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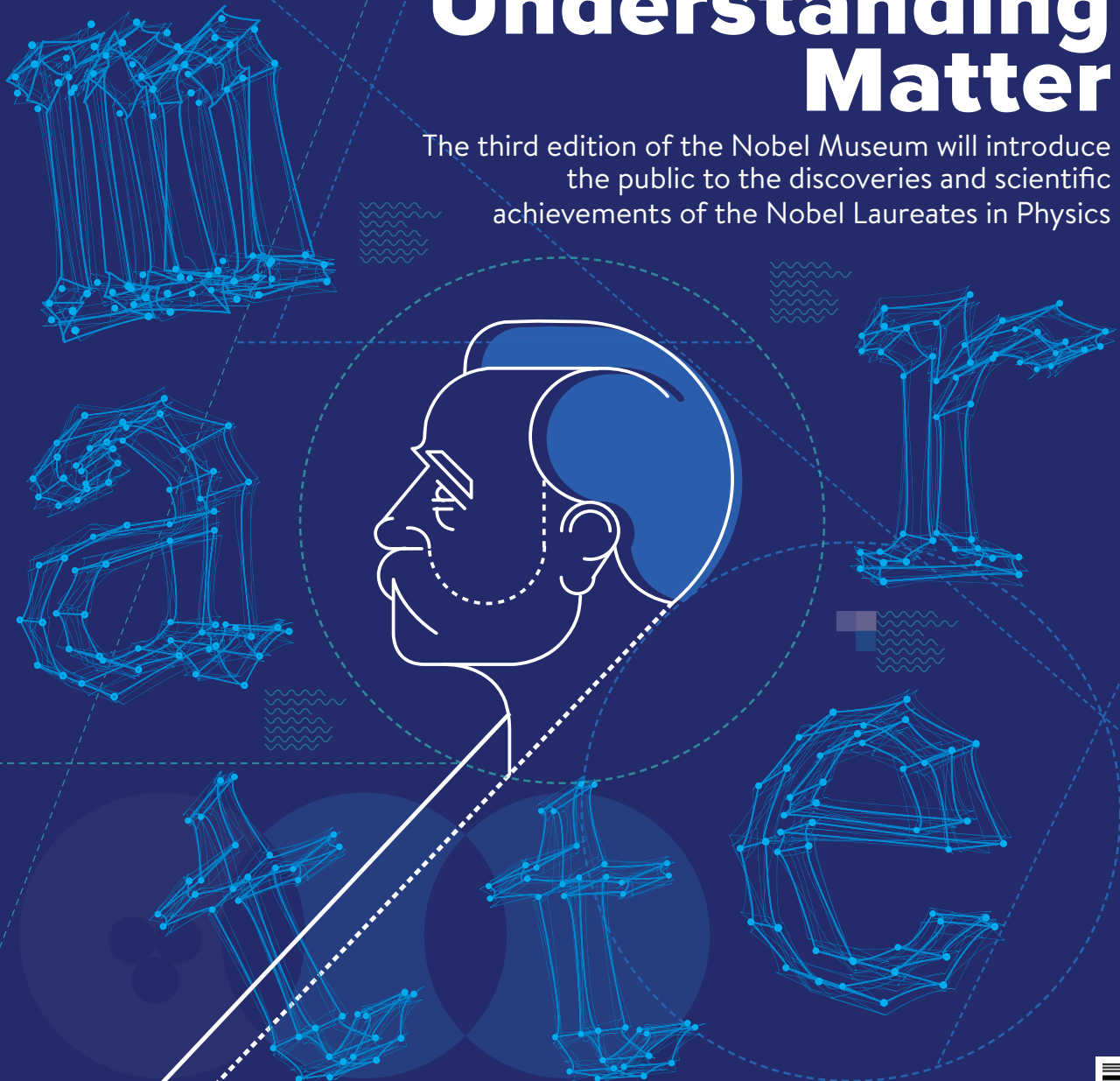
A MONTHLY MAGAZINE ON KNOWLEDGE AND DEVELOPMENT
BY THE MOHAMMED BIN RASHID AL MAKTOUM FOUNDATION

FEBRUARY 2017
ISSUE 26

#YearOfGiving

Understanding Matter

The third edition of the Nobel Museum will introduce the public to the discoveries and scientific achievements of the Nobel Laureates in Physics



Powering a Greener Future

The UAE's plan to increase clean energy use by 2050

Tackling Food Waste

A new food bank is kickstarting the UAE's Year of Giving

The Art of Geometry

How the complex art of zellige tiling is being preserved





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FOREWORD

Dear readers,

In January His Highness Sheikh Mohammed bin Rashid Al Maktoum, in his capacity as Vice President and Prime Minister of the UAE and Ruler of Dubai, unveiled the country's energy strategy for the next three decades. Energy Policy 2050 is a far reaching and ambitious plan that combines renewable, nuclear and clean energy sources that address the sustainable growth of the UAE economy, while also fulfilling the country's international commitments to cut CO₂ emissions. Central to this energy policy are the UAE's efforts to diversify the economy into a knowledge-led one, with a focus on sectors such as renewable energy. Our article on Energy Policy 2050 in this issue delves deeper into the UAE's ambitious targets in this regard.

