



**Giulio Buffo**

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**Sex**

Male

**Date of birth**

29/08/1993

**Nationality**

Italian

# Giulio Buffo

## Energy Engineer

### Work Experience

**Mar 2020 - Aug 2020**

*Teaching assistance, Politecnico di Torino, Torino*

Course in Building physics and air conditioning

- Exercise sessions on air conditioning, building physics and acoustics;
- Tutoring and support to students;
- Writing and collection of teaching material;
- Check of students' reports.

**Dec 2016 - Apr 2018**

*Website localization, Infocom S.r.l., Lecce*

Management, translation and localization of websites.

**Mar 2017 - May 2017**

*Teaching part-time assistance, Politecnico di Torino, Torino*

Course in Thermal design and optimization

Support to students during lab sessions.

**Sep 2016 - Gen 2017**

*Teaching part-time assistance, Politecnico di Torino, Torino*

Course in Building physics and air conditioning

- Tutoring and support to students;
- Writing and collection of teaching material.

**Oct 2015 - Feb 2016**

*Teaching part-time assistance, Politecnico di Torino, Torino*

Course in Building physics and air conditioning

- Tutoring and support to students;
- Writing and collection of teaching material;
- Check of students' reports.

**Mar 2015 - Jul 2015**

*Part-time Collaboration, E.Di.S.U. Piemonte, Torino*

Office for Halls of Residence

- Management of Halls of residence;
- support to evaluation of the final operating balance in year 2014.



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## Education

### May 2018 - Present

#### Politecnico di Torino - Dipartimento Energia, Torino (Italy)

PhD in Energetics

*“Carbon capture process based on innovative ionic liquids: experimental assessment and analysis of integrated CO<sub>2</sub> capture and re-utilization pathways”*

This PhD program aims to study the different elements (technologies and processes) of a polygeneration system that meets the urgencies of both integrating the renewable energy sources (RES) in the energy generation portfolio and reducing the atmospheric impacts of plants and factories doomed to progressive decarbonization.

### Oct 2015 - Dec 2017

#### Politecnico di Torino, Torino (Italy)

Master's degree in Energy and Nuclear Engineering, 110/110 *cum Laude*

Thesis in Polygeneration and Advanced Energy Systems:

*“Modeling, techno-economic analysis and optimal operation of a Reversible Solid Oxide Cell (ReSOC) polygeneration system”*

This work presents a completely carbon-free Reversible Solid Oxide Cell (ReSOC) concept plant for the combined heat and power production. The simulations of steady-state operation at full and partial loads in SOFC and SOEC modes were performed with software Aspen Plus. After a step of pinch analysis aiming to optimize the recovery of heat in the Balance of Plant, a MATLAB model interfaced the map of steady-state operating points with both the simulated loads of the residential district and a heat storage unit (HSU) containing molten salts. A techno-economic assessment and a preliminary evaluation of incidental events involving the hydrogen storage were performed to assess the viability of the system in an urban context.

### Sep 2012 - Oct 2015

#### Politecnico di Torino, Torino (Italy)

Bachelor's degree in Energy Engineering, 104/110

Thesis in Building Physics and Air Conditioning:

*“Evaluation of the performance of fibrous filtering materials” (original title in Italian: Determinazione delle prestazioni di materiali filtranti fibrosi)*

This experimental work was conducted in the framework of the European Commission's M/461 research mandate (Standardization activities on nanotechnologies and nanomaterials). The aim is the definition of a test protocol for the determination of the performance of filtering materials used mainly for air conditioning. The test rig was validated, providing the collected data with a good degree of reliability. The sampled data were processed critically, highlighting the peculiarities of the tools used and the influence of the operating conditions. The results of the spectral efficiency tests confirmed the key points of the theory of filtration mechanisms. The outcome of this analysis paves the way for the inter-laboratory comparison of experimental methods and results.

### Sep 2007 - July 2012

#### Liceo Classico Statale Virgilio, Lecce (Italy)

Classical high school degree “sperimentazione Brocca Linguistico”, 100/100 *cum Laude*



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## Publications

**2020, *Energy and environmental analysis of a flexible Power-to-X plant based on Reversible Solid Oxide Cells (rSOCs) for an urban district***

Journal of Energy Storage. Elsevier, 29 February 2020, p. 101314.

G. Buffo, D. Ferrero, A. Lanzini, M. Santarelli

**2019, *Hydrogen for bulk energy storage of renewable power sources. Power-to-X and power-to-power routes***

Solar hydrogen production: processes, systems and technologies - 1<sup>st</sup> ed. (Academic Press, 2019).

