

ICEGC
2025



The 4th International Conference on Energy and Green Computing

Hybrid Conference

ICEGC'2025

December 04-05, 2025
ENSET - Mohammedia, Morocco

TECHNICAL PROGRAM



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Preface

The 4th International Conference on Energy and Green Computing (ICEGC'2025) is organized by ENSET of Mohammeda, Hassan II University of Casablanca, Morocco, in collaboration with the Electrical Engineering and Intelligent Systems laboratory (LIESI). The ICEGC'2025 is Technically Supported by the EDP Sciences.

ICEGC'2025 focusing on the latest researches, developments, advances and new technologies in the fields of Energy Engineering, Engineering Technologies, Renewable Energy, IT Energy-aware Technologies, Green ICT Systems and Green Computing.

We work very hard to ensure high standards and quality of keynotes, panels, presentations and discussions. We aim to deliver the benefits to attendees that you have come to expect of our conference, and we look forward to meet you in person or joining you virtually at ICEGC2025 from 04 to 05 December 2025.

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KEYNOTE SPEAKERS

Amin BENNOUNA**Cadi Ayyad University****Morocco****Keynote Title****The impact of penetration of battery electric vehicles on energy and electricity needs by 2050 in Morocco**sindibad@uca.ac.ma

Dr. Amin BENNOUNA Born in Tetouan (Morocco) on 1956, twice father and six times grandfather, Amin BENNOUNA taught Physics from 1980 to 2022, won a Moroccan National Research Prize Distinction in 2009, led two energy companies (1996-2005 and 1999-2018) and held several positions in the Moroccan Solar Industry Association from 1996 until 2016. He led an 'Innoproject' solar energy research carried by all the Moroccan Universities with IRESEN funds (2014-2018) after having managed two multilateral European 'Medcampus' projects with EU funds (1990-1994). He signed more than 300 articles, conference communications, technical reports and other documents among which an energy scenario for Morocco'2030 (2007). He is presently updating his "Monograph of energy in Morocco" (first paper edition in 2011).

ABSTRACT

This summarizes the approach and main results of a study aimed at estimating the evolution of energy needs, including electricity, for Morocco in 2050 in a "business-as-usual" economy, first without, then with the massive but gradual introduction of battery electric vehicles. The French version was published on August 13, 2025 (<https://DOI.ORG/10.13140/RG.2.2.17320.28166>).

1- The foundations of a 'major trend' in energy and electricity in Morocco

- 1-1- GDP projections using GDP growth in constant Dirhams per capita
- 1-2- Energy projections using its correlation with GDP in constant Dirhams
- 1-3- Electricity projections using its correlation with GDP in constant Dirhams
- 1-4- Land fuel projections using its correlation with GDP in constant Dh
- 1-5- Future electricity requirements for battery electric vehicles
- 1-6- Conversion chains for internal combustion and battery electric vehicles

The energy involved in this conversion chain is calculated "in reverse" and shows that, for the same 299 kWh "at the wheel," the BEV must be supplied with 411 kWh of electricity instead of 1,000 kWh for diesel.

2- Replacement of all land-based fuels with distributed electricity

The electrical energy required for an BEV is 2.43 times less than the fuel energy for an ICEV (1,000 / 411), a ratio resulting from the higher efficiency of the BEV conversion chain

- 2-1- Scenarios for the gradual replacement of internal combustion engine vehicles (ICEVs)

We will approximate that distributed electricity is equivalent to the total deliveries of ONEE. To replace the fossil fuels of ICEVs with electricity for BEVs, three scenarios labeled A (early), B (intermediate), and C (late) are characterized by three logistic functions:

- Described by the same 5-year "rise front," a value chosen so that BEV penetration is slower than in France (≈ 3 years) due to the absence of subsidies,
- Centered on 2040, 2045, and 2050, chosen so that half of the substitution takes place 5 years after the year in which the EU stops sales of ICEVs, then 5 years later, and again 5 years later.

