prof. Stefano CONSONNI
CURRICULUM VITAE as of September 2017

PERSONAL

- Born in Piacenza (Italy), Dec. 8th, 1958
- Living in Piacenza, via Poggi 28
- Married, three children

EDUCATION

- Degree in Mech. Eng. (Energy Conversion) at Politecnico di Milano, 1983, 100/100 with highest honors.
- Master's in Mech. Eng., Princeton University, Dept. of Mech. and Aerospace Eng., Princeton, USA, 1987.
- Ph.D. in Mech. Eng., Princeton University, ibid., 1992, with a Thesis on Performance Prediction of Gas/Steam Cycles for Power Generation. Supervisor prof. R.H. Socolow.
- Lecture Series attended at von-Karman Institute, Bruxelles (1982, 1985, 1994) and Massachusetts Inst. of Technology (1987).

ACADEMIC EXPERIENCE

- Research assistant at Princeton University, Center for Energy and Environmental Studies, 1985-90.
- Assistant professor at Dept. of Energy Engineering of Politecnico di Milano, 1990-92.
- Associate professor with tenure, ibidem, 1992-01.
- Full professor with tenure, ibidem, since 2001.
- Since 1992 has taught "Power Plants", “Hydraulic and Thermal Machinery”, “Energy Systems”, "Environmental Impact of Energy Production", “Low Carbon Technologies” to students in Environmental, Electrical, Energy, Mechanical and Transportation Engineering.
- Since 1992, supervisor of over 80 Graduation Theses and Ph.D. Theses of candidates to degrees in Mechanical, Environmental, Electrical, Chemical Enginering.
- Since 1992 member of the Committee of the Ph.D. program in Energy Eng. of Politecnico di Milano.
- Since 1992, elected in education and scientific committees of Politecnico di Milano: Dept. of Energy Engineering, School of Engineering, Center for Research on Transportation.
- Since 1993 lead investigator and/or participant to researches financed by:

  A2A SpA, Milano
  Actelios SpA, Milano
  AEM Milano
  Amer. Forestry & Paper Ass., Wash., USA
  Air Liquide Research Center, Parigi
  Alstom Power, Milano.
  Ansaldo Ricerche, Genova.
  ATIG (Assoc.Tecnica Italiana Gas), Milano
  BP Alternative Energy, Sunbury, UK.
  CCP (Carbon Capture Project)
  CESI, Milano
  Edipower SpA, Milano
  ENI SpA, Milano
  Federambiente, Roma
  Hera SpA, Bologna
  Italcementi SpA, Bergamo
  Ministero Università e Ricerca, Roma.
  Pirelli Ambiente, Milano
  Regione Lombardia
  Tokyo Gas Ltd., Tokyo.
  US Agency for Intl. Development, NY, USA
  US Dept. of Energy, Washington DC, USA
  Veolia Servizi Ambientali, La Spezia

  for researches on: gas turbines, combined cycles, cogeneration, district heating, gasification, energy from waste and/or biomass, environmental impact of energy systems, CO_2 capture, production of decarbonized electricity and decarbonized fuels, pollution from traffic, heat transfer, residual fuels, etc.
- From 1998 to 2005, Head of the Piacenza Campus of Politecnico di Milano, administering degrees in Mechanical Engineering, Transportation Engineering, Environmental Architecture.
- Since 2005, President of LEAP (Laboratory for Energy and the Environment Piacenza), a research company promoted by Politecnico di Milano to carry out research and technology transfer on advanced, environmentally benign technologies and processes.
- Director of Lecture Series held at Politecnico on Waste-To-Energy Systems (1999 and 2005), Energy from Biomass (2006), Technologies for Energy Recovery from Waste (2008).
- Contributing author of the World Energy Assessment, UN Development Program, 1999-00.
- Visiting Research Scientist at the Princeton Environmental Institute (PEI), Princeton University (USA) for the 2002-03 Academic Year and the semester Feb-Jul 2007.
- Since 2003, contributor to the Master program *RIDEF* of Politecnico di Milano (recovery from waste).
- Since 2003, member of the Committee of the Ph.D. program in *Technologies for Energy and the Environment* of Università di Bergamo.

