



## The Combustion Institute

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## 2019 Saudi Arabian Section of The Combustion Institute Report

Section Website: <http://sas-ci.com/>

Section Chair: Hong G. Im

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### 1. Section Overview

The Saudi Arabian Section of the Combustion Institute (SAS-CI) was founded in 2010 with around 30 members. Today, it has grown to 175 active members from a number of research institutions, including King Abdullah University of Science and Technology (KAUST), King Abdulaziz City for Science and Technology (KACST), King Fahd University for Petroleum and Minerals (KFUPM), King Abdulaziz University, the Royal Commission of Yanbu Research Center, Taif University, Taibah University, Jubail University College, Prince Mohammed Bin Fahd University and Saudi Aramco. In recent years, the local meetings have also attracted greater participation from high-profile international researchers. This reflects favorably on the standard of research undertaken in the region.

Since its inception, the Saudi Arabian Section of the Combustion Institute has been organizing annual meetings. The annual events aim to promote the role of combustion science in the Kingdom by providing a forum for young combustion researchers to present and discuss their research. The nine annual meetings to date were held at King Abdullah University of Science and Technology (KAUST) in 2011, King Abdulaziz City for Science and Technology (KACST) in 2012, Saudi Aramco in 2013, King Abdullah University of Science and Technology (KAUST) in 2014, King Abdulaziz City for Science and Technology (KACST) in 2015, Saudi Aramco Technical Exchange in Dhahran in 2016, King Abdullah University of Science and Technology in 2017, King Abdullah Petroleum Studies and Research Center (KAPSARC) in 2018, and King Abdulaziz City for Science and Technology (KACST) in 2019. Amongst other activities, the local section coordinates meetings and workshops on various aspects of combustion, sustainability and energy conversion science.

### 2. Board of Officers

The current board of officers was elected in May 2017 in accordance with the section by-laws, which state that the board can serve for a maximum of four years. The current section committee is as follows:

Name	Affiliation	Title	Email
Prof. Hong G. Im	KAUST	Chair	hong.im@kaust.edu.sa
Dr. Jihad Badra	Saudi Aramco	Vice-Chair	jihad.badra@aramco.com
Dr. Kai Morganti	Saudi Aramco	Secretary	kai.morganti@aramco.com
Prof. S. Mani Sarathy	KAUST	Officer	mani.sarathy@kaust.edu.sa
Dr. Amer Amer	Saudi Aramco	Officer	amer.amer.4@aramco.com
Ms. Maryam Altaher	Saudi Aramco	Officer	maryam.taher@aramco.com
Prof. William Roberts	KAUST	Officer	william.roberts@kaust.edu.sa

### 3. Eighth Annual Meeting – May 2018

The eighth annual meeting was held from 1 to 2 May at King Abdullah Petroleum Studies and Research Center (KAPSARC) in Riyadh. The event brought together more than 100 experts from institutions in Saudi Arabia, the UAE, Oman, and the United States. The theme of the meeting was “Clean and Efficient Utilization of Fuels for a Sustainable Future.” In total, 49 presentations were made across the six different technical sessions. In addition to the technical sessions, the meeting featured a work-in-progress poster presentation session. Recently appointed KAPSARC President, Adam Sieminski, provided the opening remarks at the meeting.

As a leading global exporter of energy, Saudi Arabia has an important role to play in the development of technologies which promote and enhance sustainability. The establishment of the Saudi Arabian section in 2010 was central to this objective. “Our local section actively supports the growth and development of the Kingdom’s young scientists,” said Kai Morganti, a scientist in the Saudi Aramco R&DC and secretary of the Saudi Arabian section. “These meetings provide a forum for networking with top researchers, disseminating knowledge, and promoting the role of combustion science as a key pillar of sustainability.”

The growing global demands for energy and environmental sustainability pose tremendous challenges and opportunities for the combustion research community. “There is no one-fit-for-all solution to address these challenges,” said Hong Im, Professor at King Abdullah University of Science and Technology, and Chairman of the Saudi Arabian section. Instead, synergistic integration of conventional and emerging technologies, including renewables, will be essential in delivering solutions which are both environmentally and socially sustainable. “I am proud to be part of the many world class researchers in the Kingdom who will lead these efforts,” said Im.