This month the Mohammed bin Rashid Al Maktoum Foundation (MBRF) opens the third Nobel Museum Exhibition, which is being held in Dubai with the theme 'The Nobel Prize in Physics: Understanding Matter'. This is in keeping with MBRF's

remit to undertake projects and initiatives that help disseminate knowledge locally and around the world. The Nobel Museum will inspire young Emiratis to contribute to future discoveries in physics, thereby helping the UAE's journey towards a knowledge-led economy.

Although the UAE has ambitious plans for the future, our past is also a great source of pride. 2017 is the Year of Giving, and as HH Sheikh Mohammed noted the spirit of generosity that runs deep in the country's culture reflects the legacy of founding father the late Sheikh Zayed bin Sultan Al Nahyan who was a renowned philanthropist. The recently opened Etihad Museum, which is featured in this issue's culture section, reflects the generous and ambitious spirit of the UAE's union and serves as a rich national repertoire of knowledge and an inspiration for the future.

Jamal Bin Huwaireb

MD of Mohammed Bin Rashid
Al Maktoum Foundation



2017 Will Be a Year of Generous Giving

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai promised that, “The year of 2017 will be a year of abundance and generous giving for the UAE and its citizens.” He made this statement while chairing the Cabinet’s first meeting of the year at Union House (Dar Al Etihad), where the country’s founding fathers had gathered 45 years ago to establish one united country.

HH Sheikh Mohammed further asserted that Union House is where the UAE’s journey of generosity began. The late Sheikh Zayed bin Sultan Al Nahyan, founder of the UAE and a great philanthropist, made a positive and generous contribution to people’s lives and today the UAE continues to follow in his footsteps, Sheikh Mohammed added. The spirit of generosity and giving is the nation’s source of pride, which is firmly entrenched in the hearts and minds of its people. These values are also being instilled in the new generation in order to keep the UAE’s flag fluttering high.

“With a vision inspired by the approach of the founding fathers, we seek to achieve our limitless aspirations under the leadership of President His Highness Sheikh Khalifa bin Zayed

Al Nahyan,” Sheikh Mohammed said, while urging the Cabinet members to build on the legacy of the country’s founder who “established generous giving as a value in our society.”

Sheikh Mohammed also expressed pride in the Etihad Museum, which stands next to Union House. “Four years ago in this very place, we issued directives to commemorate the union and its makers. Today, we have a reliable historical reference.”

Sheikh Mohammed called upon the ministers and all people to visit Union House and noted that the Ministry of Education, in particular, should bring school students on field trips to the museum to learn about the

journey of the founding fathers and the establishment of the UAE.

“This edifice inspires positive energy, driving us to work as one team based on one vision for the same goals. We have a few years ahead to achieve our National Agenda to serve the nation and citizens. The Union House is a national edifice and an institute that teaches people today and future generations about the journey of building the UAE. It offers a rich national repertoire of knowledge. It inspires our future,” Sheikh Mohammed bin Rashid said. †



ETIHAD MUSEUM



Spread over
26,000
square metres

Built to tell the
FULL STORY
of the establishment
of the UAE in 1971

It is situated adjacent to Union House, where the declaration to establish the independent state of the United Arab Emirates was announced. Its inauguration coincided with the 45th UAE National Day on 2nd December.



UAE Energy Strategy Unveiled

Vice President and Prime Minister of the UAE and Ruler of Dubai His Highness Sheikh Mohammed bin Rashid Al Maktoum has unveiled the UAE's energy strategy for the next three decades. The strategy aims to increase the contribution of clean energy in the total energy mix to 50 per cent, which will enable savings of AED700 billion by 2050. The strategy also aims to increase the consumption efficiency of individuals and corporates by 40 per cent.

"Our new energy plan balances supply and demand, and takes into consideration our international commitments in terms of the environment. It also seeks to ensure a conducive economic environment for growth across sectors"

2050. The plan is a joint effort of all energy-related authorities and all executive councils in the UAE and was developed under the supervision of the federal government represented by the Ministry of Energy and the Ministry of Cabinet Affairs and Future.

