Changing Future of the Oil and Gas Industry – project report

Executive summary

The oil and gas industry is undergoing profound changes as the global energy system transitions and the world strives to deliver a Net Zero economy. Oil and gas production and consumption are predicted to decrease, but are forecast to remain a part of the global energy system for some time to come.

Oil and gas is a very significant sector of interest within the Institution of Chemical Engineers (IChemE), encompassing a significant share of the membership in a very wide variety of roles and environments. The *Changing Future of the Oil and Gas Industry* project reviewed the potential impacts of the energy transition on IChemE members and recommended relevant supporting actions. The project was based on a membership survey and five regional online workshops.

The surveys and workshops confirmed the critical importance of the energy transition to IChemE members and that changes are already underway. The future pace and path of transition are expected to vary in different regions. Europe and Australia/New Zealand are diversifying relatively more quickly, while oil and gas are expected to remain a significant part of the energy mix for the Middle East and Africa, Southeast Asia and the Americas for longer. However, companies and governments in all regions are making significant commitments to emissions reduction, energy efficiency, and low carbon energy. Many oil and gas companies are also diversifying to varying degrees into lower carbon activities (eg renewables).

A series of themes and potential actions for IChemE and its members emerged from the workshops. These are detailed in the full report and summarised here:

1. A new **Oil Gas and Energy Transition Special Interest Group (OG&ET SIG)** should be established to support IChemE members in the sector and implementation of the report recommendations.
2. **IChemE should increase engagement with governments and other stakeholders on energy transition**, drawing on the expertise of the proposed OG&ET SIG and others to actively support where appropriate. Messaging should provide a balanced and realistic view of the role of oil and gas in the future alongside the opportunities and challenges of the energy transition.

3. The OG&ET SIG should work with the Membership and Qualifications team to **ensure that IChemE's accreditation and other education activities remain appropriate and ensure students are adequately prepared for the future**, including the energy transition. The SIG and individual members have a vital role in encouraging young people to enter the profession – through degree or apprenticeship routes – and are encouraged to do this through engagement with DiscoverChemEng, outreach activities and supporting young engineers.

4. It is clear that chemical engineering and operations/business management fundamentals, and the transferable skills that a chemical engineering education provides, will remain relevant throughout and beyond the energy transition. The OG&ET SIG should work with the Learned Society team, Member Experience and Professional Learning team and others to **support and engage engineers at all career stages through meaningful professional development activities**, including webinars, publications, structured training and career support.

5. **Collaboration should be encouraged** between IChemE SIGs, staff, members and appropriate external partners to support energy transition efforts. This includes drawing on SIG and member expertise to support activities in policy, schools and public engagement, and informing technical debates – amplifying messages and increasing impact.

Glossary

ADNOC	Abu Dhabi National Oil Company
AIChE	American Institute of Chemical Engineers
AU/NZ	Australia/New Zealand
BAPCO	Bahrain Petroleum Company
BEIS	UK Government's Department for Business, Energy and Industrial Strategy (to 2023)
CCUS	Carbon capture, utilisation and storage
EU	European Union
IOGP	International Association of Oil and Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
LSC	Learned Society Committee (IChemE)
MEA	Middle East and Africa
NEPC	National Engineering Policy Centre (UK)
NNPC	Nigerian National Petroleum Corporation
NOC Libya	National Oil Company of Libya
OG&ET	Oil Gas and Energy Transition
OGUK	Oil & Gas UK (now named Offshore Energies UK)
PDO	Petroleum Development Oman
PM	Project management
R&D	Research and development
SEA	Southeast Asia
SIG	Special Interest Group
SOCAR	State Oil Company of the Republic of Azerbaijan
SPE	Society of Petroleum Engineers

1. Purpose of the *Changing Future of the Oil and Gas Industry* project

The oil and gas industry is facing unprecedented change during the energy transition to Net Zero. It is anticipated that these changes will have varying effects on different regions and industry sectors. The purpose of this project was to explore how IChemE members working in key regions may be impacted, and what networks, opportunities, new skills and support they will need to be successful through this transition.

The project collected input from members on key factors, such as the pace of transition, the regional variations, and the drivers of the transition, and how these changes may impact those working in the oil and gas sector. Additionally, it considered skills needed (cross-skilling) for chemical engineers to thrive in the evolving oil and gas industry or transfer to other sectors.

