetano IAQUANIELLO NextChem (Maire/Tecnimont group) Long-duration Storage (LDS) : a fundamental step for massive exploitation of Variable Renewable Energies.”		P
TT.III.H.4 SY.VIII.1.4	Francesco Luca BASILE University of Bologna, Italian delegate for cluster 5 Climate Energy and Mobility (EU HE) Green energy hubs for local integrated energy systems and communities		P

22 SEPTEMBER Part 2: 16:00 - 17:30

Nr. lecture	*Presenter and Institution*	*Photo*	*In presence (P) or remote (R)*
TT.IV.E.1 SY.VIII.2.1	Cosimo GERARDI ENEL Green Power The role of high efficiency innovative silicon based PV technology for distributed energy production		R
TT.IV.E.2 SY.VIII.2.2	Francesca FERRAZZA ENI (Decarbonization & Environmental Technologies R&D programme) Innovative technologies at ENI for renewable energy and decarbonization		R
TT.IV.E.3 SY.VIII.2.3	Alessandro VIVIANI The European House – Ambrosetti H2 Italy 2050: A national hydrogen value chain for the growth and decarbonization of Italy		R
TT.IV.E.4 SY.VIII.2.4	Luigi CREMA Bruno Kessler Foundation, Centre Sustainable Energy Hydrogen valleys: concepts, application in the Alpine Region and the role of novel technologies		P

Frederic CHANDEZON frederic.chandezon@cea.fr
CEA-Fundamental Research Division/IRIG, Grenoble, France

SUNERGY a European large scale initiative on fossil free free fuels and chemicals)

Running our entire world strongly depends on fossil-based energy sources and raw materials. Their intensive use over the last decades not only depleted the Earth's resources, but also caused a significant increase of the CO_2 concentration in the atmosphere and therewith global warming, with tremendous consequences for ecosystems and society in general as recently pointed again unequivocally by the Intergovernmental Panel on Climate Change (IPCC). Thus the EU faces the challenge of displacing fossil resources by renewables to achieve its vision of a zero-emission society by 2050. Converting renewable power and solar energy into chemical energy (fuels and chemicals) can make a key contribution to meet this challenge. This is the vision of the European initiative SUNERGY which gathers a community of more than 300 stakeholders (academia, industry, civil society, governmental/local authorities). Fulfilling such a vision highlights the importance of a systemic approach and the relevance in some cases of a decentralised production model as close as possible to the needs, thus the concept of hubs, whether industrial (e.g. hydrogen valleys) or residential (low energy districts). Furthermore, nanotechnology as an enabling technology is key to improve the performance of solar and renewable energy conversion in chemical form with e.g. better catalysts or photoabsorbers. The presentation will first give a general overview of SUNERGY before presenting the approach on these aspects.

Antonio LUCCI antonio.lucci@rina.org
RINA

Hydrogen storage & transport challenges

The intermittency and delocalization of renewables makes necessary to transport and storage energy in order to have it available only when it is needed by the offtakers. Hydrogen is an energy carrier that can fulfill this purpose without CO2 emissions. Hydrogen transport systems can be done via truck, ship or pipeline. An efficient solution would be to use the European existing gas pipeline network by mixing hydrogen into natural gas. In this case, checks must be undertaken to determine whether the materials are suitable and to date one of the few tools available is the ASME B31.12. At present in Italy it is not possible to inject hydrogen into the existing gas network and there are no dedicated laws or regulations. This is noted by the National Recovery and Resilience Plan and a reform in this regard is soon expected.

Together with hydrogen transportation, there is a strong need to store hydrogen for the different end users. Storage can be liquid, gaseous at high and low pressure. Low pressure storage is very convenient and it is feasible with adsorbing material that allow high hydrogen density per unit volume at low pressure (20-50 bar). In this field nanotechnologies can give an important contribution to identify mechanisms and engineering materials in order to enhance storage capabilities and overcome the challenges related to the performance over time and heating effect of current materials.

Gaetano IAQUANIELLO G.Iaquaniello@kt-met.it
NextChem (Maire/Tecnimont group)

Long-duration Storage (LDS) : a fundamental step for massive exploitation of Variable Renewable Energies."

Long-term storage(LDS), defined for storage time of 10 hours or greater, may have a strong impact to the exploitation and cost reduction of Variable Renewable Energies (VES) as wind or solar electricity systems. If batteries are used primarly for infra-day storage , LDS will be used for inter-season or even multi-years storage making more reliable and affordable electricity system . LDS technologies for VES includes today power-togas-to power(PGP), pumped hydro-storage(PHS) and compressed air energy storage(CAES). Today my short presentation will focus on PGP technologies and use of nanomaterials to improve the affordability and reduce the costs of such a scheme. PGP strategy implies the transformation of electricity (or excess of electricity) into H2 via electrolysis, storage of H2,

transformation of H2 to electricity either thermally, via combustion turbines, or electrochemically, via Fuel Cells. The electrochemically way looks particularly interesting through the use of Solid oxide Electrolizers (SOEL) and solid oxide Fuel Cells (SOFC), although there is a need to develop a proper heat storage strategy in order to increase the energy efficiency of SOFC/SOEL system to a level of 65-70%. In an alternative process architecture, H_2 could also be transformed into methane via a methanation unit using concentrated CO_2. Methane could be stored as natural gas is routinely stored today and later combusted into a gas turbine upon demand , with CO_2 captured, concentrated , stored and recycled. Although this latter scheme my seen easier to implement from a technological point of view , we need to consider the costs associated with CO_2 capture and methanation. In any of the above scheme there is anyhow a need to storage large quantity of H_2. Together with gas storage up to 700 bar, with an energy consumption of 2-3 KWh per kg of H_2 or liquid H_2 storage with an energy consumption of10-12 KWh per kg of H_2, with a major issue of the boil-off occurring 3 days after a vessel is charged, new solutions are gaining importance , achieving higher volumetric efficiency above 100 kg H_2 per m^3 : metal hydride(MH) and carbon nanotubes . In MH , H_2 is chemically bonded with metals or alloys to form hydrides, here the major issue is agian the heat management. In Carbon nanotubes adsorption , temperature is the key factor and operation is quite effective under O degree C. A proper definition of all components of the PGP architecture is then essential to reduce the costs of VES, in such quest of process optimization, nanotechnology may play a role in all the components.

