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*We Facilitate Knowledge Exchange*



# Oryx GTL Majlis Series Leading the Way!



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# About The ORYX GTL Knowledge Series

A Knowledge Series produced by Gulf Intelligence held at the ORYX GTL exhibition stand at the 20th World Petroleum Congress Exhibition with the purpose of engaging stakeholders in a dynamic exchange to bolster the ORYX GTL posture as a Thought Leader in the energy industry.

## **AGENDA**

- Dec. 5th 2011      *Session A: GTL Past & Present: What the Media Should know?*  
ORYX GTL Speaker: Anton Punt, Lead Business Analyst  
Guest Speakers: Dragan Djakovic, SASOL Business Development Manager; Eithne Treanor, CNBC Arabia Special Energy Correspondent
- Dec. 6th 2011      *Session B: Developing Local Talents*  
ORYX GTL Speakers: Walter Green, Head of Training and Development  
Guest Panelists: Dr Abdelmagid Salem Hammouda, College of Engineering Qatar University; Rob Taylor, Vice President Global Business Development, International Human Resources Development Corporation; James McCallum, CEO, Senergy
- Dec. 7th 2011      *Session C: ORYX GTL 100th Shipment: Where's it Going & What's Next?*  
ORYX GTL Speakers: Nafal Al-Hajri, Head of Sales; Gary Frank Von Berg, Marketing Manager  
Guest Speakers: Abdul Al Naemi, Marketing Director, Refined Products at Tasweeq; Bill Farren-Price, CEO, Petroleum Policy Intelligence
- Dec. 8th 2011      *Session D: Can Qatar Emerge as Global Energy Industry R&D Hub?*  
ORYX GTL Speakers: Ettiienne Rademeyer, Chief Operations Officer  
Guest Speakers: Dr Mark Weichold, Dean & CEO, TAMUQ; Dr Namir Elbashir, Assoc. Professor, Chemical Engineering, TAMUQ

# About The Congress & Exhibition

The triennial World Petroleum Congress was held from 4-8 December 2011 with more than 4000 delegates, 600 media and 550 presenters participating in a programme that covers all aspects of the Energy Industry, from technological advances in upstream and downstream operations, to the role of natural gas, renewable and alternative energy, the management of the industry and its social, economic and environmental impact.

The World Petroleum Exhibition, held alongside the congress features exhibits from the national committees of the World Petroleum Council, which include the most prestigious national oil and gas companies and agencies of the world. It also showcases the most important international oil and gas companies alongside key suppliers, service companies and manufacturers. This is the most significant global exhibition dedicated to the oil and gas industries.



## Gas to Liquids Era Just Dawning as Natural Gas Rich World Seeks Lower CO<sub>2</sub> Footprint

The unlimited potential of converting natural gas to liquids sits well in a country that has unrivalled vision for the potential of harvesting the world's third largest natural gas reserves. To dream the biggest dream is a national pastime in Qatar, with the additional caveat that this country has a knack of making dreams come true.

**PREPARE FOR THE** unexpected to be realized is a defining attribute of Qatar and one which the country's GTL industry has taken to heart – ORYX GTL produces enough clean, life giving, irrigation water – 200 cubic meters per hour -- to irrigate a 27-hole golf course. In a desert country such as Qatar, this is a valuable byproduct that currently irrigates all the landscaping needs in Ras Laffan Industrial City.

Before the second smallest Arab country dreamt about hosting The World Cup, it declared its ambition to be the largest producer of gas-to-liquids and spent the last decade achieving that goal. Qatar is now well placed to transform this successful posture into a dominant player that can shape the future GTL industry as it spreads across the world.

GTL, still in its infancy from a historical perspective, is a technology that is geared to



## More on ORYX GTL

A joint venture between Qatar Petroleum (51%) and Sasol of South Africa (49%). It is the first of a series of planned GTL production facilities that will deliver on the declared ambition of the State of Qatar to become the GTL capital of the world. The conversion of natural gas into liquid fuels is an attractive option to commercialize the world's third-largest gas reserves.