Chemical engineers working in oil and gas will need to take advantage of their transferable skills gained in the industry, and seek out guidance, training and support to successfully manage their careers for a Net Zero economy. This project aimed to provide the following benefits for IChemE and its members:

a. An overview of participants' views on important future technologies and technical skills associated with a net zero economy and transition.
b. Provide input into the appropriate ICheme channels to enhance and promote sustainability training programs and early career and university students' education.
c. Advise IChemE how it can support members in the oil and gas sector in responding to the energy transition.
d. Align with the *Just Transitions* work being carried out in support of the delivery of IChemE's climate change policy.
e. Inform future policy work related to net zero and the *Just Transition* in oil and gas.

The outputs of this project will support the members, industry, governments and society as follows:

- **members** – provide a comprehensive perspective of chemical engineers' issues, challenges and how to be future-ready regionally and globally.
- **industry** – provide oversight on business opportunities, risks and strategies in leveraging oil and gas resources skills.
- **governments** – develop local and regional perspectives as input into evolving sustainability policies and incentives.

2. Regional contexts

It was anticipated from the outset that there would be geographical variations in energy transition status and the likely path forward, driven by policy, economics, and the resource and market status in different regions. Therefore, the following regional contexts were used in setting up the workshops in each region:

- USA's *Inflation Reduction Act* and Canada's *2030 Emissions Reduction Plan* represent significant policy advancements catalysing the energy transition.
- *North Sea Transition Deal* signed by OGUK and BEIS in 2021.
  - Net zero basin by 2050 (UK gov net zero by 2050 written in law).
  - 10% emissions reduction in 2025.
  - 50% emissions reduction by 2030.
- Various oil and gas companies in Southeast Asia, including Petronas, have net zero by 2050 targets.
- Various Australian and New Zealand oil and gas companies (Woodside/Santos/Beach/Todd) have net zero by 2040-2050 targets.
- Various MEA oil and gas companies have net zero targets. Signatories to the *Oil & Gas Decarbonization Charter* include ADNOC, BAPCO, NOC Libya, NNPC – Nigeria, PDO – Oman, Saudi Aramco, Sonangol and SOCAR.

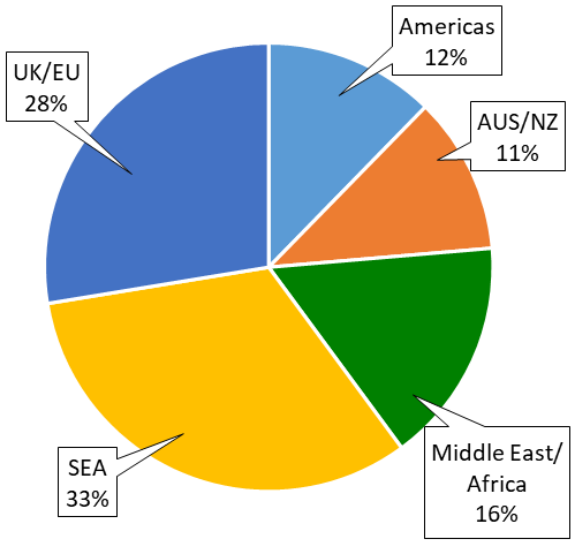
3. Data gathering and methodology

Data and insights for the project were obtained through a survey of IChemE members globally, and a series of regional workshops to build on the survey results. The survey analysis and workshops were carried out in five key regions for IChemE, namely - United Kingdom and Europe, the Americas, Middle East and Africa, Southeast Asia, and Australia and New Zealand.

3.1 Survey

The survey questions (Appendix 1) were designed to explore how chemical engineers are impacted by the ongoing changes in the oil and gas sector, the factors that influence those impacts and their perspectives on how to navigate through the changing energy demand landscape. The survey was intended to identify any global or regional trends emerging from the energy transition or response to climate change as it was anticipated that changes in the oil and gas industry would have varying effects on different regions.

The survey was carried out from December 2023 to February 2024 reaching more than 200 respondents (see pie chart below). Results from the survey provided the context for the subsequent online workshops.



