



Professor Dr. Jamal Mahmoud Nazzal

PhD, MSc, BSc

Personal Details

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| DoB: | 29/03/1961 | Nationality: | Jordanian |
| Email: | pacenazzal@gmail.com | Residence: | Saudi Arabia |
| Contact: | +966 569924493 | | Amman-Jordan |
| | +962 795261490 | Marital Status: | Married with 4 children |

Field of Specialty & Research

- 1) Fuel & Energy Conversion.
- 2) Alternative & Renewable Source of Energy.
- 3) Instrumentation & Analytical Science,

Academic Degrees

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| 1996 UK | <i>PhD, Fuel & Energy.</i> <i>(Mechanical Engineering) College of Engineering, Leeds University, UK.</i> <u>PhD Thesis:</u> <i>Influence of Process conditions on the products derived from the pyrolysis of Oil Shale.</i> |
| 1993 UK | <i>MSc, Instrumentation & Analytical Science.</i> <i>(Engineering of Environmental Measurements); University of Manchester Institute of Science & Technology, UMIST, College of Technology, UK.</i> <u>MSc. Thesis:</u> <i>Adsorptive Stripping Differential-Pulse Voltammetry of Cadmium, Copper & Lead in the presence of Surfactants.</i> |
| 1987 Jordan | <i>BSc, Mechanical Engineering.</i> <i>Yarmouk University, Jordan.</i> <u>BSc. Project:</u> <i>Jordan Oil Shale & a recommended design of Internal Combustion Engine using Solid Fuels.</i> |

Work Experience

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| | <p>Current Job: Fahad Ben Sultan University, Tabuk, KSA. 1) Professor, Mechanical Engineering Department, College of Engineering.</p> <p>Alasala Colleges, Damam, KSA 1) Founder and Head of Mechanical and Electrical Engineering Departments (2017-2018). 2) Head of Mechanical Engineering Department (2017- till now) 3) Participating in the following committees: a) Supervisor of the Development and Quality Assurance activities, (2017-2018). b) Chairman of the Evidence and developments file, (2017-2018). c) The general coordinator of the College of Engineering, (2017-2018). d) Head of the Laboratories and general supplies committee. e) Head of the Training Committee. f) Chairman of the Research Committee. g) Chairman of the Steering Committee -4 (Research & Innovation STD 7 and Community Partnership STD 8). 2019 – till now.</p> |
| <p>Oct. 2017– Sep. 2020</p> | <p>Shaqra University, Saudi Arabia Adviser in the office of his Excellency the University Rector (Rector’s Advisor).</p> |
| <p>Sept. 2013- Sept. 2017</p> | <p>Shaqra University, Saudi Arabia Founder and Head of Mechanical Engineering Department, and participated in the following committees: 1. <i>Funding Commission for Research Projects, Programs and Chairs; (Member).</i> 2. <i>Editorial Board, Shaqra University Journal of Applied Sciences; (Member).</i> 3. <i>Internal Audit Committee of Programs & Courses; (Member).</i> 4. <i>Processing and Operation Committee of the College of Engineering Labs (Chairman).</i> 5. <i>Authoring and output committee, International Conference on Higher Education 2012, Riyadh International Convention & Exhibition Centre; (Member).</i> 6. <i>Coordinator in the Scientific Research Conferences of Higher Education Students, Ministry of Higher Education, 2012 - 2015, KSA.</i> 7. <i>Academic Programs, study plans and quality control Committee; (Member).</i> 8. <i>Studies, Consultations, scientific research and community service Committee; (Member).</i></p> |
| <p>2011</p> | <p>Jordan Cooperation Group, Jordan Head of Department of Consultation, Studies, Educational Services and Training. Duties summarized in the following activities:</p> |

1. *Academy feasibility studies for new universities, colleges and academic programs.*
2. *Preparation an affiliation agreement between private local universities and colleges with prestigious foreign universities and high education institutions.*
3. *Transferring technology and knowledge between Subject-Matter Experts (SMEs) and higher education institutions.*
4. *SMEs Educational Programs for Future Employability of Graduates.*
5. *Coordinator of Power station and maintenance contracts.*

University of Buraimi, Oman

Vice-Chancellor and Academic advisor of BoD, University of Buraimi, Oman.