Sustainability was the recurring theme in the three invited lectures at this year’s meeting. Sylvain Cote, Program Director for Energy Demand, Efficiency & Productivity at KAPSARC, discussed the challenges and opportunities associated with the transition to renewable energy in the Kingdom. Among these, Cote highlighted the need for targeted policy action by government to help alleviate an anticipated skills gap. “Although the emerging renewable energy sector is expected to provide new jobs, it is equally important to recognize the limitation and reflect on the adjustment and reform efforts needed. If not, the current labor mismatch could represent a lost opportunity for the upcoming young Saudi population” said Cote.

Dr. Anvita Arora, Program Director for Transport & Urban Infrastructure at KAPSARC, discussed strategies for environmentally and socially sustainable urban transport systems. “Our research is closely aligned with the Kingdom’s Vision 2030 and the National Transportation Strategy, which seek to reduce domestic dependence on oil, while creating smart and sustainable cities throughout the Kingdom,” said Arora.

The final invited lecture was delivered by Dr. Dimitrios Kyritsis, Professor and Chair of the Department of Mechanical Engineering at Khalifa University, United Arab Emirates. This lecture highlighted the role of carbon capture in addressing the climate challenge, while also unlocking additional petroleum resources when used for enhanced oil recovery (EOR). “This technology has already been deployed in the Kingdom, with approximately 800,000 tons of carbon dioxide captured and stored each year,” said Kyritsis. “Carbon capture and storage can enhance sustainability on a large scale.”

#### 4. Ninth Annual Meeting – April 2019

The ninth annual meeting was held from 29 to 30 April at King Abdulaziz City for Science and Technology (KACST) in Riyadh. The event brought together around 100 experts from institutions in Saudi Arabia, the UAE, Oman, and the United States. The theme of the meeting was “Frontiers in Combustion Research for Clean Power Generation and Carbon Management.” A total of 46 presentations were made across the five different sessions.

The ninth annual meeting featured three keynote lectures addressing a diverse range of topics. Sylvain Cote, Senior Research Fellow in Energy & Macroeconomics at KAPSARC discussed the potential impact of demography and technological change on the Saudi labor market. Cote discussed how Saudi Arabia, which is faced with high youth unemployment and an emerging young population, has embarked on an ambitious economic modernization program. Saudi Vision 2030, which is the center piece of this plan, aims to diversify the economy in order to absorb into the labor market its young population, of which half is under 25 years of age. “While high unemployment continues to be persistent due to various structural challenges, automation will be bringing disruption to the labor market. Saudi Arabia will then be facing two colliding forces (demographics and technological change)” said Cote. This dual challenge could make it more difficult for Saudi Arabia to generate the job growth needed to provide employment opportunities for the large number of young people expected to enter the labor market in the forthcoming years. But at the same time, these challenges provide an opportunity to consider how the Saudi government could balance the efficiency gains of technological advancement with the need to generate employment to absorb its emerging youth population.

In the second keynote, Dr. Ali Al-Dawood, Head of the Technology Outlook Team in the Technology Strategy & Planning Department at Saudi Aramco discussed how transport technology has been evolving rapidly in response to concerns over air quality, increasing regulatory pressure, and increased demand for mobility. Further, the more recent push towards reducing the carbon footprint of the transport sector has accelerated the innovation and penetration of alternative fuels and propulsion technologies. “This push for the decarbonization of the transport sector appears to be driving us towards a future that involves either fuel decarbonization (i.e., hydrogen) or electrification (i.e., electric vehicles)” said AlDawood. The presentation highlighted strategic implications of this push for decarbonization, while making the case for an inclusive approach that takes advantage of new technologies, but also appreciates the importance of continuing to invest in improved oil-based fuels and advanced internal combustion engine technology.

The final keynote was delivered by Dr. Dimitris Goussis, Professor in the Department of Mechanical Engineering at Khalifa University, Abu Dhabi, United Arab Emirates. Dr. Goussis discussed multiscale dynamics in reacting flows, including the benefits and drawbacks. The drawbacks are the well-known numerical difficulties due to stiffness, while the benefits refer to the opportunity for the acquisition of the relevant physical understanding.