"The Gulf countries are similar in their economic structure, and we hope that we will one day have a unified GCC energy strategy in order to ensure sustainable growth for our people and global influence for our economies," His Highness added. ↑

Sheikh Mohammed revealed that the UAE Energy Plan 2050 is targeting an energy mix that combines renewable, nuclear and clean energy sources to achieve the UAE's economic needs and environmental goals. His Highness also said that the UAE aims to invest AED600 billion by 2050 to meet growing demand and ensure the sustainable growth of the UAE economy.

"Our new energy plan balances supply and demand, and takes into consideration our international commitments in terms of the environment. It also seeks to ensure a conducive economic environment for growth across sectors," His Highness said while launching the UAE Energy Strategy

Read our article on the Energy Plan 2050 in this issue for a complete overview.



International Humanitarian City is the world's largest humanitarian logistics hub.

Size of Dubai's International Humanitarian City to Triple

HH Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, has approved expanding warehouse facilities at International Humanitarian City (IHC) in response to urgent demand from leading UN and NGO agencies, most notably the Red Crescent, UNHCR, ICRC and the World Food Programme.

This approval green lights expanding the warehousing facilities at IHC by more than 300,000 square feet. This will streamline and strengthen operations to support aid agencies, which are struggling to cope with growing global demand for emergency services. The expansion will help IHC members to have stocks ready in the event of new pandemics, natural disasters and armed conflicts. More aid workers will also be trained. Intensifying conflicts in Syria, Yemen, Afghanistan,

Founded in 2003, the International Humanitarian City is already the world's largest humanitarian logistics hub.

Nigeria and other trouble spots have led to the mass displacement of more than 65 million people and a sharp rise in the need for emergency aid in the form of food, shelter, and medicine. Demand for such aid is now at its highest level worldwide since World War II and aid agencies need additional warehousing and logistics support to cope.

Founded in 2003, the International Humanitarian City is already

the world's largest humanitarian logistics hub. Its members include nine United Nations agencies and nearly 50 NGOs and businesses working in the aid sector. When IHC moved to its current location in Dubai Industrial City near Jebel Ali Port and Al Maktoum Airport in 2011, it tripled in size, but demand for space has continued to climb rapidly.

The IHC has played a pivotal role in first responses to crises in places as far away as Haiti and Vanuatu. UN and NGO members import and trans-ship massive amounts of aid supplies worth hundreds of millions of dirhams.

The IHC also makes a valuable contribution to the UAE economy. The UNHCR alone, for example, bought AED337 million (\$92 million) worth of goods in the UAE in 2016. ↑

Smart Majlis Yields Innovative Ideas

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai highlighted that crowd-sourcing was generating innovative ideas that improved the developmental process for building the future.

Sheikh Mohammed also added that the real team in this process was the community and the government, with the latter serving as its executive arm to implement the projects



and initiatives proposed. He pointed out that some of the mega projects in Dubai are a direct result of innovative ideas from members of the community that were adopted by the concerned entities.

Sheikh Mohammed added that the Smart Majlis is open for everyone in the community, asserting that one should not hesitate to come up with ideas no matter how simple they are.

Since its launch, the Mohammed bin Rashid Smart Majlis has received more than 35,000 creative ideas and improvement suggestions, which have been reviewed and studied by more than 460 employees from 41 government entities. †

MBRF Joins Hands with Dubai Economic Council to Build the Knowledge Economy



His Excellency Hani Al Hamli, Secretary General, Dubai Economic Council with Saif Al Mansoori, Corporate Affairs Advisor to the Managing Director of MBRF and His Excellency Jamal bin Huwaireb, Managing Director of MBRF.

The Mohammed bin Rashid Al Maktoum Foundation (MBRF) has signed an agreement with Dubai Economic Council (DEC) to increase cooperation between the two organisations and build the knowledge economy.

The memorandum of understanding (MoU), signed at the Foundation's headquarters in Dubai World Trade Centre, will see both organisations share experience, as well as financial, technical and human resources to develop knowledge-management systems and networks.

It will also see the two exchange knowledge-related material - such as library content and electronic sources of information - to support

knowledge-centric initiatives launched by the Dubai or UAE government.

The MoU states that MBRF and DEC will support each other's programmes and initiatives to enrich Emirati and Arab culture by publishing educational content and organising cultural and knowledge-focused events

"We, at the Mohammed bin Rashid Al Maktoum Foundation, realise how important it is to consolidate all efforts to build a knowledgeable society, and to enable future generations to pursue knowledge and scientific research. This agreement adds to the Foundation's successful track record and allows us to reach broader segments of society," said His Excellency Jamal

bin Huwaireb, Managing Director of MBRF. He added that the agreement would develop the knowledge, culture, and skillsets of individuals and entrepreneurs and encourage them to unleash their creative energies.

DEC Secretary General HE Hani Al Hamli asserted that partnerships were a pre-requisite to building a knowledge economy and said the MoU complements the Council's objectives to support the Dubai and UAE economy.