2010

1. *Assigned to signing an affiliation agreement with Rowan University in USA.*
2. *Completion the university executive administrative, academic, and financial regulations.*

Al-Azezia NY University of Science & Technology project, Riyadh Saudi Arabia

Director of Operations. Duties summarized in the following activities:

1. *Conducting feasibility study for the establishment of a private university in Riyadh, Saudi Arabia contains three Colleges, Engineering, Computer Science & IT and Finance and Administrative Sciences.*
2. *Prepare the required file and apply for a permit from the Ministry of Higher Education.*
3. *Assigned to signing an affiliation agreement with NYIT and NY University in USA.*
4. *Completion the university executive administrative, academic, and financial regulations*

2008-2009

NYIT in the Middle East

Director of Business Development. Relied upon in the business development of the work of NYIT in the Middle East within the following Job descriptions:

1. *Responsible for working with the executive chairman of NYIT in the Middle East to design, coordinate and execute practice business development initiatives.*
2. *Involved in the strategic direction of the business and works directly in realizing growth objectives of the NYIT sites in the Middle East*
3. *Provides critical linkages between the Business Development function and other Higher Education Practice operations functions.*

Amman University, Jordan

**Sept. 1997-
Sept. 2008**

- 1) **Dean of College of Engineering (2001-2007), Full time professor and Participated in the following committees as follows:**

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| 2006-2007 | <ol style="list-style-type: none"> 1. <i>Study Planes & Curriculum Committee (Chairman).</i> 2. <i>Buildings & Constructions Committee (Vice Chairman).</i> 3. <i>General Tenders & Orders Committee (Vice Chairman).</i> 4. <i>Student's problems Committee (vice chairman).</i> 5. <i>E-Learning Development Committee (Vice Chairman).</i> 6. <i>Quality Assurance Committee (Vice Chairman).</i> 7. <i>Recruitment Committee (Member).</i> <p> 2) Associate Professor Dec. 2002, 3) Professor Aug. 2008. 4) President Assistant (vice president) for Evening Studies (2002-2005). </p> <p>PACE (Global Energy Services), Virginia, USA Leader of the local Experts for Oil Shale Resources Development in Jordan.</p> |
| 1993-1996 | <p>Leeds University, UK Research & Teaching Assistance demonstrating to Post Graduate Students in the area of air, water pollution and fuel combustion.</p> |
| 1987-1991 | <p>Natural Resources Authority, Amman - Jordan Mechanical Engineer in the field of Oil Shale, Tar Sand and Crude Oil analysis.</p> |

Achievements & Relevant Skills

1. *Member of the Jordanian Engineering Association.*
2. *Member of the Institute of Energy, UK.*
3. *Member of the Jordan Environment Society.*

Teaching Experience

Taught the following courses:

1. *Engineering Mechanics (Statics and Dynamics)*
2. *Strength of Materials.*
3. *Mechanics of Machinery.*
4. *Mechanical Engineering Design I&II.*
5. *Engineering Materials.*
6. *Thermodynamics I & II.*
7. *Thermal Fluids systems.*
8. *Fluid Mechanics.*
9. *Power stations.*
10. *Solar Energy.*
11. *Energy conversion.*
12. *Internal Combustion Engines.*
13. *Manufacturing processes I.*

14. *Biomechanics and Physics.*
15. *Heat Transfer.*
16. *Air Conditioning and Refrigeration cycles.*
17. *Control Systems.*
18. *Water Desalination.*
19. *Industry and Environment.*
20. *Thermal Mech. Labs.*
21. *Energy conversion Lab.*
22. *Engineering Drawing.*
23. *Engineering Workshops.*
24. *Engineering Economics.*
25. *Industry and Environment.*

Organizing & Examination Committee

1) Chairman / Chairman of the Organizing Committee of the following Conferences:

1. **Chairman & plenary speaker** of SCESA-2013, Spring Conference on Energy Science and Application / SCESA 2013), organized by ASSE (American Society of Science and Technology), May 24 - 26, 2013, Hubei, China.
 2. **Chairman** of the 1st Jordanian International Biomedical Engineering Conference (JIBEC 07), 4-8 November 2007, Amman, Jordan.
 3. **Chairman** of the Youth and the Social Environment Conference, Amman University & Ministry of higher Education, Amman, Jordan, Nov. 2005.
 4. **Member of the organizing and scientific committee** of the 3rd and the 4th Jordanian Mechanical & Industrial Engineering Conference., Amman, Jordan 1999 and 2001.
- 2) External examiner of many MSc, and PhD thesis, faculty of Engineering, The University of Jordan and Jordan University of Science and Technology (JUST).
 - 3) Chairman of Committee, JEA competition of the graduation projects, Mechanical Engineering branch, 2001-2003
 - 4) Member of the Reviewing Committee, Elhijawi prize, 2002-2004.
 - 5) Member of the organising Committee of many national and international conferences and symposiums.