ORYX GTL is an integrated energy company globalizing premium, environmentally friendly GTL products. The joint-venture company actively pursues stakeholder satisfaction and creates a culture of operational excellence and continuous improvement in a zero harm manner.



unlock the world's vast natural gas resources for conversion into ultra-low emission diesel and other environmentally benign energy products.

For Qatar, shepherd of the world's largest independent non-associated gas field, it is a technology that complements its existing natural gas investments and supports Qatar's 2030 vision of adding value and diversifying its economy, all at a time when the world is struggling to add more crude oil production capacity.

The 1 billion Qatari-South African joint venture is the foundation of Qatar's desire to be pre-eminent in the establishment of a global GTL industry and is important for Qatar in terms of monetizing its gas reserves whilst diversifying its product range, His Excellency Abdullah Bin Hamad Al-Attiyah, Deputy Premier and Chairman of the Administrative Control and Transparency Authority, said at the commissioning of the ORYX GTL plant in 2006.

A joint venture between Qatar Petroleum and Sasol Ltd. of South Africa, it was the start

of a series of planned gas to liquid production facilities in the Emirate that has seen more than 120 cargoes depart Ras Laffan for world markets since its inauguration. It was the world's first commercial scale gas to liquids plant, producing GTL Diesel, Naphtha and LPG, and stands ready to break more records in support of Qatar's long-term vision.

The unique crucial value proposition is that GTL does not require the construction of a new delivery infrastructure like other new green compatible energy sources – it converts natural gas into liquid fuels that can go into existing fuel distribution infrastructure, use existing transport ships to bring it to the diesel terminals and sold through existing retail outlets and ultimately utilized by the same diesel engines, which today amounts to 55 percent of Europe's light-passenger car fleet.

Qatar's foresight to bet on GTL is prescient as the world goes deep in search of a lower carbon footprint – from "well to wheel" studies have shown that total greenhouse gas emissions are comparable



or sometimes lower than traditional refining processes. This is due to superior emission qualities or efficiency gains related to GTL products. This fact is relatively unknown due to a limited GTL presence in areas where the public would notice, such as public transport.

The biggest greenhouse gas emitters, China, the US and India, will be legally bound for the first time to cut their emissions in a new international climate change treaty to be signed by 2015 and to come into force by 2020. The "Big Three" polluters finally agreed on Dec. 11 to a legal regime of emissions cutting at the close of the UN Climate Conference in Durban, South Africa.

Learnings from ORYX GTL have shown that future GTL projects, already planned, will be of higher capacities for similar major equipment size. This together with key technology breakthroughs, such as reforming and catalysis, recently achieved will make future projects significantly more efficient and economical.

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**Anton Punt is Head of Process Engineering at ORYX GTL.**

The demand for gas to liquids transportation fuels could soar sooner rather than later if Christophe de Margerie, the chief executive of Total, the fourth largest oil company, predictions come to fruition. He told the 20th World Petroleum Congress that the world may not be facing peak oil supply but it may be facing peak oil production. The French oil giant is forecasting that crude oil production will plateau at 95 million barrels per day around 2020, up from about 89 million bpd today.

According to Total's "95 theory", falling output from old wells and scarce new ones mean we will not be able exceed this "plateau" of production regardless of effort as we are already having to find 4 million bpd just to compensate for depleted wells -- very sobering if we consider that conventional economic predictions expect us to need 130 million bpd by 2020.

The future is bright for gas to liquids. ■



## More on Qatar

The Emirate is the world's largest producer of LNG, or gas cooled to a liquid for transportation by ship. By the end of this year, it is scheduled to complete the final two or 14

planned LNG units, raising annual production capacity to 77 million tons. The country built its LNG plants in partnership with international energy companies

including Exxon Mobil Corp., Royal Dutch Shell Plc, Total SA and ConocoPhillips. Shell's Pearl GTL gas-to-liquids plant is due to be operating fully by next year.





