



**POLITECNICO
MILANO 1863**

**DIPARTIMENTO
DI ENERGIA**

Summer School

Thermophysical properties of fluids for energy and CCS applications: modelling and measurement

23 - 27 June 2025

Politecnico di Milano - Department of Energy
Piacenza Campus



**Funded by
the European Union**



Encase

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Organizing Institution

Department of Energy, Politecnico di Milano

Course Director

Prof. Manuele Gatti, Department of Energy - Politecnico di Milano

Duration

Monday 23rd - Friday 27th June, 2025, from 9:00 a.m. to 5:30 p.m.

Location

Politecnico di Milano - Piacenza Campus

Via Scalabrini, 76, 29121, Piacenza (ITALY)

Classroom L (Caserma Neve)

Attendance

The Summer School will be held in person.

Registration fee

No registration fee required for PhD students enrolled at POLIMI.

Registration fee for all other participants: 100 €

VAT is not applicable to the registration fees due to art. 10 DPR 633/26.10.72 and subsequent modifications.

Registration includes lunches and coffee breaks for 5 days.

Staff

Specializing Master and Continuing Education office

Department of Energy, Politecnico di Milano.

External relations office, Piacenza Campus, Politecnico di Milano.

Contacts

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Target audience

The School is open to:

- PhD students
- Early-stage researches/engineers (upon availability of seats)

Required documents for the application:

- Identity Document or Passport
- PhD enrolment certificate
- Curriculum Vitae (1 page maximum)
- Short motivation letter

Selection process:

PhD students from POLIMI are automatically enrolled.

In case more than 40 PhD students apply, the application will be revised and confirmed by the organizing committee, giving priority to PhD students and, if needed, assessing the coherence of the research activities with the topics of the Course and the motivation letter.

Summer School Contents

In the framework of the Horizon Europe project ENCASE Our partners - ENCASE, PoliMI organizes the 1st Summer School on “Thermophysical properties of fluids for energy and CCS applications: modelling and measurement” which will cover both advanced numerical tools (Equations of State models, properties correlations, etc.) and measurement methods and standards for the characterization of thermophysical properties of fluids relevant to the low carbon energy field such as:

- CO₂-based mixtures relevant to CO₂ capture, transportation and storage (ENCASE topic)
- Solvents for CO₂ capture
- New generation refrigerants (pure fluids and mixtures)
- Working fluids for advanced thermodynamic cycles
- Fluids for energy storage applications

Training format

Lectures will be offered by Italian and international professors and researchers expert of thermodynamic properties modelling and measurement, as well as industry experts. Q&A and discussion session will conclude each seminar.

Language

English.

ECTS/CFU credits and exam mode

Attendance at the Summer School allows the acquisition of 5 ECTS credits, recognized upon the exam completion (for PoliMi PhD students). The exam consist in a short review paper or a numerical model application to a case study of interest to the PhD student (topic and deadline to be agreed with the teacher) and it is part of the PhD program in Energy and Nuclear Science and Technology.

Certificate of attendance

At the end of the Summer School, the participants will receive a certificate of attendance, provided that they have attended at least 70% of the lectures.