Technical Journals Member of Editorial Board & Reviewer:

1. Member of Editorial Board:

- 1) Member of Editorial Board, Shaqra University Journal of Applied Sciences, 2015-2018.
- 2) Member of Editorial Board, Journal Energy Science & Technology, Canadian Research & Development Center of Sciences & Cultures.
- 3) Member of Editorial Board, Thermal Energy and Power Engineering, (TEPE), American V-King Scientific Publishing.
- 4) Member of Steering Committee, WAP Conference Series: Engineering and Technology Frontier (ETF).

2. Referee for the following Journals:

- 1) Journal of Analytical & Applied Pyrolysis, Elsevier Publications.
- 2) Communications in Nonlinear Science & Numerical Simulation, Elsevier Publications.
- 3) FUEL, Elsevier Publications.
- 4) Energy Conversion & Management, Elsevier Publications.
- 5) Chaos, Solitons & Fractals, Elsevier Publications.
- 6) Nonlinear Dynamics; An International Journal of Nonlinear Dynamics & Chaos in Engineering Systems, Springer Publications.
- 7) IEEE Transaction on Evolutionary Computation, IEEE Publications.
- 8) International Journal of Exergy, Inderscience Publishers.
- 9) Jordan Journal of Mechanical & Industrial Engineer, Jordan.

Letters of Appreciation

1. His Royal Highness the Crown Prince of Jordan, 1996. The first PhD degree in the field of Fuel & Energy (Oil Shale utilization & Environmental Impact study).
2. His Royal Highness the Crown Prince of Jordan, 1987. The first graduation project (study) on the use of Jordan oil shale in the ICE, Yarmouk University.
3. Eligible for inclusion into 2008 Edition of the International Who's Who of Professional's .

Contribution to Local Media

1. Invited guest to Jordan TV, Face To Face, a 55 minutes special program “The Future of Oil Shale in Jordan- the governmental policy, 2004.
2. Interview with “Al-Siyassa Newspaper”, Kuwait, on the behavior of a distinguished Dean of Engineering, May 2007.
3. Invited guest to many Jordan TV special programs “The properties of Jordan oil shale”, 2001,2002.
4. Invited guest to the Good morning program, JTV on “The Environmental Impact of oil shale utilization”, 2001-2007.
5. Interview on the Jordan TV (phone call) many times about the energy & the Environment, water, pollution, high education policy & political issues, 2005-2007.

References:

Professor Natheer AbuObaid

Academic Chancellor
Alasala Colleges,
Ad Dammam, KSA
Mobile: 00966 580020361

Dr. Soud Abdula Alrowaly

Supervisor of the Rector's Office
Shaqra University, KSA
Mobile: 00966 (0) 558808090

Dr. Hassan A. Khayyat

Vice Dean of Engineering 2013 - 2017
Shaqra University, KSA
Mobile: 00966 (0)555682106

Publications

1) Selected Journal Publications:

1. **Jamal M. Nazzal**, Influence of Vapour Residence Time on the Products of Oil Shale Pyrolysis by Fixed Bed Reactor, Submitted paper, Journal of the Energy Institute, May 2019.
2. **Jamal M. Nazzal**, Hassan A. Khayyat, Yaser S. Al-Thiyabi, AbdulAziz A. Al-Subaie, Sultan A. Al-Dalbahi, Jalal M. Al-Otaibi, Ahmad S. Al-Ghazwani, Saad A. Al-Mwanas, Mousa S. Al-Amry, Mohammad A. Al-Rowidan , Design and Performance study of Flat-Plate Solar Collector submitted paper, 2020.
3. Hassan A. Khayyat, **Jamal M. Nazzal**, Omar M. Alsawadi, Said R. Mikdad, Abdulrahim Y. Alshami, Tamam F. Maziad, and Abdulwahab S. Alhuwaymil, Hybrid Wind/PV Renewable

Energy System, submitted paper, 2020.