## Developing Local Talent is Key to Avert Shortage of Petroleum Engineers

The energy industry is a cool place to work! At least that is what the generation who came into the industry in the 1970s and 1980s thought. Of course that was before Yahoo, Google and Facebook started to compete for the dreams of aspiring engineers and scientists.

**OUR HAIRIS** a little shorter and a little greyer, but that enthusiasm for the exciting pioneering work of the energy industry still runs through the veins of my generation and we have an obligation to use the last decade we have before retirement to communicate that opportunity to a new generation and ensure we leave the business well supplied with future minds.

One of the most pressing issues facing the petroleum industry is developing, attracting and retaining a highly skilled talent pool and replenishing an ageing workforce with a new generation of future leaders -- Cambridge Energy Research Associates produced a prescient survey in 2007 of international energy executives that highlighted that more than 50 percent of engineers employed in the industry at that time would be retired by 2015.

Time is short! Especially when you bear in mind that the historical source of petroleum engineers came from the West and since the 1970s, when 40 colleges in the U.S., the world's largest energy consumer, offered degrees in petroleum engineering, today, now there are less than 20.

The development of local talent in energy resource-rich countries is one of the key ways for the global energy industry to avert the pending talent shortage crisis.

Qatarization, Emiratization and other national programs that provide career development paths for Gulf nationals to enter their country's respective energy industry are now about a decade old and an absolutely essential necessity to ensure that resource holders have the competent skills in country to manage and develop their vast hydrocarbon wealth through the 21st century.

In the state of Qatar, the program is designed to increase the number of Qatari nationals in all joint venture industries and government departments – the target is 50% of the workforce in the Industry and Energy sector, which presents a great challenge to us all given the increasing number of career options that are open to young nationals in an economy that is seeing consistent double digit growth.

The energy and industrial sectors in Qatar, which holds the world's third-largest natural gas reserves, currently employs about 5,500 Qataris holding permanent positions, with a further 4,000 undergoing requisite training.

ORYX GTL, a joint venture between Qatar Petroleum and South Africa's Sasol Ltd., has almost a third of its work force made up of Qatari Nationals and provides them with every opportunity for high quality learning,

training and development. Employers should be encouraged to engage more with facilitating a coaching and mentoring culture as part of long-term plan to retain this next generation of local talent once they have stepped through the door.

The key to retaining talent in the industry is to provide multiple opportunities for career development, meeting the aspirations of the employees and ensure that their core competencies continue to grow and are rewarded for doing so – especially in the technical side of the business. But industry can no longer wait for a supply of young graduates to come knocking on their doors. It is crucial to engage in a direct partnership with academia and develop outreach programs that connect with children while they are still in school.

Qatar University, where ORYX GTL sponsors the Chair of Mechanical Engineering, has realized the value of making the energy industry appear cool.

“ It is crucial to engage in a direct partnership with academia and develop outreach programs that connect with children while they are still in school.

The Emirate's biggest university has developed a school program called Gasna, the Arabic for Our Gas, which is built around the objective of getting Qataris to feel ownership and pride over their blessed resources through engaging them through the love all young people have for cars – they teach the kids about the magical engineering behind how a car works and also give them the opportunity to take the car to the race track.

The energy industry has done a relatively poor job in recent decades communicating the excitement and reward that the field offers over the length of a career. The economic challenges presented by the current global economic difficulties facing so many other industries presents the energy industry with a vital window of opportunity to tell the story of a very exciting business that is hiring today and tomorrow and will be a key engine of growth through the 21st Century. ■

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**Walter Green is Head of Training and Development at Oryx GTL.**



## Gas to Liquids 2.0 as the Industry is Set to Break New Markets

The Gas to Liquids technology is opening up new markets for natural gas as its products are tied to the high-value oil market. This allows gas resources to enter into the existing transportation fuel market which is predicted to have a supply-demand deficit in the foreseeable future.