Under the MoU, both sides can benefit from each other's experience in the fields of knowledge, culture, science, and education, as well as any other sectors where they can collaborate either directly or through their subsidiaries. †

Mohammed bin Rashid Al Maktoum Foundation Concludes a Very Successful 2016

KNOWLEDGE SUMMIT 2016

The third edition of The Knowledge Summit continued to build on the success of the high attendance.



GLOBAL SPEAKERS

SUMMIT 2016

The previous two summits, as evidenced by the culture of its speakers and the high attendance.



GLOBAL SPEAKERS



NOBEL PRIZE SERIES

NOBEL LECTURES LIGHT UP YOUNG MINDS IN DUBAI

A series of sessions linked to MBRF's Nobel Lecture highlighted major scientific discoveries.

NOBEL LECTURES LIGHT UP YOUNG MINDS IN DUBAI

A series of sessions linked to MBRF's Nobel Lecture highlighted major scientific discoveries.

MBRF's Knowledge Summit 2016 Takes an In-Depth Look at "Knowledge - Present and Future"



"It is the only true wealth that we need to invest in if we want to establish the UAE's stature among the advanced nations of the world."

H.E. Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, emphasized the importance of knowledge in the UAE's vision for the future.

MBRF Launches 'Esterah Sayedat' (Ladies Book Club)



The Mohammed bin Rashid Al Maktoum Foundation (MBRF) has launched a new initiative called 'Esterah Sayedat' (Ladies Book Club). The club aims to promote reading and knowledge among women in the UAE.

Global Strategic Partnership Between MBRF and Frankfurt Book Fair



The Mohammed bin Rashid Al Maktoum Foundation (MBRF) has entered into a strategic partnership with the Frankfurt Book Fair. The partnership aims to promote reading and knowledge in the Arab world.

MBRF Launches 'Esterah Sayedat' (Ladies Book Club)



The Mohammed bin Rashid Al Maktoum Foundation (MBRF) has launched a new initiative called 'Esterah Sayedat' (Ladies Book Club). The club aims to promote reading and knowledge among women in the UAE.

The Mohammed bin Rashid Al Maktoum Foundation finished 2016 with several notable achievements that cemented its status as a global knowledge-driven organisation.

During the year the Foundation, followed the directives of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, and to the general policies of the UAE.

It held another successful edition of its Knowledge Summit in December – bringing together a number of high-profile Arab and international experts, academics and decision makers.

During the event, the Foundation unveiled a new version of the Arab Knowledge Index launched the previous year to chart knowledge levels in the Arab World. To disseminate the results and highlight the Index a number of events and workshops were organised in Egypt, Algeria, Jordan, Kuwait, the USA, Germany, and France.

It also conducted the Mohammed bin Rashid Al Maktoum Knowledge Award ceremony to honour individuals who have made notable contributions to the production and dissemination of knowledge.

Earlier in the year, HH Sheikh Mohammed issued Decree No. 17 of 2016, establishing the Board of Trustees of the Mohammed bin Rashid Al Maktoum Knowledge Award and appointed its members for three renewable years.

The Board is headed by HH. Sheikh Ahmed bin Mohammed bin Rashid Al Maktoum as Chairman, with H.E. Jamal bin Huwaireb as Secretary General. Members include representatives from the United Arab Emirates University; the University of Cairo; Nanyang Technological University, Singapore; the University of Oxford; and National Geographic.

Also at the Knowledge Summit 2016, the Foundation launched the Arab Reading Index, which studied reading in the Arab region according to international indices, polling more than 148,000 people in all 22 Arab countries.

Other notable achievements came during the holy month of Ramadan when MBRF launched a campaign to distribute 100,000 books to 100 libraries across Yemen as part of the 'Reading Nation' initiative launched by HH Sheikh Mohammed. The Foundation also distributed 'smart reading library bags' to refugee children to equip them with the knowledge and skills to build a better future.



MBRF's Initiative to Provide Books for Libraries in Yemen Gains Societal Support

The Mohammed Bin Rashid Al Maktoum Foundation (MBRF) has signed a partnership with the Foundation for Exhibitions to support the foundation's campaign to provide books for public libraries in Yemen.

The books that will be distributed in Yemen will cover a wide range of topics, from the art of writing, history and heritage, to science, nature and inspirational books.

His Excellency Jamal bin Hawsawi, Managing Director of MBRF, said: "This initiative follows directives from the UAE Government to support reading and knowledge locally, regionally, and globally. It serves to expand the foundation's efforts towards disseminating knowledge on a global scale and reaching out to those in need wherever they may be, especially in war-torn areas where multiple crises are threatening people's access to knowledge, such as in Yemen and a number of countries in the region." He added: "We are delighted to have received support from various institutions, especially the Galleria Sgarbi Corporation - a UAE-based SME."