4. **Jamal M. Nazzal** & Ammar N. Natsheh, *Chaos control using sliding-mode theory*, *Chaos, Solitons & Fractals*, Volume 33, Issue 2, July 2007, Pages 695-702.
5. Ammar N. Natsheh, J. Gordon Kettleborough, & **Jamal M. Nazzal**, *Analysis, Simulation & Experimental Study of Chaotic Behavior in Parallel-Connected DC-DC Boost Converters*, *Chaos, Solitons & Fractals*, 39 (2009), pp. 2465-2476.
6. **Jamal M. Nazzal**, "The Influence of grain size on the products yield & shale oil composition from the Pyrolysis of Sultani oil shale", *Journal of Energy Conversion & Management*, 49 (2008), P 3278.
7. **Jamal M. Nazzal**, *The presence of Polycyclic Aromatic Hydrocarbons (PAH) in the Oil derived from the pyrolysis of Jordan Oil Shale*, *Oil shale Journal*, Vol.24, No. 3, 2007.
8. **Jamal M. Nazzal**. 'Al-Balqa Journal for research & Scientific Studies, Vol. (12) No. (1), 2007.
9. **Jamal M. Nazzal**, Salam A. Najim & Ibrahim M. El- Emary, *Investigating Jordan Oil Shale Properties Using Artificial Neural Network (ANN)*, *World Applied Sciences Journal* 5 (5): 553-559, 2008.
10. **Jamal M. Nazzal**, Salam A. Najim & Ibrahim M. El- Emary, *Multilayer Perceptron Neural Network (MLPs) For Analyzing the Properties of Jordan Oil Shale*, *World Applied Sciences Journal* 5 (5): 546-552, 2008.
11. **Jamal M. Nazzal**. & Williams, P. T., 'Influence of temperature & steam on the products from the flash pyrolysis of Jordan oil shale', *International Journal of Energy Research*, 2002; 26: 1207-1219.
12. **Jamal M. Nazzal** 'Influence of Heating Rate on the pyrolysis of Jordan oil shale', *Journal of Analytical & Applied Pyrolysis*, 62 (2002) 225-238.
13. **Jamal M. Nazzal**' Gas evolution from the pyrolysis of Jordan oil shale in a fixed-bed reactor' *Journal of Thermal Analysis & Calorimetry*, Vol. 65 (2001).
14. **Jamal M. Nazzal** 'Pyrolysis of Scrap Tires: Environmental Impact of the Derived Oil'; *Jordanian Journal of Energy Abstracts, the National Energy Research Center*, Vol. 4, No. 1, March 2000.
15. Williams, P. T., & **Jamal M. Nazzal**' Polycyclic Aromatic Compounds in Shale Oils: Influence of Process Conditions', *Environmental Technology*, 2000, Vol. 19, pp 775-787.
16. Williams, P. T., & **Jamal M. Nazzal**, 'Oil Shale Pyrolysis, Influence of particle grain size & steam on the polycyclic aromatic compounds in the derived shale oils', *Journal of the Institute of Energy*, June 1999, 72, pp 48-55.
17. Williams, P. T., **Jamal M. Nazzal** 'Polycyclic Aromatic Compounds in Oils derived from the Fluidized Bed pyrolysis of Oil Shale', *Journal of Analytical & Applied Pyrolysis*, 35 (1995), 181-197.
18. Williams, E. A., **Jamal M. Nazzal**, Nugr&, N., & Williams, P. T., 'Thermogravimetric Analysis of a Renewable Source of Energy', *Renewable Energy*, 5, 2073-2075, 1994.
19. Anabtawi, M. Z., & **Jamal M. Nazzal** 'Effect of Composition of El-Lajjun Oil Shale on its Calorific Value' *Journal of Testing & Evaluation*, Vol. 22(2), 1994, 175.

20. **Jamal M. Nazzal** 'Geochemistry of El-Lajjun Oil Shale', *AlMohandis Alordoni Journal*, 40, Jordan Engineering Association, 1988.