**THE DEMAND** for gas to liquids transportation fuels could soar sooner rather than later if Christophe de Margerie, the chief executive of Total, the fourth largest oil company, predictions come to fruition. He told the 20th World Petroleum Congress that the world may not be facing peak oil supply but it may be facing peak oil production.

The French oil giant is forecasting that crude oil production will plateau at 95 million barrels per day around 2020, up from about 89 million bpd today – global oil demand forecasts are seen rising to 120 million barrels a day by 2030.

ORYX GTL, the world's first commercial gas-to-liquids project, has played a pioneering role to build and diversify the international customer base for these environmentally-friendly gas-to-liquid products. The primary upgraded products produced by the Fischer-

Tropsch process are synthetic diesel, naphtha, lubricants and more specialized commodities. They are clean burning, almost odourless and biodegradable – qualities that make them very attractive in particular to European refiners.

Since starting commercial production in 2007, ORYX GTL – a \$1 billion joint venture between Qatar Petroleum and South Africa's Sasol - has exported more than 25 million barrels of premium products in more than 120 cargoes. The products were sold initially on the spot market and subsequently have matured to three- to six-month term contracts as customers got more familiar and dependent on these fuels.

The challenge of exploiting remote gas has partly been overcome by chemically converting it to methanol or ammonia (for fertilizers), or cooling it to liquefied natural gas. All of these products can be readily

transported on land and at sea. GTL has now established itself as another economically attractive option, producing synthetic oil from natural gas.

Large gas reserves can in this way be tied to oil market transportation fuels without the market challenges associated with natural gas. The GTL process offers the potential to convert gas to higher value, high purity, and synthetic liquids like diesel, naphtha and lubricant base oils which can be transported to consuming markets.

At triple digit oil prices the GTL process may create greater value than the main alternatives for gas monetization.

The technology is a catalytic process invented by two German scientists and has been known since the 1920's -- indeed, Germany produced petroleum from coal in this way to partly fuel its military machine during the Second World War. However, it is only in recent years with much help from industry leader ORYX GTL that the process has been sufficiently advanced to produce hydrocarbon liquids economically from natural gas.

The Qatari-South African joint venture adopted a 'broad-brush' approach to GTL sales from the get go to maximize product availability to a diverse base of clients who seek high-performance, low-emission diesel and high-grade naphtha.

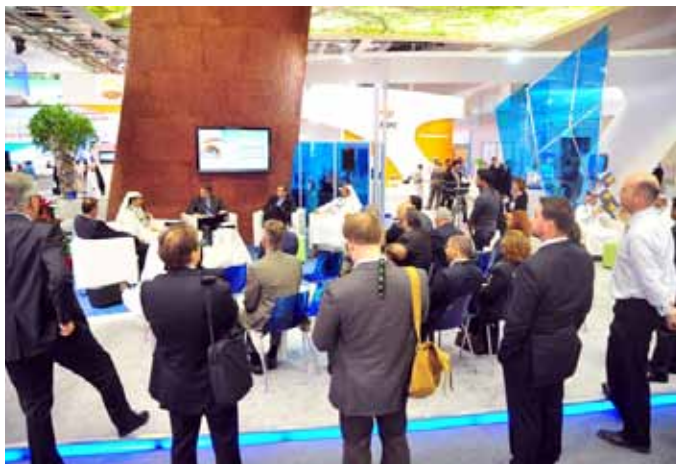
At conception ORYX GTL decided it would allow as many buyers as possible to access the products, there-by setting the platform for the Qatar-based company to pioneer the development of, and interest in these products in the market place, and start positioning Qatar as the world's GTL capital.

This sales strategy is underpinned by reliable output from its state-of-the-art complex in Ras Laffan, which has a total GTL output capacity of around 34,000 barrels per day.