- National coordinator of research project PRIN 2006 sponsored by the Italian Ministry of Research on "Comparative analysis of paths for the recovery of materials and energy from waste", 2007-09.
- Coordinator of graduate course on "Global Change and Sustainability" given at Alta Scuola Politecnica, managed by Politecnico di Milano and Politecnico di Torino, 2009-2015.
- Coordinator of unit "Waste & Power" of FIRB (Basic Research) Project sponsored by the Italian Ministry of Research on "Optimization of secondary energy systems", 2007-10.
- Since 2009, coordinator of the international Masters' program in Renewables and Environmentally Sustainability (RES) offered at the Piacenza campus of Politecnico di Milano.
- Since 2010 component of the Scientific & Technical Advisory Council (STAC) of CEWEP (Confederation of European Waste-to-Energy Plants), Bruxelles.
- Since 2011, Director of MatER (Material & Energy from Refuse), a study center established at LEAP with the scientific support of Politecnico di Milano.
- Since 2017, Coordinator of CLEANKER, a EU H2020 project for the construction of a Ca-Looping pilot plant to test CO2 capture in a cement plant. Total funding 9 million Euros.
- Invited speaker at meetings and conferences on gas turbines, cogeneration, energy from waste and biomass, gasification, energy scenarios, energy and climate change, CO_2 capture, CO_2 capture in the cement industry, etc. since 1990.

PROFESSIONAL EXPERIENCE

- Scientific consultant in the field of energy systems and their environmental impact of A2A (Milano) AFPA (American Forestry & Paper Association), AMSA Milano, Ansaldo Genova, ASM Brescia, ASM Piacenza, Chemrec (Sweden), Cofely/Gas de France-Suez, Fiat Power Train, Franco Tosi, General Electric, Hera, Italcementi, Navigant Consulting (USA), Nykomb (Sweden), San Marco BioEnergie, SNAM, Viscolube, Weyerhaeuser (USA).
- Court-appointed Technical Expert in a number of civil and criminal cases on power plants, district heating plants, waste-to-energy plants, combined cycle plants, biomass-fired plants, biogas plants, steel plants, photovoltaic plants, industrial plants, etc.
- Member of the Board of the Municipal Utility of the city of Piacenza (1995-96)
- President of Tecnoborgo, project company managing the WTE plant in Piacenza (1996-98).
- Member of the Board of the Foundation of the city of Piacenza (2001-2003).
- Member of the Testing Committee of the WTE + District Heating plant in Brescia, 1997-99 and 2003-04.
- Member of the Testing Committee of the WTE + District Heating plant in Milano, 2000-03.
- Member of the Testing Committee of the fluidized bed, WTE plant in Parona (PV), Italy, 2007-08.
- President of the Testing Committee of the de-NOx system of the WTE plant in Milano, 2007-09.
- Member of the Evaluation Committee of the WTE plant in Torino, Italy, 2007-10.
- President of the Scientific Committee for the realization of the WTE plant in Naples, Italy, 2009-10.
- Member of the Testing Committee of the WTE plant in Parma (2011-14).
- Scientific support to the test of the steam generators of the WTE plant in Acerra (Naples, Italy, 2014-16).
- President of the Testing Committee for the revamping of the WTE plant in Milano (since 2016).
- Technical expert for the verification of the emissions from the 800 MW Combined Cycle plant in Scandale (Calabria, Italy, since 2017).

PUBLICATIONS

- Over 150 papers published on national/international journals or presented at scientific congresses.

AWARDS

- Fulbright Fellowship Italy-USA (1985).
- 12-months fellowship CNR-NATO, Advanced Fellowship Program (1988/89 and 1990/91).
- Best Paper Award at 38° ASME Turbo-Expo, (Cincinnati, 1993) for paper 93-GT-223: Chiesa P., Consonni S., Lozza G. Macchi E., "Predicting the Ultimate Performance of Advanced Power Cycles Based on Very High Temperature Gas Turbine Engines"
- Best Paper Award at 42° ASME Turbo-Expo, (Orlando, 1997) for paper 97-GT-273: Consonni S., Larson E., Berglin N. "Black Liquor-Gasifier/Gas Turbine Cogeneration"
- Best Paper Award on Future Recovery at the 2007 International Chemical Recovery Conference (Quebec City, Canada, May 2007): Larson E., Consonni S., Katofsky R., Iisa K., Frederick W.J. "Gasification-based biorefining at kraft pulp and paper mills in the United States".
- Recipient (together with M. Gatti, D. Di Bona, E. Martelli and F. Viganò) of the *General Electric GHG Ecomagination Innovation Challenge* award on novel ways to target waste heat recovery in Canada's oil sands (Calgary, Canada, 2015).

INTERNATIONAL PATENTS

P1. European Patent WO2011089383 *Separation of Gases*, presented 21 Jan 2010, published 28 Jul 2011. Inventors Consonni S., Gatti M., Martelli E., Viganò F. Applicant: BP Alternative Energy. Phase-change process for the separation of CO_2 from syngas and similar gas mixtures.