Jamal bin Hawsawi, general manager of Galleria Sgarbi, underscored the importance of this initiative, which aims to disseminate knowledge and highlight the concept of charity and philanthropy that the Emirati people grew up with.

"As a national institution, and as part of our responsibility to society, we are keen to contribute and support humanitarian campaigns that work towards peace, tolerance, and education, especially given that reading and knowledge are the most important pillars for the development and progress in any society."

The campaign to provide Yemeni libraries with books is part of the UAE's Reading Nation initiative, which was launched by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, last Ramadan, and seeks to provide the cultural books to students in refugee camps, as well as to establish 5,000 libraries in the Islamic world.



MBRF Signs Agreement with LinkedIn, Launches 'Arab Professionals Forum' Initiative

The Mohammed Bin Rashid Al Maktoum Foundation (MBRF) signed an agreement on October 12 with LinkedIn to increase cooperation between the two parties and launch a number of joint, knowledge-based initiatives in the Arab region.

The agreement was signed during a press conference held by MBRF, which is part of Mohammed bin Rashid Al Maktoum's Global Initiatives, after His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, signed the agreement.

Managing Director of MBRF, said: "The Foundation is keen to enter into alliances and agreements with prominent and private institutions in the UAE and internationally, in an effort to exchange experience and effectively contribute towards building knowledge-based activities, as well as reaching out to Arab professionals and professionals everywhere."

He further explained that MBRF's cooperation with LinkedIn guarantees positive results, as the latter enjoys a global reach and already serves as a specialized platform for professionals and experts in all sectors. LinkedIn has built close ties with key government and private institutions, and serves as a platform where experts can communicate directly with regional and global Arab talent.

The Forum will serve as a platform where highly qualified Arab talent can interact with international and regional organizations in order to share knowledge and help build their careers, and abilities to build their career and professional lives.

His Excellency Jamal bin Hawsawi, Managing Director of MBRF, said: "The Foundation is keen to enter into alliances and agreements with prominent and private institutions in the UAE and internationally, in an effort to exchange experience and effectively contribute towards building knowledge-based activities, as well as reaching out to Arab professionals and professionals everywhere."

Educational Bags for Refugee Children

The Mohammed Bin Rashid Al Maktoum Foundation (MBRF) is working to provide educational bags for refugee children everywhere and equip them with the knowledge and skills they need to build a better future for themselves.

The bags will be carried out in stages. The first of which consisted of distributing 5,000 bags - worth AED 10 million - to 100,000 children in Syrian refugee camps in the Hashemite Kingdom of Jordan. The second phase is to go beyond that to include children around the world who are in need of education and knowledge.

Each of these "Smart Reading Library Bags" contains 20 books, including five stories, five textbooks, five historical records and five educational cards, in addition to a smart pen that can read letters and words to teach children proper Arabic pronunciation.

This initiative is also in line with the "Reading Nation" initiative.



10 FLASHES AUGUST 2016

Last year saw the return of the Nobel Museum to Dubai in its second edition and the first to tackle the subject of medicine. This lasted three months and was organised under the theme 'Exploring Life: Nobel Prize in Physiology'. HH Sheikh Mohammed encouraged the organisers to move the museum to other cities in the UAE and Arab world in the future.

MBRF also expanded its 'Bil Arabi' initiative in GCC countries leading one million people around the world to interact with the hashtag #Bil_Arabi across social media platforms.

During the year, the Foundation signed a number of important agreements including one to establish the Oxford-Sheikh Mohammed bin Rashid Al Maktoum Graduate Scholarships system with the UK's University of Oxford. This was joined by an agreement with business social network LinkedIn to launch the 'Arab Professionals Forum' to gather Arab subject-matter experts, academics and scientists on a platform where they can communicate directly with Arab talent from across the world.

Closer to home the foundation cooperated with the Roads and Transport Authority to launch the 'Knowledge Chair' initiative - a mini library containing recent publications at public transport stations across the UAE - and completed the translation

of the Paralympic Summer Games' rules into Arabic to be published on the portals of international federations.

The organisation also launched the first book club dedicated to women in the Arab world - 'Esterahat Sayedat' - and hosted a six-month workshop to train those interested in writing children's books. The workshop formed part of the Dubai International Programme for Writing and produced 19 books.

Other collaborations came with the the Ministry of Education to launch the 'Qesaty' competition to promote the Arabic language among secondary and preparatory school students and staff in the UAE.

In addition MBRF didn't forget its long-running initiatives. 'My Family Reads' now includes more than 35 government departments and 'Book in Minutes' initiative has now published as many as 105 books - summaries of international bestsellers - reaching more than two million people.