- 2-2- Impact of the three ICEV substitution scenarios on ONEE's total deliveries

- 2-3- Impact of the three ICEV substitution scenarios on net electricity demand

Year	Net elec., No BEC (GWh)	Net elec., Scen. C (GWh)	Net elec., Scen. B (GWh)	Net elec., Scen. A (GWh)
2025	49'884	50'187	50'698	52'029
2030	64'890	65'876	67'490	71'426
2035	84'057	87'190	91'933	101'826
2040	108'440	117'879	129'737	148'034
2045	139'206	164'591	186'400	208'209
2050	178'133	234'176	260'075	276'858

- 2-4- Impact of the three VMCIIP replacement scenarios on maximum power output

Year	Max Power, No BEC (MW)	Max Power, Scen. C (MW)	Max Power, Scen. B (MW)	Max Power, Scen. A (MW)
2025	8'163	8'212	8'294	8'508
2030	10'372	10'526	10'779	11'393
2035	13'109	13'584	14'302	15'793
2040	16'477	17'860	19'586	22'224
2045	20'573	24'141	27'160	30'137
2050	25'552	33'034	36'401	38'553

3- Future electricity requirements for battery electric vehicles

- 3-1- Energy consumption with the three BEV scenarios
- 3-2- Segmentation of electrical/non-electrical energy with the three BEV scenarios

Mohammed TARBOUCHI**Royal Military College, Ontario****Canada****Keynote Title****Comparison of metaheuristics for the problem of electric vehicle optimal charging and discharging in a smart parking lot**

Prof. **Mohammed Tarbouchi** received M.Sc. and Ph.D. degrees in electrical engineering from Laval University, Quebec, Canada in 1993 and 1997, respectively. In September 1997 he joined the Department of Electrical and Computer Engineering at the Royal Military College of Canada where he is currently Professor. His current research interests include power systems, analysis and control of electrical machines, variable speed drives, and real-time applications.

Rachid SAADANE**EHTP Casablanca****Morocco****Keynote Title****Toward 6G Networks: Vision, Enabling Technologies, Key Challenges, and Future Research Directions**

Prof. **Rachid Saadane** holds a B.Sc. (2001) and an M.S. (2003) from Mohammed V University, as well as a Ph.D. (2007) from the University of Mohamed V in collaboration with the Eurecom Institute, a graduate school and research center in digital science. He is currently a full professor in the Department of Electrical Engineering at the Hassania School of Public Works (HSPW or EHTP). From March 2003 to July 2006, he worked at the Eurecom Institute in France as a research engineer, focusing on the development of a framework for Radio Frequency channel modeling.

His research interests encompass a wide range of areas, including Wireless Communications, Big Data, Software Engineering, Signal and Image Processing and applications, Smart Cities and applications, IoT, IIoT, Society 5.0, Artificial Intelligence, Smart and Precise Agriculture, Green Hydrogen, Artificial Intelligence and Economy, and Wireless Sensor Networks. He is also a 5G ICT instructor, contributing to the advancement of modern communication technologies. In addition, he has made significant contributions to the reliability of UWB Communication Systems and has expanded his research to include renewable energies and their applications in sustainable technologies.

Rachid Saadane was honored with the SCA'19 Award for the best paper at the Smart Cities Applications Conference in 2019. He has authored and co-authored over 200 publications and completed over 500 verified peer reviews, reflecting his active involvement in academia, as evidenced by his profile on Web of Science. He also serves as the Head of the LaGeS laboratory at HSPW, a position he has held since 2018. Currently, he is the Deputy Director in charge of research, cooperation, and partnerships at HSPW, where he continues to drive innovation in renewable energy systems and their applications across various sectors.