ORYX GTL pioneering role has helped create a global market and drive the development of a vibrant, innovation-led community of companies in Qatar who leverage the country's abundant natural resources to manufacture high-specification products increasingly coveted globally.

As well as being a global GTL pace-setter, Qatar is a long-standing and dominant force in the global liquefied natural gas (LNG) market, helping power Asian economic growth as well meeting demand from more mature yet highly regulated European markets.

A successful hydrocarbons-based industry



is a key component of Qatar's long-term national economic and social development vision. The sector is also a pillar of the economy, which is expected to grow by 19 per cent in 2011, the fastest in the world for the second consecutive year, according to the International Monetary Fund.

Holding the world's third largest natural gas reserves, Qatar is well located to serve both the fast growing Asian markets and the established and highly regulated European markets. The firm's success has triggered renewed interest in this ground-breaking GTL technology across the world, including Brazil, Algeria and Columbia.

The GTL industry is now poised to go global after the significant technological advancements made in Qatar, particularly well placed to be the technology of choice to harvest the massive Shale Gas finds in the U.S. and across the world. ■

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**Gary Von Berg is the  
Marketing Manager at  
ORYX GTL**



## Qatar's Well on Its Way to Becoming Global Energy R&D Hub

Qatar, which holds the world's third-largest natural gas reserves, is well placed to achieve its ambition of establishing the Emirate as a research and development hub for the global energy industry.

**THE GULF** holds about 60 percent of the world's known oil reserves and 40 percent of the known gas reserves, with Saudi Arabia the largest oil exporter and neighboring Qatar the largest producer of liquefied natural gas. There is no doubt that creating a global R&D center in the region makes perfect sense and Qatar is not wasting anytime cementing its position as the leading contender, with environmentally-friendly fuels producer ORYX GTL at its heart.

The international era of large scale GTL technology dawned with the start-up of the ORYX GTL plant in 2006. The plant employs proven, cutting-edge technology which is acknowledged as a key performance driver within the industry. The project had positioned Qatar to become the world's leading clean fuels producer, inspiring renewed interest in ground-breaking technology around the world.

The Qatari-South African joint venture has pioneered complex Fischer Tropsch technology to convert natural gas into low-sulphur liquid fuels at its \$1 billion plant in Ras Laffan Industrial City. The company continues to take a leadership role within Qatar's academic and research community, where earlier this year it sponsored the Chair of Mechanical Engineering at Qatar University, the first joint-venture energy company in the Emirate to take such a step.

With the world's third-largest natural gas reserves, Qatar is leveraging its vast resource wealth to establish a thriving community of innovation-driven energy projects. In doing so, it is fostering a culture of collaboration and information-sharing between industry and academia as the country makes the strategic transition from mere energy producer to knowledge incubator.

His Excellency Dr Mohammed bin Saleh

Al-Sada, Minister of Energy of Qatar and Chairman of ORYX GTL, last month underscored the critical importance of research to the future of the country's oil and gas industry. Speaking at the Qatar Foundation's Second Annual Research Forum, he said "the biggest challenge the oil and gas business will be facing in the future is the need for more knowledge-based development and new technology."

The wealth of the Arabian Gulf Region is tightly linked to the quantity of recoverable hydrocarbons. Accordingly, future research in the region certainly must focus on technologies that maximize oil and gas recovery. These include techniques for imaging subsurface structures and for extracting petroleum from reservoirs. Such work must take top priority in Arabian Gulf Region research.

Given the low recovery of petroleum from most reservoirs, future research will focus on enhanced oil recovery. Higher petroleum prices in triple digits will bring research involving EOR tools such as surfactant flooding to the forefront. Modification of reservoir rocks to improve flow characteristics will play a role in this research. Modeling will grow in importance as detailed understanding of reservoir flow characteristics provides opportunities to enhance production.

The bridge between industry and academia is crucial to provide the solutions the energy industry will need to maximize the recovery of the region's hydrocarbons as we move into the era of post easy oil and gas production.