Lecturers

Dr. Monika Thol | Ruhr University Bochum, Germany

Dr. Laura Fedele | National Research Council (CNR), Italy

Dr. Gabriele Chinello | TÜV-SÜD National Engineering Laboratory, Scotland

Dr. Carlo De Servi | Delft University of Technology, The Netherlands

Prof. Ferruccio Doghieri | University of Bologna, Italy

Prof. Manuele Gatti | Politecnico di Milano, Italy

Dr. Andreas Jaeger | Technical University Dresden, Germany

Prof. Jean-Noël Jaubert | University of Lorraine, France

Prof. Georgios Kontogeorgis | Technical University of Denmark, Denmark

Dr. Eric Lemmon | National Institute of Standards and Technology, USA

Dr. Davide Menegazzo | National Research Council (CNR), Italy

Prof. Luca Molinaroli | Politecnico di Milano, Italy

Prof. Christophe Proust | University of Technology of Compiègne, France

Eng. Stefano Signorini | LEAP s.c.a.r.l., Italy

Prof. Roland Span | Ruhr University Bochum, Germany

Dr. Morten Tjelta | Institute for Energy Technology (IFE), Norway

Prof. Martin Trusler | Imperial College London, United Kingdom

Prof. Thijs J.H. Vlugt | Delft University of Technology, The Netherlands

Lecturers

Dr. Monika Thol | Ruhr University Bochum, Germany



Dr.-Ing. Monika Thol is Academic Council and head of the "Accurate Modeling of Thermophysical Property Data" group at Ruhr-University Bochum. She holds a PhD in Thermodynamics and has conducted multiple research stays in the USA. Her work focuses on modeling thermophysical properties, with over 130 scientific publications. She actively supervises early-career researchers and has received several academic awards.

Dr. Laura Fedele | National Research Council (CNR), Italy



Laura Fedele is a researcher focused on technological solutions for decarbonization in refrigeration and construction. Her work includes low-impact refrigerants, energy-efficient materials, and thermal energy storage. She holds a degree in Chemical Engineering and a PhD in Technical Physics. She leads the ITC Padua branch and coordinates the EU project HE ECHO. In 2023, she received the IIR Women in Refrigeration Award and has published over 200 scientific works.

Dr. Gabriele Chinello | TÜV-SÜD National Engineering Laboratory, Scotland



Dr. Gabriele Chinello is Head of CCUS at TÜV-SÜD Northern Europe, overseeing R&D and consultancy projects. He contributes to the development of UK CO₂ flow measurement test facilities and advises the UK Government on CCUS metering. He served as metering technical assessor for the UK's Track-1 CCUS clusters. Gabriele is also an external advisor to the Department for Energy Security and Net Zero (DESNZ).

Dr. Carlo De Servi | Delft University of Technology, The Netherlands



Dr. Carlo De Servi is a senior researcher at TU Delft and VITO, a Belgian research center focused on sustainable technologies. He studied at Politecnico di Milano where he earned his PhD in Energy Systems in 2014. His professional experience revolves around propulsion and power technologies and CFD-based design methods for compact heat exchangers.

Lecturers

Prof. Ferruccio Doghieri | University of Bologna, Italy



Dr. Doghieri is a full professor at the University of Bologna, where he served as Director of Studies and Department Head in Chemical Engineering. Dr. Doghieri was visiting professor at the University of Minnesota in Minneapolis, at the Technical University of Dortmund and the Columbia University in New York City. His main research interest refers to thermodynamic and mass transport properties in polymeric materials.

Prof. Manuele Gatti | Politecnico di Milano, Italy



Manuele Gatti is Associate Professor of Energy Systems at Politecnico di Milano. His research focuses on thermophysical property modeling, CO₂ capture technologies, advanced thermodynamic cycles, and decarbonization. He is principal investigator for POLIMI in Horizon Europe projects related to CCUS and fluid properties. He also leads several research collaborations with energy industry partners.

Dr. Andreas Jaeger | Technical University Dresden, Germany



Andreas Jäger earned his PhD in 2015 from Ruhr University Bochum, focusing on gas hydrate modeling and accurate equations of state. He continued as a postdoctoral researcher at TU Dresden, working on predictive mixture models for energy and refrigeration processes. Since 2022, he has led the Thermal Power Machinery and Plants group at TU Dresden. His research centers on thermodynamic modeling and applications in energy engineering.

Prof. Jean-Noël Jaubert | University of Lorraine, France



Jean-Noël Jaubert is a Professor of Chemical Engineering Thermodynamics at ENSIC, one of France's prestigious Grandes Écoles. He leads the "Kinetics, Thermodynamics and Energy" department at LRGP and chairs the French working party on thermodynamics. He represents France in the EFCE's working party on thermodynamics and transport properties. His research focuses on equations of state, phase equilibria, entropy scaling, and fluid selection for energy systems.