Souad TAYANE**FST Mohammedia**
Morocco**Keynote Title****Programmable matter, towards a new generation of intelligent systems**

Souad Tayane is a professor at the Faculty of Science and Technology of Mohammedia. Her work lies at the intersection of chemistry, computer science, and mechatronics, with a strong emphasis on the development of intelligent materials and systems derived from programmable matter. A former researcher at the Louis Pasteur University in Strasbourg, she has oriented her scientific activity toward the design of active materials capable of integrating reactivity, adaptation, and programmability. Her research has led to several patents filed in Morocco, France, and the United States. These innovations include controlled-deformation devices, programmable systems dedicated to 4D rapid prototyping, as well as high-performance bio-based composite materials derived from agricultural co-products and applied to the building, environmental, and energy sectors. Alongside her research activities, Souad Tayane is actively involved in promoting innovation and entrepreneurship. She is a certified trainer of trainers in entrepreneurship accredited by the International Labour Organization (ILO), and has been supporting project holders, students, educators, and young researchers for several years in the creation, maturation, and valorization of technological solutions. She also contributes to strengthening the university entrepreneurial ecosystem through incubation programs, mentorship, and training in creativity, design thinking, and technology transfer.

ABSTRACT

Programmable matter is emerging as a transformative paradigm in which materials are designed to actively modify their shape, properties, and functions in response to physical, chemical, or digital stimuli. Positioned at the intersection of materials science, computer science, and mechatronics, this field enables adaptive architectures capable of perception, actuation, and real-time reconfiguration.

The presentation explores how advances in soft deformable structures, distributed actuation mechanisms, articulated intelligent geometries, and multi-scale material architectures are reshaping the boundaries of material capabilities. Beyond classical design, programmable matter introduces the idea of embedded behavior—materials that can be “informed,” trained, or guided to adopt multiple functional states. Several patented innovations will be highlighted, including bio-inspired multifunctional materials, intelligent energy systems, programmable hydrogels, and hydrogen storage devices operating under mild conditions, demonstrating the rapid maturation of this field.

This synthesis shows how programmable matter is becoming a new multidisciplinary technological paradigm, where chemistry structures reactivity, computer science orchestrates behavior, and mechatronics enables action. It is matter that senses, learns, and evolves a new generation of intelligent systems capable of adapting to tomorrow's needs