Distribution of responses by region

3.2 Workshops

IChemE members were invited to participate in the workshop for their region. The survey results were provided as pre-read information to provide the participants with the key feedback for their region.

The 1.5-hour workshops focussed on two questions:

- Part 1 – How will future changes in the oil and gas industry affect you and other chemical engineers?
- Part 2 – What are the critical actions for IChemE and members?

Sixty-six IChemE members participated in the workshops. Feedback from the workshops was collated and analysed to identify key themes and recommendations.

4. Survey key themes and insights

4.1 Survey global observations

In designing the survey, it was recognised that global energy demand is forecast to increase, whereas requirements to reduce greenhouse gas emissions will inevitably lead to reduced proportion of oil and gas in the overall energy supply mix. Various scenarios forecast a reduction in oil and gas use and diversification of energy sources, with significant regional

variations. Globally, other factors such as energy security, affordability and technology are expected to affect consumption.

IChemE member feedback reflected this high-level context and highlighted several key issues:

- Most survey respondents expected oil and gas demand to decline over the next decade but remain significant.
- Energy security, affordability and emissions were all considered important by respondents across all regions.
- Energy transition is perceived to be having a moderate to low impact now and is expected to become more significant.
- Policy, economic and technology gaps are prevalent issues across all regions.
- Technology strategies are seen as critical enablers in addressing energy transition, and Carbon Capture Utilisation and Storage (CCUS) and hydrogen are considered key decarbonization enablers.
- Technical skills and understanding new technology were seen as most important new skill areas, but other skills (eg economics, emissions reporting etc) were also considered important.
- Training, on the job learning and industry knowledge sharing seen as the most important route to enhancing technology skills; other methods (eg university, research etc) were also considered important.

IChemE members completing the survey believed there were opportunities across all regions for professional institutions to respond to the above issues by providing insights on industry trends, technology and policy updates, support for R&D, upskilling via training and sharing of best practice, and influencing development of policies.

4.2 Survey regional perspectives

There were certain areas where regional responses diverged from the global results. Some of these are noted in the following sections.

4.2.1 Americas

- Respondents in the Americas have significantly higher expectations of the likely development of new oil and gas reserves in the next 5-10 years compared to the global response.

4.2.2 UK and Europe

- A greater proportion of UK and EU respondents felt the energy transition would impact work-related activities, projects and decisions over the next 5 years (61%) compared to the global average (52%).
- More respondents (87% UK and EU, compared to 75% Global) felt the energy transition activities were currently moderate or significant.
- A smaller proportion (circa 60%) of people in the UK and EU believe the development of new oil and gas reserves is likely compared to the global sample (about 75%). The results were mimicked at the 10-year level, with a drop in positive responses to around 40%.
- Most respondents from the UK and EU expected that the proportion of oil and gas will fall from 50-70% to 25%-50% of the energy mix in 10 years' time. This was lower than the global average, where a majority responded that oil and gas contributed >75% currently and will contribute up to 50-70% of energy in 10 years' time.

4.2.3 Southeast Asia (SEA)

- Energy security and affordability were seen as priorities in SEA, where there is also growing pressure for emission reductions. The survey indicated more emphasis on affordability in the region, compared to the global feedback.
- Respondents expect oil and gas to remain predominant in the overall energy mix in SEA region, although about half of the respondents expected this to change significantly over the next 10 years.
- Hydrocarbon exploration and development are expected to continue to a peak in SEA region in the next 5 years.
- CCUS and renewable energy technologies are seen as more critical for SEA compared to global responses, with hydrogen being of equal importance.
- SEA respondents emphasised the importance of development of sustainable energy systems based on renewable energy to support economic development, address climate change, and achieve energy security and affordability goals.

4.2.4 Australia and New Zealand (AU/NZ)

- AU/NZ and global responses are broadly similar, with renewables, hydrogen, CCUS and electrification seen as the most critical technologies.
- AU/NZ chemical engineering demand is expected in the areas of screening, design, project management and operations.