P2. European Patent WO 2011095759 *Separation of Gases*, published 11 Aug 2011. Inventors: Bailey M. E.; Consonni S.; Forsyth J. A.; Gatti M.; Martelli E.; Moryi Y.; Ogura K.; Viganò F. Applicant: BP Alternative Energy. Hybrid process based on methanol-absorption and phase-change process for the separation of CO_2 and H_2S from syngas and similar gas mixtures.

NATIONAL PATENTS

P3. Italian patent application MI2012 A00382 *Improved Process for the Production of Cement Clinker and related Apparatus* (in Italian). Inventors Marchi M.I., Cinti G., Romano M.C., Campanari S., Consonni S. Co-owned by Italcementi SpA and Politecnico di Milano. Ca-looping process for CO_2 capture in cement production.

P4. Italian patent application MI2012 A00383 *Process and Improved Plant for the Production of Cement Clinker* (in Italian). Inventors Marchi M.I., Cinti G., Romano M.C., Campanari S., Consonni S. Co-owned by Italcementi SpA and Politecnico di Milano. Ca-looping process for CO_2 capture in cement production.

FIELDS OF ACTIVE RESEARCH

- technologies and processes for CO_2 capture
- technologies and processes for the recovery of energy from waste and residues
- production of electricity and cogeneration from biomass and non-conventional fuels
- gas turbines and combined cycles
- coproduction of synthetic fuels and electricity
- technologies, processes and strategies to mitigate the greenhouse effect
- simulation and optimization of cogeneration systems, with and without district heating

SELECTED PUBLICATIONS

1. Chiesa P., **Consonni S.**, Kreutz T., Williams R.H. (2005), "Co-production of hydrogen, electricity and CO_2 from coal with commercially ready technology. Part A: Performance and emissions. Part B: Economic analysis". International Journal of Hydrogen Energy, Vol. 30, Issue 7, pp. 747-784.
2. **Consonni S.**, Viganò F. (2005), "Decarbonized hydrogen and electricity from natural gas", International Journal of Hydrogen Energy, Vol. 30, Issue 7, pp. 701-718.
3. **Consonni S.**, Giugliano M., Grosso M. (2005), "Alternative strategies for energy recovery from Municipal Solid Waste. Part A: Mass and energy balances. Part B: Emission and cost estimates". Waste Management, Vol. 25, pp. 123-148.
4. **Consonni S.**, Larson, E.D., Katofsky R.E. (2009), "A gasification-based biorefinery for the pulp and paper industry", Chemical Engineering Research and Design, Vol. 87, pp. 1293-1317.
5. Larson E.D., Fiorese G., Liu G., Williams R.H., Kreutz T.G. and **Consonni S.** (2010), "Co-production of decarbonized synfuels and electricity from coal + biomass with CO_2 capture and storage: an Illinois case study", Energy & Environmental Science, 2010, Vol. 3, pp. 28-42.
6. Viganò F., **Consonni S.**, Grosso M., Rigamonti L. (2010), "Material and energy recovery from Automotive Shredded Residues (ASR) via sequential gasification and combustion", Waste Management, Vol. 30, pp. 145-153.
7. E. Martelli, T. Kreutz, M. Carbo, **S. Consonni**, D. Jansen (2011), "Shell coal IGCCs with carbon capture: conventional gas quench vs. innovative configurations". Applied Energy, Vol. 88, pp. 3978- 3989.
8. E. Martelli, E. Amaldi, **S. Consonni** (2011), "Numerical optimization of heat recovery steam cycles: Mathematical model, two-stage algorithm and applications", Computers & Chemical Engineering, Vol. 35, pp. 2799- 2823.
9. M. Mantovani, P. Chiesa, G. Valenti, M. Gatti, **S. Consonni** (2012), "Supercritical pressure–density–temperature measurements on CO_2-N_2, CO_2-O_2 and CO_2-Ar binary mixtures", The Journal of Supercritical Fluids, Vol. 61, pp. 34- 43
10. **S. Consonni**, F. Viganò (2012), "Waste gasification vs. conventional Waste-To-Energy: A comparative evaluation of two commercial technologies". Waste Management, Vol. 32, pp. 653- 666.
11. S.Cernuschi, M. Giugliano, S. Ozgen, **S. Consonn**i (2012), "Number concentration and chemical composition of ultrafine and nanoparticles from WTE (waste to energy) plants", Science of the Total Environment, Vol. 420, pp. 319- 326.
12. E. Martelli, T.G. Kreutz, M. Gatti, P. Chiesa, **S. Consonni** (2013). "Numerical optimization of steam cycles and steam generator design for coal to FT plants". Chemical Engineering Research & Design, Vol. 91, pp.