Conference Program

Thursday 04 th					
8h ³⁰ –9h	Reception and registration				
9h – 9h ⁴⁰	Opening Ceremony				
9h ⁴⁰ – 10h ²⁰	Keynote 1				
	Impact of battery electric vehicles penetration on energy needs in Morocco by 2050 Prof. Amin BENNOUNA Cadi Ayyad University- Morocco				
	Plenary session Chairs: Prof. Hasna NHAILA ENSET-Mohammedia-UH2 Prof. Naoual SEMLALI EMI-Rabat-UM5				
10h ²⁰ – 10h ⁵⁰	Break				
10h ⁵⁰ – 12h ⁵⁰	Session 1	Session 2	Session 3	Session 4	Session 5
	Session Chairs Pr. Mohammed QBADOU ENSET-Mohammedia- UH2 Pr. Hasna NHAILA ENSET-Mohammedia- UH2 Pr. Soufiane HAMIDA ENSET-Mohammedia- UH2	Session Chairs Pr. Karim CHOUKRI ENSET-Mohammedia- UH2 Pr. Abdelmounime EL MAGRI ENSET-Mohammedia- UH2 Pr. Asmae OUHMIDA ENSET-Mohammedia- UH2	Session Chairs Pr. Abdesslam AIT MADI ENSA-Kenitra-UIT Pr. Elhadi BAGHAZ FS-El Jadida-UCD Pr. Anass SAKIM ENSAM - Casablanca-UH2	Session Chairs Pr. Rachid LAJOUAD ENSET-Mohammedia- UH2 Pr. Abdellah AILANE ENSA-Khouribga-USMS Pr. Abdelouahed BELLAT ENSAM-Rabat – UM5	Session Chairs Pr. El Ayachi CHATER EST-Salé-UM5 Pr. Karim ELMEZDI ENSET-Mohammedia- UH2 Pr. Achraf BENBA ENSAM-Rabat – UM5
12h ⁵⁰ – 15h	Break				
15h – 15h ⁴⁰	Keynote 2				
	Comparison of metaheuristics for the problem of electric vehicle optimal charging and discharging in a smart parking lot Prof. Mohammed TARBOUCHI Royal Military College, Ontario - Canada				
	Plenary session Chairs: Prof. Mohammed QBADOU ENSET-Mohammedia-UH2 Pr. El Ayachi CHATER EST-Salé-UM5				
15h ⁴⁰ -16h	Break				
16h – 18h	Session 6	Session 7	Session 8	Session 9	Session 10
	Session Chairs Pr. Naoual SEMLALI EMI-Rabat-UM5 Pr. El Ayachi CHATER EST-Salé-UM5 Pr. Abderrazak AMMAR ENSET-Mohammedia-UH2	Session Chairs Pr. Sara SANDABAD ISEM - Casablanca Pr. Nadia MOUHIB ISEM - Casablanca Pr. Houssam Eddine CHAKIR ENSET-Mohammedia- UH2	Session Chairs Pr. Bouchaib CHERRADI CRMEF-El Jadida-UCD Pr. Mohamed KISSAOUI ENSET-Mohammedia-UH2 Pr. Souad AHRIZ ENSET-Mohammedia-UH2	Session Chairs Pr. Lhoussine BAHATTI ENSET-Mohammedia-UH2 Pr. Hamza SABIR ENSET-Mohammedia-UH2 Pr. SAKIM ANASS ENSAM - Casablanca-UH2	Session Chairs Pr. Abdessamad DIDI HIHS - Settat - UHP Pr. Abdellah ZAMMA ENSET-Mohammedia-UH2 Pr. Mohammed Hicham ZAGGAR ENSET-Mohammedia-UH2

Conference Program

Friday 05th

Keynote 3

Programmable matter, towards a new generation of intelligent systems

Prof. Souad TAYANE

FST Mohammedia – Morocco

Plenary session Chairs :

Prof. Abdelhadi RAIHANI
ENSET-Mohammedia-UH2

Prof. Abdesslam AIT MADI
ENSA-Kenitra-UIT

9h⁰⁰ – 9h⁴⁰

Break

9h⁴⁰ – 10h

Session 11

Session 12

Session 13

Session 14

Session 15

10h – 12h

Session Chairs

Pr. Abdelkabar BACHA
ISEM - Casablanca
Pr. Asmae OUHMIDA
ENSET-Mohammedia-UH2
Pr. Hasna NHAILA
ENSET-Mohammedia- UH2

Session Chairs

Pr. Souad TAYANE
FST-Mohammedia-UH2
Pr. Lahcen AMHAIMER
ENSAD-Mohammedia - UH2
Pr. Naoual LOUAGGADIA
ENSET-Mohammedia-UH2

Session Chairs

Pr. Laidi ZAHIRI
ENSET-Mohammedia-UH2
Pr. Mohamed RAFIK
ENSET-Mohammedia-UH2
Pr. Abdeslam LACHHAB
EST-Meknes - UMI

Session Chairs

Pr. Salah NISSABOURI
ENSET-Mohammedia-UH2
Pr. Ahmed BABAHAMMOU
ENSET-Mohammedia-UH2
Pr. Zakaria MIGHOUAR
ENSET-Mohammedia-UH2

Session Chairs

Pr. Azeddine KHIAT
ENSET-Mohammedia-UH2
Pr. Zakaria NAIMANI
ENSET-Mohammedia-UH2
Pr. Mohamed GUERBAOUI
EST-Meknes - UMI

12h – 15h

Break

Keynote 4

Toward 6G Networks: Vision, Enabling Technologies, Key Challenges, and Future Research Directions

Prof. Rachid SAADANE

EHTP Casablanca – Morocco

Plenary session Chairs :