4.2.5 Middle East and Africa (MEA)

- About 88% of MEA respondents believe the energy transition will impact work-related activities, projects and decisions over the next 5 years. A greater proportion of MEA respondents felt it would have a significant impact (58%) compared to the global average (52%).
- Energy transition is having a low impact currently and is expected to become more significant.
- Over the coming 10 years oil and gas demand are expected to reduce but remain significant.
- Energy security, affordability and emissions were all considered important.
- Renewables, hydrogen, CCUS, electrification seen as key technologies.
- MEA chemical engineering demand expected across design, R&D, project management, operations, and option screening.
- The majority of MEA respondents (58%) felt strongly that energy security was a priority compared to 39% globally. MEA was highest for all regions, and this was an unexpected result. However, the workshops could not explain these data. Subsequent discussions suggested this may have been due to the wide range of interpretations given to 'energy security' and probably related to 'affordability'.

5. Feedback from regional workshops

5.1 Changing future of oil and gas

5.1.1 Outlook for oil and gas

- Although oil and gas production and consumption are forecast to decline, IChemE members expect the transition pace and pathway to vary by region and considerable uncertainty remains.
- While oil and gas will undoubtably become a decreasing share of the energy mix, the entire global energy system will need to be overhauled, and this will likely take decades.
- Workshop attendees also anticipated that oil and gas will be needed for some time in developing economies. It will be required to sustain global activity while renewable resources and energy infrastructure are developed and implemented at scale. In broader terms, technology, policy and finance are all relevant factors for transition.
- For example, the Middle East regional demand profile anticipates a significant proportion for oil and gas in the energy mix, albeit with emissions reduction and

carbon abatement implementation. Although oil and gas production are anticipated to remain predominant for some time in the region, major National Oil Companies (NOCs) in the region are committed to substantial operational emissions reduction near term and to 'Net Zero' by 2050 at the latest.

- In SEA renewable resources are slowly displacing oil and gas, but the change is expected to be slow, due to several factors:
  - Alternative sources of energy such as renewables were considered uneconomic and unreliable at present, requiring the need to demonstrate practicality and predictability in real world applications.
  - Participants considered demonstration of total carbon footprint and lifecycle analysis of renewable facilities was still needed.
  - Competition to secure biofuel base feedstock.
- Europe and Australia/New Zealand (AU/NZ) are diversifying from oil and gas to alternative energy resources relatively more quickly because of economic factors, security of supply concerns and progressive policy initiatives. Oil and gas development projects are becoming smaller, although engineers in the region are still engaged in larger developments around the world.
- All regions are seeing an increase in activity related to emissions reduction, energy efficiency, corporate emissions reporting, electrification of operations and increased use of renewables.
- Falling oil and gas demand will also result in declining asset utilisation and a need to reconfigure and repurpose facilities to maintain efficient operation and respond to market needs. Energy transition means industry should be reviewing future demand and potential triggers for these decline projects in advance.

5.1.2 Outlook for energy transition

- While workshop participants expected oil and gas to be displaced in the energy mix by renewables in the medium to longer term, progress is currently perceived to be relatively slow. Typical barriers experienced in practice are:
  - Costs and risks associated with newer technologies.
  - Government policy and regulatory uncertainties.
- For example, there is a perception that the EU/UK are more progressive, and this is in part due to policy initiatives such as emissions trading.

However, workshop attendees felt the regulatory pathway remained unclear.

- By contrast many areas of the developing world may have to rely on oil and gas revenues for development in the near term and then to finance the energy transition.

For example, new refineries are being built in West Africa to reduce dependence on imported products, support energy security, and help to reduce costs and prices. Representatives from the Middle East and Africa noted the major reliance on heavy fuels for domestic heating and industry, although there is some movement towards gas to reduce carbon footprint, and internal combustion engines still dominate in transportation. Traditional oil and gas opportunities are available and, although there is significant potential for use of hydrogen, solar and wind, there is currently not a rapid move away from fossil fuels. However, opportunities do exist for engineers to contribute to new technology and policy initiatives in developing areas.