Prof. Georgios Kontogeorgis | Technical University of Denmark, Denmark



Georgios M. Kontogeorgis is Professor of Applied Thermodynamics at DTU and leads the KT-Consortium. He has authored over 370 peer-reviewed articles and four books, and supervised more than 60 PhD and postdoctoral researchers. He served as chairman of CERE-DTU for six years. His awards include the ERC Advanced Grant, EFCE Excellence Award, and the Knight's Cross of the Order of Dannebrog.

Lecturers

Dr. Eric Lemmon | National Institute of Standards and Technology, USA



Dr. Lemmon is a scientist at NIST and the principal author of REFPROP, NIST's best-selling software for thermophysical properties. He holds a PhD in Mechanical Engineering from the University of Idaho. His research focuses on developing equations of state for pure fluids and mixtures, including refrigerants and cryogenes. He has created software tools for industrial applications and has chaired several committees in natural gas associations for over 20 years.

Prof. Luca Molinaroli | Politecnico di Milano, Italy



Luca Molinaroli (M.Sc. in Mechanical Engineering; Ph.D. in Energy Engineering, both from Politecnico di Milano) is currently an Associate Professor at the Dipartimento di Energia, Politecnico di Milano. His research activities focus on vapour compression heat pumps, with particular emphasis on the use of carbon dioxide–hydrocarbon blends as working fluids and on the development of fault detection and diagnosis methodologies for these systems.

Prof. Christophe Proust | University of Technology of Compiègne, France



Christophe Proust is a Professor at the University of Technology of Compiègne, where he developed courses on general safety, process safety, and major risks. He leads the EPICE team (Environmental Protection in Chemical Engineering) and is also a Research Manager at INERIS, focusing on industrial safety. He graduated as a Chemical Engineer from INSA and later earned a MSc in mechanics, a PhD, an MBA, and a DSc in industrial safety.

Eng. Stefano Signorini | LEAP s.c.a.r.l., Italy



Environmental Engineer, graduated from Politecnico di Milano in April 2009, with more than 15 years of professional experience within Energy and Environmental Engineering sector as LEAP's researcher involved in experimental activities concerning Emissions & Air Quality, Thermal Energy Generation and Low Carbon Technologies (CCS).



Lecturers

Prof. Roland Span | Ruhr University Bochum, Germany



Prof. Roland Span is Chair of Thermodynamics at Ruhr-University Bochum. He developed the reference equation of state for CO₂ and has published extensively on thermodynamic properties and energy technologies. He received several awards, including the ERC Advanced Grant (2022) and an honorary doctorate from NTNU (2023). He serves on multiple scientific boards and coordinates CO₂ transport activities within the European Energy Research Alliance

Dr. Morten Tjelta | Institute for Energy Technology (IFE), Norway



Dr. Morten Tjelta holds a PhD in (photo)electrochemistry from NTNU. Since 2013, he has worked at IFE, first as a postdoc and now as a research scientist. He is part of the corrosion department, focusing on corrosion and scaling in various industries. His expertise includes H₂S corrosion in oil & gas pipelines, geothermal energy, alkaline water electrolyzers, and CO₂ transport.

Prof. Martin Trusler | Imperial College London, United Kingdom



Martin Trusler is Professor of Thermophysics at Imperial College London. His research focuses on thermophysical properties and phase behaviour of fluids under extreme conditions, with applications in energy, CCS, and hydrogen. He has published over 250 papers and supervised 35 PhDs. He received the Guggenheim Medal in 2016 and is a Fellow of the RSC. He is also Co-Director of the Digital Rocks research programme

Prof. Thijs J.H. Vlugt | Delft University of Technology, The Netherlands



Thijs J.H. Vlugt did his PhD at the University of Amsterdam in 2000. After postdoctoral periods in Mainz (Germany) and Leiden (The Netherlands) he became assistant professor at Utrecht University in 2003. In 2007 he moved to Delft University of Technology as Associate Professor, and he became full professor and Chair of the Engineering Thermodynamics section in 2010. He has supervised over 35 PhD students and has over 350 scientific publications.