Qatar has taken dynamic leaps forward to ensure that the framework to achieve this starts to fall into place – the milestone building block in this has been the establishment of the Qatar Foundation.

At the forefront of industry-university collaboration, Qatar Science & Technology Park is located in Qatar Foundation's Education City, alongside campuses of several leading universities. Its objective is to attract companies and entrepreneurs from around the world to develop & commercialize their technology in Qatar.

One of the world's top engineering institutions -- Texas A&M University – is a cornerstone of the project. Its Qatar campus now has about 500 undergraduates, and this year it started a Masters program in chemical engineering, the first of its kind in the region.

Texas A&M has reported that Production of gas from sour reservoirs will continue to grow as sweet resources near depletion. New



sulfur disposal approaches must be examined in light of estimated sulfur production volumes of 20,000-30,000 tons per day for Qatar and the UAE in the next few years. Reinjection of sour gas must be examined in light of the magnitude of this issue. Research in a number of areas, such as fluid properties, will be required to evaluate the sour-gas reinjection option.

Qatar Science & Technology Park key aim is to help organizations develop and commercialize their technologies. Among its first tenants include the world's biggest companies such as EADS, ExxonMobil, GE, Microsoft, Shell and Total -- bringing research and business together, while spurring the development of Qatar's knowledge economy.

One of the most recent developments at QTSP involved Maersk Oil establishing a long term collaboration agreement with TNO, the Netherlands Organization for Applied Scientific Research, to jointly develop new technologies for increased oil recovery (IOR). Focus will be on long horizontal wells and increasing oil recovery through integrated operations and production optimization.

Maersk Oil is investing \$100 million in its research facility at the Qatar Science and Technology Park.

The accumulative affect of all these developments over the last decade since Qatar's former Minister of Energy, His Excellency Abdullah Bin Hamad Al-Attiyah, took the brave and ambitious decision to develop the ground breaking gas to liquids technology with the formation in ORYX GTL, the Gulf Emirate has slowly but surely been assembling the critical mass of a world standard R&D hub. ■

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**Ettienne Rademeyer,**  
**Chief Operating Officer**  
**at Oryx GTL**



## Desert Irrigation: The Miracle of GTL Process Wastewater

Beneath the arid desert sands and clear blue seas of the Qatari peninsula lies the third largest reserve of natural gas on the planet.

**THE EXPLOITATION** of this natural gas has generated extraordinary wealth for Qatar, and in 2010 the country boasted the world's highest GDP growth per capita, while its economy grew faster than any other. In 2009, it was the United States' fifth-largest export market in the Middle East, after the UAE, Israel, Saudi Arabia and Egypt.

At the heart of Qatar's rapid economic development is the burgeoning gas-to-liquids (GTL) industry, which came online in 2006 with the completion of ORYX GTL's 34,000 barrels-a-day (BPD) plant in Ras Laffan Industrial City. As well as delivering a high performance fuel, GTL delivers an end-product that is more environmentally friendly than its crude-oil derived counterparts. It is sulphur-free, burns more cleanly in an internal combustion engine and contains virtually no airborne toxic components.

Crucially, the GTL process itself also generates huge amounts of process wastewater. At the ORYX GTL plant, the Fischer-Tropsch (FT) reactors produce approximately 250 cubic metres of water an hour, which is used internally or treated for external irrigation purposes. And in an arid country such as Qatar, where water is

a scarce commodity provided exclusively by the desalination of seawater, the value of wastewater generation cannot be over-emphasised. Therefore, by expanding its GTL capabilities, Qatar is not only driving economic development and creating sustainable energy, but is delivering much needed irrigation in a dry, desert land.

### **The rationale and benefits of GTL**

Much of the world's industrial fuels and virtually all of its transportation fuels are sold in liquid form. Liquids have a number of distinct advantages over gases. For a start, they are readily transportable by commonly available means and in relatively unsophisticated containers. Qatar's geographical location, for example, allows for the shipment of fuel by sea to virtually any location in the world. However, its distance from major consumers largely precludes the transportation of natural gas by pipeline.