- IChemE members expect that diverse technology and system-wide solutions will be required for the energy transition. These include electrical infrastructure development, enhanced data monitoring and reporting, electrification (including vehicles, industry and domestic consumption), hydrogen infrastructure, short- and long-term energy storage, low-carbon fuels, and Carbon Capture Utilisation and Storage (CCUS).
- Although technologies such as CCUS have seen some false starts in the EU, there are some longer-term projects being pursued through 'Regional Clusters'. Meanwhile, there is significant activity in some Middle Eastern National Oil Companies, where there is a greater strategic imperative and capacity to handle financial risks.
- In the meantime, there is a significant and growing effort underway in all regions on reducing operational carbon footprint. Energy efficiency and fugitive emissions are a near term focus, and electrification is a key technology challenge.
- Oil and gas companies are also evolving into energy companies, and diverse sources such as geothermal are being progressed. A significant role for gas in reducing emissions was also seen in the short term.
- Workshop participants noted that innovation and breakthrough technologies have the power to change the landscape quickly and disrupt plans. Consumers will adopt desirable new products and technologies at the right price.

5.1.3 Impact on oil and gas employees

5.1.3.1 Existing employees

- While there has been significant workforce churn in Australia and NZ due to the changing oil and gas industry, and to some extent in Europe/UK, the expectation of major job losses in the future was diminishing (note this feedback was before the UK election).
- These same workforce trends have not been seen in most of the other regions involved in the study. Refineries in Southern Africa have shut down with widespread job losses, but new refineries have been developed in West Africa and more are expected in the medium term. There may be new opportunities in Africa generally, but

many chemical engineers have moved away – particularly to the Middle East. There is also a demand for experienced engineers to help shape the energy transition on the African continent – especially as the continent is expected to significantly increase its per capita energy consumption over the next decade.

- While many oil and gas companies are investing in renewable energy, the scale and nature of these projects is requiring engineers to evolve their skills. Oil and gas companies have been providing support for engineers and technicians to develop new skills.
- Many engineering firms are continuing to work globally from existing centres in the US and EU/UK, while growth areas such as India are seeing rapidly increasing engineering capabilities.

5.1.3.2 Job opportunities

- Several of those attending workshops shared experiences of transitioning from core oil and gas activities to roles related to the wider energy transition and to other sectors, demonstrating that in many cases change should be manageable. A general conclusion was that chemical engineering fundamentals, systems thinking, project and operations management, and business experience will remain relevant through the energy transition and across various sectors.
- Engineers with oil and gas experience are now involved in hydrogen business development, electricity industry, renewable energy and CCUS projects. Some considered it easier to transition to different roles and sectors at earlier career stages.
- Meanwhile, engineers working in oil and gas are becoming increasingly involved in emission reduction and energy efficiency activities, and electrification/renewable power projects. For example, changes in corporate (energy) disclosure in SEA mean that chemical engineers are playing key roles in emissions monitoring/measurement and driving decarbonization efforts.
- Many believe there is an urgent need to equip and keep future chemical engineers abreast with the new challenges they face, for example, venting/flaring/emissions management and process optimisation, new energy technology, together with digitalization and the interplay with data science.
- Chemical engineers are also increasingly working with other disciplines to develop the overall clean solutions such as electrification, CCUS and low carbon energy, hydrogen and its infrastructure. Building awareness and cross-skilling in these areas was seen as beneficial.
- Many observed that new talent is becoming harder to attract in most regions, with engineering not always appealing to the younger generation. The oil and gas industry has particular challenges in some regions because of perceptions about the sector. Significant ongoing effort is required to attract new talent into engineering and those

working in oil, gas and energy transition expressed willingness to support outreach efforts (see section 5.2.2).

5.2 Advocacy and brand

- There was a general message from members in the study that IChemE should demonstrate thought leadership and be more engaged in policy advocacy on energy transition topics.
- Workshop attendees believed IChemE and its members should be encouraged to be more proactive in engaging with governments, and in working in partnership with others (eg AIChE, SPE). Technical advocacy should be part of a broader strategy on the energy transition.
- Members were unclear on IChemE strategy in relation to energy transition. Some observed that the IChemE Position on Climate Change has been developed, but this mainly defines an end point and focus is needed on actions.

5.2.1 Government policy

- Workshop attendees felt chemical engineers can and should play an important role in the debates related to energy transition.
- Engineers perceive there can be a lack of 'technical reality' in much public policy and there is a piecemeal strategy to change. Some felt it was often driven by broad economic assumptions, which do not accurately reflect the technical and deliverability challenges, and ultimately impact costs.
- Some feel the energy transition dialogue needs a refresh and needs to balance around broader energy and industrial policy, which involves of a mix of solutions.
- Many believed that IChemE and its members should also emphasise emissions reduction and energy efficiency, alongside alternative energies. Carbon capture, hydrogen, electric vehicles should be recognised as key areas of future activity.