Prof. El Ayachi CHATER
EST-Salé-UM5

Prof. Naoual SEMLALI
EMI-Rabat-UM5

15h – 16h

Session 16

Session 17

Session 18

Session 19

Session 20

16h – 18h

Session Chairs

Pr. Soufiane HAMIDA
ENSET-Mohammedia-UH2
Pr. Hamza SABIR
FST-Mohammedia-UH2
Pr. Mohamed CHARQI
FSDM-Fez-USMBA

Session Chairs

Pr. El Hassan ACHOUYAB
ENSET-Mohammedia-UH2
Pr. Nezha BENMOUSSA
ENSET-Mohammedia-UH2
Pr. Bensalem BOUKILI
FSDM-Fez-USMBA

Session Chairs

Pr. Ahmed REBBANI
ENSET-Mohammedia-UH2
Pr. Adil MANSOURI
ENSET-Mohammedia-UH2
Pr. Abdelghani EL OUGLI
FSDM-Fez-USMBA

Session Chairs

Pr. EL Hassan SAMRI
ENSET-Mohammedia-UH2
Pr. Soufiane EL OUARDI
ENSET-Mohammedia-UH2
Pr. Zakaria MIGHOUAR
ENSET-Mohammedia-UH2

Session Chairs

Pr. Abdelmajid BOUSSELHAM
ENSET-Mohammedia-UH2
Pr. Bouchra BOUIHI
ENSET-Mohammedia-UH2
Pr. Noredine CHAIBI
FSDM-Fez-USMBA

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Closing Ceremony

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- 131** Yassine Benkirane, Asmae Ouhmida, Abdelhadi Raihani and Bachir Benhala
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- 133** Adil El Arfaoui, Hasna Nhaila, Mohamed El Khaili and Ismail Essamlali
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- 135** Mohammed Amine Rhondali, Abdelmounime El Magri, Ilyass El Myasse and Lhoussain Bahatti
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- 125** Souad Tayane, Jaafar Gaber, Lotfi M'Hamdi, Bochra Bejaoui and Naceur M'Hamdi
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- 59** Amal Lamarti, Abdelilah Hachim, Jamila Bouchgl, Sara Sandabad, Khadija Ouaisa and Khalid El Had
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- 224** Manjulata Bhoi and Priya Vij
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- 90** Anwar Hasni, Hassan El Fadil, Abdellah Lassioui, Yassine El Asri, Marouane El Ancary and Mohamed Mouyane
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- 240** Mangoné Fall, Bathie Pouye, Ibrahima Gueye and Idy Diop
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- 35** Badr Salhi, Azeddine Mouhsen and Abdelhadi Radouane
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- 36** Semou Ndiaye, Idy Diop and Saidou Talla
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200 Mohammed Drissi, Mohammed Kaddouhi, Ahmed Mazouji, Othmane Horma, Ouassila Salhi and Ahmed Mezrhab
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- 112** Tarik El Moudden, Meriem Tahrib, Bahaa Eddine Elbaghazaoui and Mohamed Amnai
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- 249** Fatima Zahra Saaidi, Abderrahim Boulanouar, Yves Géraud and Abdelaali Rahmouni
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- 172** Ahmed Mazouji, Mohammed Drissi, Othmane Horma, Mohammed Kaddouhi, Mohammed Amine Moussaoui and Ahmed Mezrhab
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- 196** Mohammed Kaddouhi, Mohammed Drissi, Othmane Horma, Ahmed Mazouji and Ahmed Mezrhab
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- 214** Abdellatif Assaghir, Abdellah Mir and Younes Achaoui
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- 245** Amina Lagssai, Abderrahim Boulanouar, Omar Abounachit, Yves Géraud and Abdelaali Rahmouni
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- 248** Rachid el Jemli, Nisrine Hanchi, Radouane Elbahjaoui and Hamza Faraji
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Friday 05th

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15h³⁰
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