2) Selected Conferences Publications

21. S. Hemidat, I. Jalham, and **J. M. Nazzal**, *Evaluation of Sultani Oil Shale Exploitation, GCREEDER 2013, Amman, Jordan, Sept. 10th – 12th, 2013.*
22. **Jamal M. Nazzal**, "The Sustainable Developments in the Biotechnology", the 5th International Conference of Biotechnology & Environmental Sciences, 12-15 November, 2007, Faz-Morocco.
23. Sameh El-Shaero & **Jamal M. Nazzal**, " Systematic Approach in Studying Biomedical Engineering", The First Biomedical & Clinical Engineering Conference in Arab Countries, 12-14 January 2008, Riadh, Saudi Arabia.
24. **Jamal M. Nazzal**, The Characteristic aspects of potential environmental effects on translocation in Plants from carbonaceous-spent shale, The 4th International Conference of Biotechnology & Environmental Sciences, 19-24 November, 2006, Mahdia-Tunis.
25. Rada Hussain, Sameh El-Shaero & **Jamal M. Nazzal**, Utilizing System Approach in Biomedical Engineering & Health Care, 1st Jordanian Egyptian Conference: The system Approach & its applications in Science, 18-21 July, 2005, Irbid, Jordan.
26. **Jamal M. Nazzal**, The Quality Assurance Management in the Engineering Studies, The new techniques in the Engineering Learning Conference, Federation of Arab Engineers, 30-31/8/2005, Cairo, Egypt.
27. **Jamal M. Nazzal** & Williams, P. T., 'Pyrolysis of U.K. Oil Shale in A semi-continuous Fluidized Bed Reactor', in proceeding of the 1996 IChemE research event-second European Conference for Young Researchers in Chemical Engineering, University of Leeds, 2-3 April 1996.
28. **Jamal M. Nazzal**, Williams, P. T., & Ahmed, N., 'Some Characteristics of El-lajjun Oil Shale', in proceeding Int. Conf. On Advances in Strategic Technology, Bangio, Malasia, 12-15 June 1995.
29. Ahmed, N., Williams, P. T., & **Jamal M. Nazzal** 'Chemical Analysis of Pakistani Oil Shales' Int. Conf. On Advances in Strategic Technology, Bangio, Malasia, 12-15 June 1995.
30. **Jamal M. Nazzal** "Gas Evolution during Jordan Oil Shale pyrolysis in a Fixed Bed Reactor" in Proceeding of the Third Jordanian Mechanical & Industrial Engineering Conference, May 9-12 1999, Amman-Jordan.
31. Al-Tahinah, H. A., **Jamal M. Nazzal** & Tahat, M., "Mini Solar Pond Performance at Irbid" in Proceeding of the Third Jordanian Mechanical & Industrial Engineering Conference, May 9-12 1999, Amman-Jordan.
32. **Jamal M. Nazzal**, "Pyrolysis of Jordan Oil Shale: The presence of PAH in the derived oil" in the proceeding of the 6th combustion Symposium, July, 19-22, 1999, Istanbul-Turkey.
33. **Jamal M. Nazzal** "The presence of Polycyclic Aromatic Hydrocarbons in the pyrolysis of Jordan Oil shale' In the proceeding of the International Conference of Energy Systems, ICES, 2000, University of Jordan, Sept., Amman, Jordan.
34. **Jamal M. Nazzal** & Williams, P. T., ' Influence of temperature of the products from the flash pyrolysis of Jordan oil shale' Proceeding of the Fourth Jordanian International Mechanical

Engineering Conference', 8-10 October 2001, Amman University.

35. **Jamal M. Nazzal** 'Influence of Pyrolysis Temperature on the products of Jordan Oil Shale in A Semi-Continuous Fluidized Bed Reactor', Arab Energy & Sustainable Development Symposium, AESD 2000, Damas, Syria, 2000.
36. **Jamal M. Nazzal** 'Hydrogen as a new Energy Carrier workshop, Cairo, Egypt, Feb. 2001.

3) BOOKS

Jamal M. Nazzal. & Abdullah M. 'Basic Engineering Drawing for Engineering with AutoCAD', Al-Basheer 2000.