5.2.2 Chemical engineering and oil and gas brand

- There were some general messages relating to the need to enhance perception of chemical engineering to encourage new talent into the profession and gain recognition for the part chemical engineers play.
- Members believe people outside of the IChemE and process engineering should be more familiar with the Institution and its relevance. IChemE should continue to reach out to chemical engineering and other engineering graduates on the role of chemical

engineers highlighting the profession's importance to support sustainability, climate change actions and the energy transition.

- There were many discussions in the workshops on the need to attract new talent into chemical engineering:
  - Many have wrestled with the question: "How do you attract 18-year-olds into Chemical Engineering?"
  - Does the word "chemical" put off the younger generation? Is some rebranding of IChemE needed?
  - Some workshop attendees suggested we need to "*Make engineering cool again*" – by enhancing outreach and leveraging other volunteering bodies to reach out to school children and communities.
- Some felt the transferable skills of chemical engineers and their application across the diverse aspects of the energy transition should be publicised. One suggestion was a poster or infographic mapping chemical engineering applications and touchpoints along the value chains.
- A more positive portrayal of engineers working across the energy industry, including oil and gas, would be helpful in encouraging engineers to continue to support the ongoing change process. Oil and gas are vital to society today, will help deliver the sustainable development goals in the future, and the experienced people and funds generated will ultimately drive the energy transition.
- *The Chemical Engineer* in-house publication is well-received by members, including regular articles related to the energy transition. Some would like it to include more on policy, in addition to technical matters.

5.3 Academic curriculum

- Workshop attendees felt courses which are accredited by the IChemE should prepare students adequately for the energy transition.
- Some believe there is a misconception around the skills needed for the energy transition. Core chemical engineering knowledge and skills will be required, in addition to a diverse set of engineering skills (eg data management, electrical engineering, business management).
- The chemical engineering syllabus should be continually enhanced to embed decarbonisation and sustainability. Workshop attendees felt that some topics such as economics/carbon accounting and policy are becoming as important as traditional chemical engineering topics.

- Attendees suggested that IChemE and its members could support the ongoing evolution of academic programmes by reviewing the syllabus and providing content, as well as programs to upskill educators.
- One suggestion was for practicing engineers and academics to come together in regional forums (where this does not happen already) to enhance academic delivery and link industry to research and innovation.
- Many attendees believed innovation and R&D will have a role in driving change (eg lithium extraction from produced water).

5.4 Continual professional development and training

5.4.1 Evolving chemical engineering careers

A key observation from the workshops was that the energy transition is not something occurring in the near future, but that it is happening now. Many of the workshop attendees had an oil and gas industry background but were already taking on tasks and roles related to the energy transition. Some attendees were building new skills in emissions and energy management or working on renewable power projects in oil and gas. Some were working on repurposing or decommissioning existing oil and gas assets, or extending the geographical focus of their core oil and gas roles. Others had already taken opportunities in businesses such as hydrogen, green energy supply and storage, and carbon management. Key messages from the workshops included:

- Chemical engineering fundamentals, practical industry experience and business skills provide a solid and enduring foundation for a broad range of potential careers. Feedback from members demonstrated that experience gained in the oil and gas industry is applicable in a wide range of settings.
- It is important that IChemE members in oil and gas build awareness of the energy transition and develop their own plan for up-skilling/cross-skilling and career mentoring to play their part and help navigate the transition.
- IChemE and its constituent groups can support members in their professional development by providing and signposting:
  - Awareness building opportunities.
  - Selected training offerings.
  - Career advice and mentoring.
- Links to others with common interests, through Special Interest and member groups.
- There was a clear message that attendees wanted to hear ‘career-stories’ and experiences of people with oil and gas backgrounds, who were successfully evolving their careers in the light of the evolving energy landscape.

5.4.2 Continuing professional development and training

The workshops identified opportunities for IChemE and its Special Interest Groups (SIGs) to support members through the energy transition by facilitating webinars, publications, selected structured training (or signposting to external resources) and career support at all career stages. There was a particular emphasis on understanding the practical application and readiness of technologies. Understanding and making the 'business case' for transition related projects was also seen as critical. The universal positive feedback for the part played by IChemE's in-house magazine *The Chemical Engineer* in providing technology, policy, industry and career updates was notable.