Francesco Luca BASILE f.basile@unibo.it
University of Bologna, Italian delegate for cluster 5 Climate Energy and Mobility (EU HE)

Green energy hubs for local integrated energy systems and communities

Local energy communities are collective energy actions that include citizen participation in the energy system and from which benefits are derived for members of local communities. They represent a crucial element for a bottom-up strategy of building the energy infrastructure and to develop innovative nanotech tools for better planning and performance of local energy communities, integrating distributed energy resources and multiple energy carriers at various levels. By promoting the notion of the Energy Hub as a conceptual model for controlling and managing multi-vector and integrated energy systems, this tools will promote tangible benefits in terms of sustainability and energy security for all stakeholders in local energy communities. The results will benefit local prosumers by reducing energy costs and promoting local low-carbon energy.

Cosimo GERARDI cosimo.gerardi@enel.com
ENEL Green Power

The role of high efficiency innovative silicon based PV technology for distributed energy production

Today, increasing efficiency and average energy generation are the most powerful levers for overall cost reduction in photovoltaics (PV). Silicon Heterojunction Technology (HJT) is an innovative silicon PV approach, which is now ready to compete with mainstream technologies. By leveraging on high efficiency, thermal stability, lower degradation and high bifacial factor, HJT solar cell is very attractive for its remarkable reduction of the levelized cost of energy (€/kWh). The fabrication process of HJT solar cells is simpler and low temperature (180 – 200°C), making it the most performing technology based on silicon. Moreover, HJT is compatible with several advances enabling the solar cell to overcome the theoretical limits of silicon, aiming at achieving over 30% energy conversion efficiency with a tandem approach. Several approaches to find a tandem structure that can be industrialized are under study. However, despite some interesting results obtained in the last five years, it is an open issue of how to transfer these research results to industrial mass production, which is driven by cost reduction, high efficiency and including big challenges like upscaling and long-term stability

We report on the efforts for the development and industrialization of innovative bifacial Si heterojunction technology towards more than 25% efficiency, as well as on the activities to overcome the theoretical limits of silicon through implementation of a multiple junction structure based on the tandem perovskite/silicon

approach..

Francesca FERRAZZA Francesca.Ferrazza@eni.com
ENI (Decarbonization & Environmental Technologies R&D programme)

Innovative technologies at ENI for renewable energy and decarbonization

Technology and innovation guide Eni on the path to decarbonization. Eni intends to play an active role in the energy sector's virtuous path to contribute to carbon neutrality by 2050, in order to limit average global warming within the 1.5°C threshold at the end of the century. Eni has decided to accelerate its transformation path. In February 2021, Eni announced its new strategy to relaunch short, medium and long-term operational targets, which outline the evolutionary and integrated path of the individual businesses and that will lead Eni to carbon neutrality by 2050. As part of this strategy, Eni is developing a series of innovative technologies that will be presented.

Eni will pursue a strategy that, by 2050, aims to achieve net zero on GHG Lifecycle emissions Scope 1, 2 and 3 (Net GHG Lifecycle Emissions), and the associated emission intensity (Net Carbon Intensity) for the entire life cycle of tge energy products sold, further strengthening the intermediate decarbonization targets.

Alessandro VIVIANI alessandro.viviani@ambrosetti.eu
The European House – Ambrosetti

H2 Italy 2050: A national hydrogen value chain for the growth and decarbonization of Italy

Italy can use hydrogen to its advantage both to reach decarbonisation targets and to create new forms of industrial competitiveness, by leveraging its manufacturing potential and its expertise in the natural gas supply chain. This is what emerges from the study H2 Italy 2050: a national hydrogen supply chain for the growth and decarbonisation of Italy, carried out by The European House - Ambrosetti in collaboration with Snam to examine for the first time the potential of the Italian hydrogen supply chain

Luigi CREMA crema@fbk.eu
Bruno Kessler Foundation, Centre Sustainable Energy

Hydrogen valleys: concepts, application in the Alpine Region and the role of novel technologies

FBK is developing multiple key technologies for a sustainable energy, playing a critical role in developing and implementing energy hubs: (i) battery technologies (flow and next generation) for energy storage; (i) innovative solutions for the production of green hydrogen; (iii) initiatives related to energy grids: micro grids, distribution grids and transmission grids. Within this framework, a relevant role will be played by hydrogen, with its application in an energy hub called hydrogen valley. Hydrogen Valleys has been part of the Mission Innovation programme, inside the Innovation Challenge 8: Hydrogen technologies and systems. It will be represented the concept of an hydrogen valley, which technologies could constitute the hydrogen hub at the light of the EC objectives and the development of novel technologies and solutions. A specific example will be dedicated to the hydrogen valley concepts in the Alpine Region, with an overview of the main specific technologies that could constitute the different districts and the role of research and development on novel materials to enable some missing links to efficient and sustainable future technologies. At Fondazione Bruno Kessler, in the Center for Sustainable Energy, we are developing several enabling solutions from the hydrogen production, the hydrogen logistics, to the end uses in transport and industrial sector..