1467- 1482.
13. **S. Consonni** (2014), "Conversion: Power", in *What Science can Tell Us - Forest Bioenergy for Europe*, (ISBN 978-952-5980-10-3), P. Pelkonen at al. editors, par. 2.3, pp.47-51, Painotalo Seiska Oy.
14. M. Gatti, E. Martelli, F. Marechal, **S. Consonni** (2014). "Review, modeling, heat integration, and improved schemes of Rectisol®-based processes for CO_2 capture". Applied Thermal Engineering, vol. 70, p. 1123-1140.
15. **S. Consonni**, L. Lombardi, F. Viganò (2017), "Municipal Solid Waste to Energy Technology", in Abraham M.A. (Ed.), Encyclopedia of Sustainable Technologies, First Edition, Vol 3, pp. 389-401, Elsevier, ISBN 978-012-8046-77-7.

RECENT INVITED TALKS

- "Carbon Capture: Basic Concepts and Novel Technologies", to be given at Buzzi-Unicem Workshop on *Carbon Capture and Storage Technologies*, Casale Monferrato, Italy, 06 Oct 2017.
- "Carbon Capture & Storage for a tolerable climate change", at *Energy for a Carbon-Constrained World*, a public symposium in honor of Robert H. Williams, Princeton, US, 03 April 2017
- "From Incineration to Waste-to-Energy: evolution of energy recovery from waste" (in Italian), Workshop on *Waste Treatment* organized by the Italian Association of Chemical Engineering, Palermo, Italy, 30 Jan 2017.
- "Systems and Technologies for Energy Production from Biomass", post-graduate education program of the University of Naples Parthenope, Naples, Italy, 07 dec 2016.
- "Past, present and future of energy recovery from waste" (in Italian), at Symposium on waste treatment organized by the Association of Physicians of Florence, Florence, Italy, 25 nov 2016.
- "Thoughts on the estimation of national waste-to-energy capacity" (in Italian)" at *New frontiers for the recovery from waste*, Ecomondo 2016, Rimini, Italy, 10 nov 2016.
- "Integration of Ca-Looping Systems", at Conference organized by the European Cement Research Academy (ECRA) on *CO_2 capture an reuse in the cement industry: from the lab to the plant*, Univ of Mons, Belgium, 09 Nov 2016.
- "Waste Management Research in Italy", at the 2016 bi-annual meeting of the Global WTERT Council, Columbia University, New York, US, 07 Oct 2016.
- "Thoughts on Zero Waste", at meeting of the Scientific and Technical Advisory Committee (STAC) of the Confederation of European Waste-to-Energy Plants (CEWEP), Piacenza, Italy, 12 Apr 2016.
- "Processes and Technologies for Energy Recovery from Waste", at course on *Thermochemical Conversion of Biomass and Residues and Biorefineries*, Univ of Seville, Spain, 22 Oct 2015.
- "Mitigation of Greenhouse Gas Emissions", at *Impacts of Climate Change on Ecosystem Services*, Universities for Expo 2015, Milano, Italy, 23 Jun 2015.
- "Energy Recovery", at *Italy-China Innovation Forum*, China Day at Expo Milano 2015, Milano, Italy, 08 Jun 2015.
- "Comparative Evaluation of waste treatment technologies", at *Energy and Materials from Waste*, 3rd International VDI Conference 2015, Düsseldorf, Germany, 07 May 2015.
- "Evaluating the quality of energy recovery from waste", meeting of International Solid Waste Association (ISWA) Working Group on Energy Recovery, Vienna, Austria, 16 Apr 2015.
- "Calcium-Looping for CO_2 capture in cement plants", at Conference organized by the European Cement Research Academy (ECRA) on *From CO_2 to energy: CO_2 capture and reuse in the cement industry*, Univ of Mons, Belgium, 26 Nov 2014.
- "Energy Recovery from Waste: Combustion, Gasification, Pyrolysis" (in Italian), expert presentation to the Committee for the Environment, Senate of the Italian Republic, 24 Sep 2014.
- "Ultimate energy performances of grate combustor WtE plants", keynote talk at *WastEEng 2014*, Rio de Janeiro, Brasil, 28 Aug 2014.
- "An overview of waste-to-energy technologies: potentials and limitations (for energy production)", International Solid Waste Association (ISWA) 8th Beacon Conference, Malmo, Sweden, 28 Nov 2013.