Some key feedback from the member workshops is summarised below:

- Workshop attendees identified key topics of interest, including:
  - Flaring, venting, energy efficiency and other emissions reduction technologies for oil and gas operations, including case studies and business case metrics for screening. Some topics could be targeted at asset engineers and include small/medium projects that may get missed.
  - Energy production, storage and management – including power generation, electrification, basic electrical engineering, batteries and other storage systems, demand management and electrochemical engineering.
  - Renewable power project experiences, technology readiness and business cases/economics.
  - Carbon Capture Utilisation and Storage (CCUS) experiences, business cases and regulatory aspects.
  - Energy transition and climate related policy and regulatory developments.
  - Recommendations on economics for new energy related projects. For example, it may not be justified to apply same risk/hurdle rate as for oil and gas exploration and development projects.
  - Design and lifecycle principles for dealing with excess plant capacity and rationalisation; for example, design allowing for turndown, triggers for simplifying/downsizing, remote operation/automation/simplification of existing assets. Also, decarbonisation options for repurposing existing assets (eg use of different feedstocks, modified processes, biological processes).
  - Learning from other industries and broader aspects of energy transition, such as processing of critical minerals, could also be useful (eg lithium, vanadium).
- Awareness building through webinars, publications, workshops and sharing experience were seen as key vehicles for member support. A role for more structured training was also identified in the workshops:

- Hydrogen related courses were seen as a 'good start' by some and could provide a base to build on.
- Cross-discipline learning was seen as important. Structured courses that enable chemical engineers to speak comfortably to other disciplines (eg electrical engineers, lawyers etc) could support members in the multi-disciplinary approach required for the energy transition.
- IChemE is bringing new energy transition related offerings, but geographical coverage could be enhanced. For example, some in the MEA region perceive there is a gap and IChemE could help the local universities develop more courses in these areas.

- There was also a debate around how training should be provided. While many felt there was a role for IChemE to provide training suitable for members, it was recognised that there are many external providers who may well be in a better position to provide the type of courses needed for the future. Signposting and partnering might be a better approach in these instances.
- Some innovative ideas emerged from the workshops, which are likely beyond the scope of what the institution and its members could deliver in the near-term, but these were captured for future reference. For example:
  - A roadmap of what the future energy transition and systems might look like, could showcase how chemical engineers fit into different positions with different roles, using a system-wide thinking.
  - A career transition toolbox could be developed that is relevant to the energy transition.
  - A comprehensive technology readiness and project status databases could support those working on transition projects.
  - In the future AI tools might be able to support career development.

5.5 IChemE interest groups, networks and collaboration

5.5.1 Oil Gas and Energy Transition Special Interest Group

The surveys and workshops identified an array of needs and opportunities for supporting members involved in the oil, gas and related sectors as the global energy system transitions. This included support for those involved in the ongoing activities of the sector, as well as responding to the evolving landscape of policy, technology and career opportunities (over 3,700 IChemE members have a special interest in oil and gas, or around 12%). It was concluded that an Oil Gas and Energy Transition Special Interest Group (OG&ET SIG) within IChemE's Learned Society area would be the best way to take forward the proposals from the project and provide ongoing support to members. Such a group could:

- Act as a focal point for engagement with relevant IChemE members and staff, and for external activities related to oil, gas and the energy transition
- Organise a programme of webinars and awareness building activities for members with an interest in both oil and gas and relevant energy transition areas.
- Develop networks to connect and support members in the relevant area of interest. Active member networks could support specific areas, such as policy and new technologies. *IChemE Connect* communities and LinkedIn groups could enable this.
- Partner with related SIGs/groups with an interest in the energy transition area to deliver member offerings and coordinate unified positions.

This approach would support members in being proactive in driving the energy transition and maintain the momentum built during the project. It would also provide volunteering opportunities for members to contribute to the work of the institution in this area and for personal growth.