These efforts were coupled with participation in key events including MBRF's first appearance at Gitex Technology Week 2016 in Dubai and its second appearance in the Careers UAE exhibition. Affiliate Qindeel Printing, Publishing, and Distribution's also participated in the 26th Abu Dhabi International Book Fair, the 35th Sharjah International Book Fair, the 41st Kuwait International

Book Fair and the 2nd Jeddah International Book Fair.

While on the same note, MBRF made its second appearance at the London Book Fair and took part in the 68th Frankfurt Book Fair, where it signed a strategic partnership agreement with the Fair to develop media and content-production products and to organise related events in Dubai and the Arab region. †



CELEBRATING THE ACHIEVEMENTS OF EMIRATI WOMEN

The Mohammed Bin Rashid Al Maktoum Foundation (MBRF) held a special ceremony on August 12 to mark the occasion of Emirati Women's Day, which is an annual event since last year.

The event took place during the 'Reading in Motion' exhibition in Dubai's Jumeirah Park, which was attended by a number of prominent Emirati women, particularly from the government sector - in addition to journalists, poets, and social media figures from the UAE.

The celebration began with a panel discussion that included prominent figures of Emirati media, as well as women from the UAE's private sector and academia. The panel discussed the role of women in the UAE's development and the challenges they face.

His Excellency Jamal bin Hawsawi, Managing Director of MBRF, said: "Emirati women have made their mark on various sectors in the economy, proving their ability to innovate and make wise decisions along the way. This makes them strategic partners in the quest for sustainable development in the UAE."

The celebration was held in the exhibition of the first Emirati home-made products by Emirati businesses, which visitors could buy. The second exhibition, devoted primarily to cultural heritage from Emirati women, showcased the rich culture and society of the UAE.

MBRF EXPANDS REACH OF ITS 'MY FAMILY READS' INITIATIVE

A large number of government and private agencies have joined the "My Family Reads" initiative, according to the Mohammed Bin Rashid Al Maktoum Foundation (MBRF).

This initiative was launched in 2014 to spread culture and promote reading among all segments of society and family members in the UAE.

His Excellency Jamal bin Hawsawi, Managing Director of the Foundation, said that MBRF continued and expanded its initiative in order to keep up with the aspirations of the UAE with regard to reading and spreading knowledge in society. His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE, had announced that every family in the "Year of Reading" would have a book to read.

HE has therefore provided for the initiative in the Highways Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, who had signed a clear vision that underscored the importance of reading and the need to spread it in order to raise the level of knowledge among Emirati families and the general public in the UAE.

The Foundation has responded by making use of government and private agencies to help with disseminating knowledge, and to replace the distributed packages to include a wider variety of books that will appeal to all family members.

The initiative has had a wide reach since its launch, and has been recently renewed by individuals and families that received the package - a collection of books from across the world, including books by Emirati businesses, which visitors could buy. The second exhibition, devoted primarily to cultural heritage from Emirati women, showcased the rich culture and society of the UAE.



UNITED ARAB EMIRATES

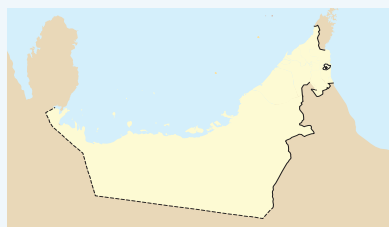
Country: UAE

Reading Rank Overall: 4th

Total Reading Time Per Year: 57 hours

2016 Sample Size: 148,000

Number of Arab Countries Sampled: 22



The Arab Reading Index (ARI) was first released in 2016 by the Arab Knowledge Project in partnership with the Mohammed bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Programme (UNDP).

The Arab Reading Index aims to provide an objective assessment of the state of reading in the Arab region under the wider vision of the Arab Knowledge Index. As reading is the basic tool in knowledge acquisition, exchange, and dissemination this assessment is of primary importance. The Arab Reading Index focuses

mainly on reading within the more general knowledge development concept, emphasising the role of reading as a tool for enlightenment and empowerment.

It is a unique tool that brings together all these different components under a single index measuring the extent of reading (hours and books read), access and availability (at the levels of family, educational institutions and society), and personal attributes (skills and capacity, motives and incentives and attitudes and standpoints).



**AVERAGE
TOTAL
READING
HOURS**



28

Electronic documents



8

Printed documents



20

Work related



33

Extracurricular



84%
**ACCESS AND
AVAILABILITY**



88%

Family



89%

School



68%

Society



81%
**EXTENT OF
READING**



51 hrs

Average of total reading (annual)



24

Average number of books read (annual)



80%
**PERSONAL
ATTRIBUTES**



72%

Skills and abilities



64%

Motivation



70%

Attitudes



**AVERAGE
NUMBER
OF BOOKS
READ**

ابت

18

In Arabic

تا

8

In foreign languages



8

Work related



15

Extracurricular

find new and improved ways to transfer knowledge and spread it across all segments of society. Furthermore, the exhibition will introduce to the public the discoveries and scientific achievements of the Nobel laureates in physics, which have played a significant role in improving people's lives.