G. Buffo, P. Marocco, D. Ferrero, A. Lanzini, M. Santarelli

**2019, *Reversible Solid Oxide Cell (ReSOC) as flexible polygeneration plant integrated with CO<sub>2</sub> capture and reuse***

SUPEHR19 SUstainable PolyEnergy generation and HaRvesting. Savona: E3S Web of Conferences, pp. 1-6.

G. Buffo, D. Ferrero, A. Lanzini, M. Santarelli

**2019, *In-service performance assessment of electrostatic precipitators serving a rubber vulcanization process***

Aerosol Science and Technology. Taylor & Francis, 53(8), pp. 886-897.

G. Buffo, C. Asbach, S. Barale, P. Tronville

## Conferences

**Sep 2019, SUPEHR19 SUstainable PolyEnergy generation and HaRvesting, Savona**

Oral Presentation.

**Jul 2019, Energy for Sustainability 2019, Torino**

Oral Presentation. "Energy performance of carbon capture with ionic liquids", G. Buffo, G. Latini, S. Bocchini, A. Lanzini, M. Santarelli, F. Pirri

**Mar 2018, - Filtech Conference 2018, Cologne**

Oral presentation. "Analysis of aerosol emissions from a rubber vulcanization process", G. Buffo, S. Barale, P. Tronville



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## Projects

### **Dec 2019 - Jul 2020, Research activity - Integration of innovative solutions for the decarbonization of thermal power stations**

*Participants: Politecnico di Torino, Environment Park. Client: Gruppo IREN S.p.A.*

The study aimed to assess the techno-economic feasibility and the compliance with regulatory framework of innovative solutions for the decarbonization of the CHP waste incinerator in Turin (Italy) owned by Gruppo IREN S.p.A. Different technological solutions were analyzed to retrofit and integrate capture of CO<sub>2</sub> from flue gases and production of hydrogen from water electrolysis to convert CO<sub>2</sub> into synthetic natural gas (SNG). SNG was then doomed either to injection in the gas network or to automotive sector as fuel. The results of this preliminary study were employed to prepare the official proposal of the H2020 project "INDECARBON", currently under review.

### **Jul 2020, Technical Report - Realization of a heating system based on a hydrogen-fired boiler in the framework of a public tender for the project "Servizio Energia per gli edifici della provincia di Modena 2020-2027"**

*Participants: Consulting group of Politecnico di Torino - Department of Energy. Client: Asia Progetti S.r.l.*

The consultancy regarded the assessment of the technical feasibility of a retrofitting intervention to upgrade the heating system in a school located in Modena (Italy). The project required the installation of a boiler fed by the hydrogen produced via in-situ low-temperature water electrolysis and compressed in a seasonal storage. The electric energy feeding electrolysis was produced by a rooftop photovoltaic system. The system was sized with an operating logic aiming to maximize the overall energy efficiency and the conversion of solar energy in hydrogen, available then in a long-term storage for heat generation.

### **Jul 2018 - Dec 2018, Research activity - Preliminary assessment of the viability of hydrogen generation via water electrolysis fed by thermal power stations**

*Participants: Politecnico di Torino - department of Energy. Client: Gruppo IREN S.p.A.*

The activity focused on the analysis of techno-economic scenarios for hydrogen generation via water electrolysis fed by part of the electric power produced by gas-fired combined cycle plants in Torino Nord and Turbigio owned by Gruppo IREN. Produced hydrogen was then compressed and stored to feed a fleet of fuel cell electric vehicles or trains. We developed a model to simulate and analyze the system operation. The demand of mobility hydrogen was fulfilled coherently with a flexible refueling schedule and in compliance with the safety regulation on the storage of hazardous substances. One of the main outcomes is the range of the production cost of hydrogen in different scenarios, which was compared with the results of an analogous system fed by electric energy from the waste incinerator in Turin (Italy), owned by Gruppo IREN.

### **May 2018 - Present, Project - INFRA-P CO<sub>2</sub> Circle Lab: test rig for CO<sub>2</sub> absorption with liquid solvents**

Designed during the 1st year of my PhD and trialed at Environment Park as part of the INFRA-P CO<sub>2</sub> Circle Lab project, the test station replicates a traditional two-column scheme for the removal of CO<sub>2</sub> from different gas mixtures (N<sub>2</sub>, O<sub>2</sub>/H<sub>2</sub>, CH<sub>4</sub>, CO). The rig allows the execution of tests in both continuous and batch configuration.