5.5.2 External collaboration

It was recognised that IChemE is just one player in the large array of organisations involved in the energy transition. It is necessarily a multidisciplinary effort, where others may be in a better position to access key decision makers and achieve progress. Collaboration with selected organisations would leverage IChemE efforts and provide mutual benefits. Some of the organisations mentioned in the workshops included:

- National Engineering Policy Centre (UK)
- Engineers Australia (EA)
- American Institute of Chemical Engineers (AIChE)
- Society of Petroleum Engineers (SPE)
- IPIECA – the global oil and gas association for environmental and social issues
- International Oil and Gas Producers Association (IOGP)

6. Recommendations

Recommendations from the Changing Future of the Oil and Gas Industry study are summarised in the Executive Summary. Specific actions are presented in this section and more specific supporting information is contained in Section 5.

Topic	
1. Future of oil and gas in IChemE	
1.1 Oil Gas and Energy Transition SIG	Establish an Oil Gas and Energy Transition Special Interest Group (OG&ET SIG) as the lead volunteer group to progress implementation of the report recommendations and support members with an interest in the industry sector (Report Section 5.5)
2. Advocacy, strategy and brand	
2.1 Advocacy	IChemE and its members should continue to enhance policy engagement activities to ensure a sound technical basis and *Just Transition* for those affected (Sect 5.2.1). This could be facilitated by formation of active member networks to support these efforts (see Recommendation 5.1)
2.2 Transition strategy	The OG&ET SIG should work with others to build on this report over time to create a more comprehensive picture of the evolving transition and refresh the recommended response strategy (Report Section 5.2)
2.3 Brand	A positive dialogue should be promoted on the essential role of oil and gas and chemical engineers in the energy transition. Particular emphasis is recommended for new chemical engineering talent and the next generation of engineers. (Section 5.2.2)
3. Academic institutions and new talent	
3.1 Academic curriculum	OG&ET SIG should work in partnership with staff to ensure the core chemical engineering curriculum of accredited courses remains relevant to the energy transition (Report Section 5.3)
3.2 Industry – academia forums	IChemE members with energy transition experience should where possible participate in forums that bring industry and academia together. This would be facilitated by building a partnership between the proposed OG&ET SIG, and Qualifications and Member Experience/Engagement staff (Section 5.3) inter alia.
3.3 New chemical engineering talent	Outreach to the potential engineers of the future (including for the oil and gas sector) is also vital and member volunteers should support staff in these efforts (Report Section 5.3)

4. Continual professional development and training	
4.1 Continuing professional development	Oil and Gas Sector engineers should be encouraged to establish their own plan for continually growing their skills for both their current role and for the future. This should include maintaining awareness of potential transition pathways and consider opportunities for upskilling and cross skilling (Section 5.4.1)
4.2 Awareness building of transition policy, Technology and career development	A series of IChemE webinars and published articles should be developed by the OG&ET SIG and other relevant groups to build awareness on transition and technology readiness topics, including: ■ Global and regional policy developments ■ Emissions reduction, energy efficiency, CCUS, renewable power, energy storage and demand management ■ Asset rationalisation and repurposing, transition project economics and practical case studies (Report Section 5.4.2 for more details)
4.3 IChemE training	OG&ET SIG should engage with staff and volunteers in appropriate areas to share opportunities for upskilling and reskilling training in energy transition related topics. Skill building for a multi-disciplinary environment (eg 'Electrical Engineering for Chemical Engineers'), project economics and legal aspects are needed, in addition to the topics mentioned in Recommendation 4.2
4.4 Career support and mentoring	OG&ET SIG should be ready to partner with relevant staff to support mentoring and sharing of transition career experiences (Report Section 5.4)
5. Networking and external collaboration	
5.1 Networking	OG&ET SIG should establish partnerships with related SIGs/groups in the energy transition area and develop active supporting networks of members with energy transition interests (eg policy, renewables). An IChemE Connect community and Linked in Group could support this (Report Section 5.5)
5.2 External partnerships	IChemE Policy networks and Learned Society groups should seek to selectively build on the partnerships established with bodies such as National Engineering Policy Centre, American Institute of Chemical Engineers and Engineers Australia. This might include the international oil and gas industry association for advancing environmental and social performance (IPIECA), International Association of Oil and Gas Producers (IOGP) and Society of Petroleum Engineers (SPE) (Section 5.5)

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