SUMMER SCHOOL AGENDA

23-27 JUNE 2025

Piacenza Campus

Dept. of Energy - Politecnico di Milano

TIMESLOT	MONDAY 23 JUNE	TUESDAY 24 JUNE	WEDNESDAY 25 JUNE
09:00 - 10:00	Manuele Gatti Thermodynamic models for process simulation: state of the art, requirements and trends (start at 09:30)	Jean-Noël Jaubert The state of the Cubic EOS: theory and mixing rules, evolution and applications	Martin Trusler Thermophysical Properties and Phase Behavior of Fluids involved in geological CO ₂ Storage, as part of the CCS chain
10:00 - 11:00	Manuele Gatti Thermodynamic models for process simulation: state of the art, requirements and trends	Jean-Noël Jaubert The state of the Cubic EOS: theory and mixing rules, evolution and applications <i>(Applicative session)</i>	Martin Trusler Thermophysical Properties and Phase Behavior of Fluids involved in geological CO ₂ Storage, as part of the CCS chain
Coffee Break & Logo and Activities Presentation "<u>Associazione La Matita Parlante</u>" (23rd June)			
11:30 - 12:30	Carlo De Servi Computer-Aided Cycle and Working fluid optimisation in power cycles	Monika Thol How to calculate transport properties of fluids and mixtures? An application of the TREND software <i>(Applicative session)</i>	Eric Lemmon REFPROP software demonstration <i>(Applicative session)</i>
Lunch			
14:00 - 15:00	Carlo De Servi Computer-Aided Cycle and Working fluid optimisation in power cycles <i>(Applicative session)</i>	Eric Lemmon Past, present and future of High-Accuracy Equations of State combining Art and Science	L. Fedele & D. Menegazzo State of the art techniques and methods for measuring the thermophysical properties of new pure refrigerants and mixtures
15:00 - 16:00	Ferruccio Daghieri Statistical Associating Fluid Theory (SAFT) for the computation of thermodynamic properties of fluid mixtures: the most relevant developments and applications	Eric Lemmon Past, present and future of High-Accuracy Equations of State combining Art and Science	Georgios Kontogeorgis Electrolyte thermodynamic models with potential applications to CCS
Coffee Break			
16:30 - 17:30	Monika Thol How to calculate transport properties of fluids and mixtures?	Andreas Jaeger Influence of the Equation of State on the Design of Advanced Power and Refrigeration Cycles	Georgios Kontogeorgis Electrolyte thermodynamic models with potential applications to CCS
SOCIAL EVENT TUEASDAY 24 JUNE H. 21:30 Evening Concert offered by Campus Cultura with free entrance (Politecnico di Milano - Piacenza - Campus Arata)			

SUMMER SCHOOL AGENDA

23-27 JUNE 2025
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Dept. of Energy - Politecnico di Milano

TIMESLOT	THURSDAY 26 JUNE	FRIDAY 27 JUNE
09:00 - 10:00	Gabriele Chinello The relevance of high accuracy thermophysical properties data in CCUS: an overview on flowmetering aspects	Roland Span Multiparameter EOS: theory and applications, history, recent trends and future challenges
10:00 - 11:00	Gabriele Chinello The relevance of high accuracy thermophysical properties data in hydrogen: an overview on flowmetering aspects	Roland Span Multiparameter EOS: theory and applications, history, recent trends and future challenges
<i>Coffee Break</i>		
11:30 - 12:30	Stefano Signorini Measuring density, VLE and heat capacities of CO ₂ -based mixtures	Christophe Proust Modelling phase equilibria with solids: how to extend from VLE to SVLE models
<i>Lunch</i>		
14:00 - 15:00	Thijs J.H. Vlugt Molecular simulation for predicting the thermophysical properties of fluids	Morten Tjelta The relevance of thermophysical properties of CO ₂ mixtures for assessing acid reactions and corrosivity
15:00 - 16:00	Thijs J.H. Vlugt Molecular simulation for predicting the thermophysical properties of fluids (<i>Applicative session</i>)	Manuele Gatti Wrap-up session interactive discussion, main highlights and takeaways from the school
<i>Coffee Break</i>		
16:30 - 17:30	L. Molinaroli The search for new and optimal refrigerants for low and high temperature heat pumps: methods and applications	

Contacts

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