“The fast dynamics generate constraints, in which the reacting process evolves. Given these constraints, the process can be simulated by a model much more simple than the full” said Goussis. The Computational Singular Perturbation (CSP) algorithm and some of its extensions can provide all the required tools for such an analysis. Dr. Goussis analyzed several reactive processes, with emphasis placed on (i) the benefits resulting from the wide range of fast/slow dynamics, and (ii) the acquired physical understanding. These processes included homogeneous auto-ignition, flames and knock.

## 5. KAUST-CI Clean Combustion Summer School, 2018

The KAUST Clean Combustion Research Center (CCRC) hosted a Combustion Institute- Summer School (CI-SS) on April 1-5, 2018, to increase the visibility of combustion science to young scientists. The organizing committee funded the KAUST CI-SS using funds from both KAUST and the Combustion Institute (\$50 K). In the spirit of KAUST diversity requirements, the school welcomed students from all over the world, as well as a reasonable proportion of female students (20%). The majority of students of the 160 students (> 80%) were from Saudi Arabia, and students travelled from across the globe to attend. The participants included graduate students (50%), industry professionals (40%), and academic faculty/researchers (10%). We also succeeded with making this the first virtual CI-SS by having live high quality video streaming of lectures for global participation.

Country	Participants
Saudi Arabia	58 (+ 80 KAUST participants)
Spain	4
Italy	4
USA	3
India	2
Egypt, UK, Norway, China, Ireland, Netherland, Poland, Germany, Chile, Australia and Brazil	1 each

The KAUST CI-SS educated students on how to innovate fuels, flames, and engines to ensure that combustion technologies meet the societal and environmental challenges of the 21st century. These topics were taught using a combination of lectures on fundamental combustion science together with practical laboratory sessions demonstrating how theory can be applied. Instructors included experts from academia and industry, in order to provide students with a broad understanding of fundamental and applied combustion science. The instructors were Kaoru Maruta (Tohoku, Japan), Hong Im (KAUST, Saudi Arabia), Bengt Johansson (KAUST, Saudi Arabia), Anthony Dean (GE, USA), Aamir Farooq (KAUST, Saudi Arabia), and Angela Violi (Michigan, USA).

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## 6. International Combustion Symposium

The Saudi Arabian section has been well represented at the International Symposium in recent years. The number of accepted papers from SAS-CI members has grown progressively from 6 at the 34<sup>th</sup> Symposium, up to 38 at the 36<sup>th</sup> Symposium in Korea. A total of 23 papers were presented at the 37<sup>th</sup> Symposium in Ireland. Papers are currently in preparation for the 38<sup>th</sup> Symposium in Australia.

Symposium	Accepted Papers
34 <sup>th</sup> Symposium	6
35 <sup>th</sup> Symposium	13
36 <sup>th</sup> Symposium	38
37 <sup>th</sup> Symposium	23

## 7. SAS-CI Website

A Saudi Arabian Section of the Combustion Institute website was developed in 2017. The website is administered by the KAUST IT Department, and includes information on the local section and the annual meeting reports. The website can be accessed at: [www.sas-ci.com](http://www.sas-ci.com).

## 8. Future Plans

At the 2019 ASPACC Conference, it was announced that the next ASPACC will be held in Abu Dhabi, UAE, jointly hosted by SAS-CI and Khalifa University (led by Dimitrios Kyritsis). The tentative dates will be early December 2021. This is a recognition of the growing activities and contributions from SAS-CI. Considering its location and easy travel access, it is anticipated that the 2021 ASPACC will attract a large number of attendees with diversities nearly at the level of the International Symposium.

The board of officers continues to work on a number of improvements for the local section. The proposed short and medium term action plan includes:

- Continuing to grow the number of members from Saudi Arabia and neighboring countries.
- Arranging frequent social gatherings and events for members.
- Creating a bank account to handle financial transactions.
- Continuing to create value for the Kingdom and the local combustion research community.

Hong G. Im

Chair, Saudi Arabian Section

July 21, 2019