### **Jan 2018 - Mar 2018, Technical report - Design, optimization and analysis of a polygeneration system based on a low-temp electrolyzer in Aosta**

The operation of an alkaline electrolyzer (900 kW) fed by a photovoltaic system was simulated thanks to the real data provided by a group of local public and private stakeholders and analyzed. Hydrogen was then blended (15% vol.) in natural gas. A share of "hy-thane" fed a CHP engine used to run the local district heating network (DHN), hence reducing the emissions of CO<sub>2</sub> and other pollutants; a share was compressed at 200 bar to fuel 23 buses (with a reduction of 5 t/year of emitted NO<sub>x</sub>). With the aim of maximizing the efficiency of the polygeneration system, the electrolytic oxygen by-produced was supplied to a steel plant in the same area; heat generated by electrolysis reaction was used to raise the temperature of water inlet of a heat pump serving the DHN, hence increasing its COP.



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**Apr 2016 - Sep 2016, Research activity - Determination of performance of filtering materials**

We monitored and analyzed the emission control systems of some post-curing ovens, serving a production unit manufacturing small parts containing rubber for the automotive industry. We measured the emissions exhausted by two different types of ovens: in-line and batch ones. Each emission control unit was equipped with a heat exchanger cooling the exhaust gases to a value suitable for the operation of the downstream two-stage electrostatic precipitator. The goals in performing the measurements were:

- To assess the performance of the exhaust fume purifying unit, with emphasis on the electrostatic precipitator performance and its assessment;
- To evaluate the adequacy and efficacy of the current maintenance schedule, whose time interval may significantly influence the performance of the electrostatic precipitators;
- To develop a robust measurement protocol to evaluate the reliability of innovative solutions for removing the pollutants.

## Projects in Student Teams

### Analysis of possible long-term scenarios for electricity production in Germany: a macro-scale modeling approach

The aim of this project work was the study of possible long-term scenarios for power production in Germany, starting from the collection and analysis of historical data and projections regarding the main socioeconomic drivers of the electric demand.

### Feasibility study of a residential CHP system based on SOFC

The following project work performed the design of a SOFC micro-CHP system for a residential unit: it provided a preliminary feasibility study and the cash flow analysis in a certain number of economic scenarios and compared the results of simulations with the present configuration involving traditional systems and dynamics for heat production and power purchasing.

### Preliminary assessment of the variation of air quality after the realization of CHP plant serving a district heating network

Along the lines of an environmental impact assessment, this study assessed the variation of air quality as a consequence of the realization of the CHP plant in Torino Nord owned by Gruppo IREN and serving the local district heating network.

### Exergo-economic analysis, design improvement and investment analysis of a CAES system

This report was devoted to the study of the compressed air energy storage (CAES) plant operating in Huntorf, Germany. After having modelled the system with the software Aspen Plus fixing the default operating thermodynamic conditions, we performed the exergy cost and exergo-economic analysis of the system; these data were then exploited in order to assess the cost formation process according to the design improvement methodology, that allows to identify the components that can be improved. Furthermore, we modified the system configuration, the operating conditions and the design parameters aiming to reduce the cost of the products. Finally, an investment analysis and a revenue account of this final optimized layout were carried out.

### A simplified model for the electrical energy consumption of household refrigerator - freezers

This project work aimed to define the crucial parameters for the simulation of base energy consumption of refrigerator-freezers in dwellings, starting from the data published by producers in datasheet. A preliminary correlation between these parameters and the energy consumption was searched.



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## Languages

### Italian

Mother tongue

### English

Certification: B2 - First Certificate English (FCE).

### Spanish

Certification: B2 - Diploma de Español como Lengua Extranjera (DELE).

### French

Certification: B1 - Diplôme d'études en Langue Française.

### German

Basic knowledge in Writing, Speaking and Listening.

## Technical Skills

### Digital Skills

- European Computer Driving License (ECDL)

### Operating System

- Windows

### Programming Language

Good knowledge: C

### Applications

Advanced knowledge:

- Matlab
- FreeFem++
- Aspen Plus
- Microsoft Office (*Word, Excel, Powerpoint, Access, Visio*)

Good knowledge:

- Solidworks
- Comsol Multiphysics

Basic knowledge:

- Polysun
- Tonatiuh
- EES (Engineering Equation Solver)
- Star-CCM+
- Breeze

## Expertise

- Modeling and optimization of polygeneration and energy storage systems.
- Feasibility study in compliance with the regulatory frameworks.
- Assessment of techno-economic scenarios.
- Design and trial of experimental test rigs/demonstrators.
- Experience with in-person and remote teaching activities.

## Skills

- Problem solving.
- Attention to detail and hard work.
- Management of technical workgroup and in cross-cutting projects.
- Able to reach compromises and make decisions to achieve the best results.
- Adapt in working or collaborating with others and in an international environment.

## Others

### Interest

Art, Music, History, WaterSports, Movies.

### Driving License

B

Autorizzo il trattamento dei miei dati personali ai sensi del D. Lgs. 196/2003. Dichiaro che quanto riportato nel presente Curriculum Vite corrisponde a verità ai sensi del D.P.R. 445/2000.