His Excellency Jamal bin Huwareb, Managing Director of MBRF, said: "Once more, the Mohammed bin Rashid Al Maktoum Foundation is strengthening its ties with esteemed global knowledge-centric organisations. These relationships consolidate our efforts to create projects and initiatives that help disseminate knowledge around the world. For the third year in a row, we are organising the Nobel Museum in Dubai as part of our long-term relationship with the Nobel Foundation, which allows audiences to see how knowledge can be used to improve the world we live in."

"This event underlines Dubai's leading position and the forward-thinking vision of our leadership, represented by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai. Our leadership is keen on organising more of these events that emphasise the importance of creativity and innovation, especially among the youth."

Dr Olov Amelin, Director of the Nobel Museum in Sweden, lauded the collaboration with MBRF. He highlighted that the Dubai exhibition will introduce audiences to the field of physics and its role in explaining natural phenomena. Dr Amelin hopes the Nobel Museum will inspire young Arabs to contribute to future discoveries in physics. The Nobel Museum 2017 is made up of eight different sections:

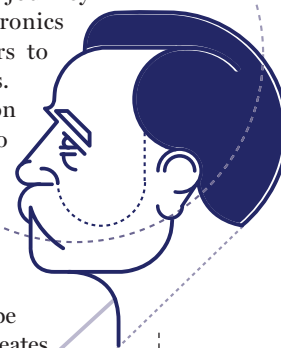
Rays and Waves, Matter, Stars and Universe, Quantum Physics, Electronics, Cloud Chamber, Laureate Arena, and VR experience.

The Rays and Waves section allows visitors to discover the interior of objects and bodies using X-ray imagery, while the Matter section presents an interactive table with three touchscreens that allow visitors to build atoms and learn about their constituent parts and the properties of elements.

Stars and Universe offers visitors a completely immersive experience through a video that takes them on a journey through our universe. The Electronics section, meanwhile, allows visitors to build their own electronic inventions.

In the Quantum Physics section 'A Quantum World' allows visitors to explore different effects in quantum physics. The audience will also have a chance to witness a Cloud Chamber, where cosmic particles leave tracks that can be seen by the audience. Last but not least, visitors will be introduced to the different Nobel laureates in the Laureate Arena.

The previous instalment of the Nobel Museum bore the theme 'Exploring Life: Nobel Prize in Medicine or Physiology', which highlighted contributions made by Nobel laureates in treating chronic diseases, such as diabetes, cancer, and thalassemia. It featured an Islamic Medicine section, which recounted the achievements of Muslim scientists in the medical and pharmaceutical fields. †



The Nobel Prize in Physics 2016 was divided, one half awarded to David J. Thouless, the other half jointly to F. Duncan M. Haldane and J. Michael Kosterlitz for theoretical discoveries of topological phase transitions and topological phases of matter.



The oldest Nobel Laureate in Physics to date is Raymond Davis Jr., who was 88 years old when he was awarded the Nobel Prize in 2002.

The most common research field for Nobel Laureates in Physics is particle physics. It is the field for 34 Nobel Laureates.

2

WOMEN HAVE BEEN AWARDED THE PHYSICS PRIZE SO FAR.

There are 203 individuals who have been awarded the Nobel Prize in Physics since 1901.



25

YEARS WAS THE AGE OF THE YOUNGEST PHYSICS LAUREATE EVER, LAWRENCE BRAGG, WHEN HE WAS AWARDED THE 1915 PHYSICS PRIZE TOGETHER WITH HIS FATHER.



UNITED ARAB EMIRATES

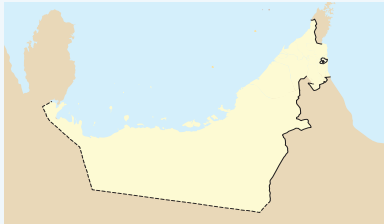
Country: UAE

Reading Rank Overall: 4th

Total Reading Time Per Year: 57 hours

2016 Sample Size: 148,000

Number of Arab Countries Sampled: 22



The Arab Reading Index (ARI) was first released in 2016 by the Arab Knowledge Project in partnership with the Mohammed bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Programme (UNDP).

The Arab Reading Index aims to provide an objective assessment of the state of reading in the Arab region under the wider vision of the Arab Knowledge Index. As reading is the basic tool in knowledge acquisition, exchange, and dissemination this assessment is of primary importance. The Arab Reading Index focuses

mainly on reading within the more general knowledge development concept, emphasising the role of reading as a tool for enlightenment and empowerment.