Attending the Following Selected Conferences, Symposiums & Workshops

1. Program report Workshop, Quality Control unite, Shaqra University, 10/12/2011.
2. Description of Program Workshop, Quality Control unite, Shaqra University, 17/10/2011.
3. Description of Course Workshop, Quality Control unite, Shaqra University, 30/10/2011.
4. National Conference for the development of Study Plans, Teaching & Learning & Scientific Research, 15-17 June 2010, MoHE, Amman, Jordan.
5. Conference of High Education E-learning, 2009, MoHE, Riyadh, Saudi Arabia.
6. Learning Management System (LMS), Amman University, 18/1/2007.
7. The society of the Engineering Colleges, Ein-Shams University, 19-21/2/2006, Cairo, Egypt.
8. The day of Energy, Jordan University of Science of Technology (JUST), 16/ 11/2005, Irbid, Jordan.
9. Oil Shale, An alternative Source of the imported crude oil, Jordan Engineers Association (JEA), August 2005, Amman, Jordan.
10. The future of the University Atmosphere, Muta'a University, 19/3/2005, Kerak, Jordan.
11. The new aspects of the Engineering Learning, Philadelphia University, 8/2/2005, Amman, Jordan.
12. The high Education in Jordan, Amman University, 6/2/2005, Amman, Jordan.
13. The environment Assessment, the Natural gas transferring Egyptian-Jordanian project, Phase II, RSS, 16/2/2004, Amman, Jordan.
14. Towards a high education quality Assurance, Central Bank of Jordan, 23/10/2003, Amman, Jordan.
15. The Technical Learning Economy, Al-Quds Open University, 31/8-4/9/2003, Amman, Jordan,

My Personal Teaching Philosophy includes:

1. Treating all students with absolute equality, regardless of age, gender, nationality, intellectual ability or personal attractiveness.
2. Making it clear that I am always available on request, and living up to this by devoting time to personal tuition on demand.
3. I make it my business to try to understand the student's point of view however erroneous before attempting to give them my own. This means that when I do teach I can choose a conceptual path that leads from the student's current understanding to a broader or more conventional one. The students in my classes know this and ask me for help in their other subjects!
4. I try to set a good professional example in written solutions and in conversation, by always referring everything back to the standards of the engineering industry, where a single error could lead to tremendous expense or even loss of life.
5. Enthusiasm is critical to good teaching, and students have a sixth sense for it.
6. In most Mechanical Engineering lab classes, students carry out lab activities by following step by step directions printed in the lab manual. Students do not experience the joy of discovery since every step of the experiment, including expected results, is explicitly stated, requiring little creative thought. In my lab classroom, we use an inquiry-based lab curriculum, centering on the principle that students should actually do science themselves. My students leave the lab classroom with the ability to discuss and develop ideas to address problems in collaboration with their peers, which is the underlying structure of the process of scientific inquiry. More importantly, though this may be the final Mechanical course which my students experience, developing the ability to collaborate and persevering to see projects to completion are skills which are transferable to many aspects of my students' lives.

Research philosophy

1) Introduction to my Research Philosophy:

To introduce my research philosophy, it is important to say that depending on the fact that my country Jordan is poor in fossil energy sources, crude oil, which forced me to concentrate on the national needs towards the utilization of the oil shale where south of Jordan contains enormous reserves about 50 billion tons. My research was investigated the influence of pyrolysis conditions on the oil and gas production and their composition. The environmental impact assessment is investigated also. As a result of this part of my research, a 13 articles are published in technical journals and 6 article are published in international conferences.

- 2) My experience in several engineering fields including specialized instrument fabrication, gas chromatography/ mass spectrometry, health risks analysis, source apportionment, and framing complex problems to make a substantive contribution to Combustion, Characteristics of Air Toxics Exposure, Risks, and Sources Research. The main source of energy and electricity is combustion and that will likely continue to be the case for the foreseeable future even as the fuels we burn evolve. Fuel combustion is a complex chemical interaction involving numerous chemical species where the properties of the chemical interaction determine pollutant emissions and efficiency of the system. Studying the combustion characteristics of a wide range of conventional, synthetic and alternative fuels, as well as fuel components and blends.
- 3) Solar power is likely to become a significant and possibly even the dominant, post-fossil fuel global power source. It looks unlikely that conventional crystalline silicon photovoltaics (PV) can fulfil this role because of high production costs. Thus, there is a vital need to boost the efficiency of inherently cheaper, greener, innovative designs.
- 4) Hydrogen production is an expanding global industry. Hydrogen is regarded as a key fuel for low carbon energy systems, particularly as an energy carrier in fuel cells and as way of storing surplus electricity generated through distributed networks.
- 5) Transforming the future of energy, through integrated innovations is my philosophy in the second part of my research that will investigates a variety of questions in the intersection of energy, the environment, and the global economy. These include:
 - a) The optimal energy transition to a sustainable,
 - b) The contribution of the maritime industry to local pollution levels in coastal areas,
 - c) The implications of innovation and new technologies, such as storage and autonomous vehicles, and the design of self-enforcing international climate agreements.