Historically, this has meant that the costly logistical challenges of bringing natural gas to market have prohibited its development. As a result, natural gas continues to suffer from a unit energy-price disadvantage compared to traditional crude oil-based fuels.



But GTL now offers natural gas producers a chance to 'level the playing field' with crude oil-derived hydrocarbons in the transportation fuel marketplace. By converting remote natural gas into liquid before transportation, the process is a more cost-effective and commercially viable proposition.

Which means the world can now start to enjoy the multiple benefits of natural gas-derived products. And the sooner this happens, the better. Because not only are GTL products more environmentally friendly, they are also of significantly higher quality than their crude oil-derived equivalents. GTL diesel, for example, has a high cetane number, low sulphur, low aromatics and good cold flow characteristics, which can be optimised to suit specific applications. A clean, premium product, GTL diesel can be used in all modern diesel engines and its high-performance properties result in reduced noise and a more efficient, cleaner-burning combustion environment.

#### **Reaction water by-product**

The other main benefit of the GTL process is, of course, the generation of large volumes of process wastewater. Indeed, on a weight basis, the FT reaction produces 25% more water than hydrocarbon products. The process wastewater generated by GTL industries needs to be treated to comply with the standards set by Regulatory Agencies for effective reuse, as well as for safe discharge into the sea. But once treated and managed, this treated water can be used to increase the environmental performance and economic efficiency of GTL industries and offers a vital, alternative water resource in one of the most arid regions in the world.

Within GTL production facilities, the main sources of process wastewater are: reaction water from the FT unit, recovered water from the heavy ends recovery unit, sour water from the product work-up unit, and blow-down water from the steam generation units. In addition to minor condensate sources, the major chemical reaction that generates reaction water within the GTL process can be summarised as follows:  $n\text{CO} + 2n\text{H} (-\text{CH}-) + n\text{H}_2\text{O}$ .

The water produced as a result of FT reaction contains dissolved hydrocarbons and acidic contaminants, such as alcohols, acids, ketones, aldehydes, acetates and other oxygenates. These elements are recovered in the Heavy End Recovery Unit and routed to a wastewater treatment facility, along with other



waste water streams.

The Heavy End Recovery facility incorporates degassing, coalescing to remove hydrocarbons, and distillation to remove all the residual CO<sub>2</sub> and hydrocarbons from the water. Offgas and liquids produced by these treatment steps are then routed to the plant fuel system for heat recovery.

The primary treatment is followed by bio-treatment in a three-stage bio-reactor to reduce a chemical oxygen demand. A final stage of clarification and filtration results in decontaminated water that is suitable for irrigation.

The use of treated industrial water to irrigate food crops is prohibited by law. However, the reuse of process wastewater for landscaping irrigation is practiced in almost all arid areas of the world, and treated GTL process wastewater meets the recommended limits issued by USEPA guidelines. This means that it can be reused for irrigation in parks, golf courses, highway medians and sports fields.

In a country as dry as Qatar, this alternative water resource is critical, and currently between 75-90% of the wastewater generated at the ORYX GTL plant in Ras Laffan is being used to irrigate green areas in Industrial City. GTL process wastewater is also upgraded and reused in concrete mixing, fire-water backup, boiler-feed and hydrostatic testing, among other applications.

Given the time and energy involved in the desalination of seawater, the reuse of GTL process wastewater offers Qatar numerous environmental and cost-saving advantages. According to ORYX GTL, the goal for 2012 is to ensure there is zero treated water discharge back into the sea to make the whole process as sustainable as possible, further enhancing the GTL industry's reputation for delivering economically-efficient and environmentally friendly fuel for the future. ■

*This article is based on a presentation and lecture given by Marcel Krause, ORYX GTL Technical Manager, at the 20th World Petroleum Conference 2011*