It is a unique tool that brings together all these different components under a single index measuring the extent of reading (hours and books read), access and availability (at the levels of family, educational institutions and society), and personal attributes (skills and capacity, motives and incentives and attitudes and standpoints).



**AVERAGE
TOTAL
READING
HOURS**



28

Electronic documents



8

Printed documents



20

Work related



33

Extracurricular

84%
**ACCESS AND
AVAILABILITY**



88%
Family



89%
School



68%
Society



81%
**EXTENT OF
READING**



51 hrs

Average of total reading (annual)



24

Average number of books read (annual)



80%
**PERSONAL
ATTRIBUTES**



72%

Skills and abilities



64%
Motivation



70%
Attitudes



**AVERAGE
NUMBER
OF BOOKS
READ**

ابت

18

In Arabic

أ

8

In foreign languages



8

Work related



15

Extracurricular

Country: UAE

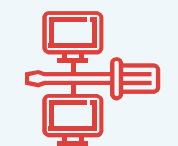
Knowledge Index Rank Overall: 1st

Number of Arab Countries Sampled: 22

The Arab Knowledge Index is a joint initiative between the Mohammed Bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Programme (UNDP). The Index, which was initially launched at 2015's Knowledge Summit, monitors the status of knowledge in 22 Arab countries to help decision makers, experts and researchers to implement development policies and identify knowledge gaps.

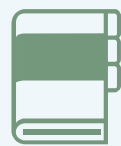
The Arab Knowledge Index was preceded by the Arab Knowledge Project, which was launched in 2009 to address the significant lack of credible data and research that can feed the decision making process in the areas of knowledge and development. It addresses this need for region-specific monitoring and evaluation tools that take into consideration the Arab region's contexts, cultures and needs.

The Arab Knowledge Index focuses on several critical sectors including education at pre-university, higher and technical vocational and training levels, research, development and innovation, economy, and ICT. It employs a total of more than 360 variables across these different sectors. The Index methodology was developed in consultation with top-level local, regional and international experts and academics, in addition to regional workshops across the Arab region. At the statistical level, data was collected from credible international datasets (UNESCO, World Bank, ILO, World Economic Forum) and treated as if clean and error-free, in addition to addressing any variables that might potentially incur bias on the values of the indicator, by using appropriate statistical methods.



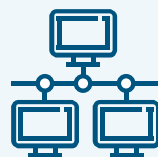
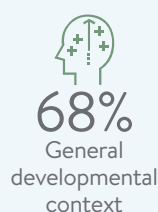
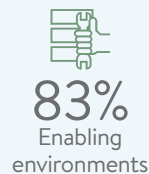
72%

**TECHNICAL
VOCATIONAL
EDUCATION
AND TRAINING**



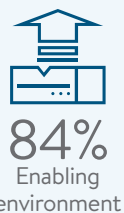
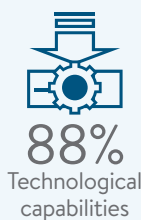
74%

**PRE-UNIVERSITY
EDUCATION**



86%

**INFORMATION
AND
COMMUNICATION
TECHNOLOGY**



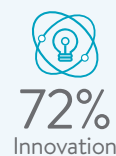
61%

**HIGHER
EDUCATION**



69%

**RESEARCH AND
INNOVATION**



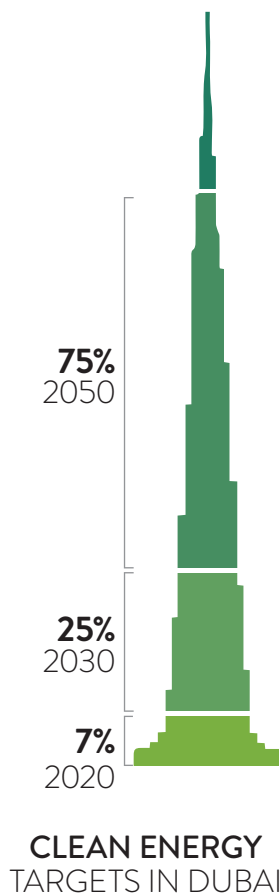
83%

ECONOMY



POWERING A GREENER FUTURE

The UAE Energy Plan for 2050 will see a significant growth in renewable energy, the slashing of CO₂ emissions, and sustained growth of the country's knowledge-led economy.



His Highness Sheikh Mohammed Bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, launched the UAE Energy Plan for 2050 in January this year. This far-reaching policy aims at meeting the UAE's growing energy needs, building a sustainable economy, and meeting its international obligations.

The UAE became the first Arabian Gulf country to ratify the Paris Climate Agreement on 7 September 2016, which is due to take effect in 2020. It aims to limit the increase in the global average temperature to no more than 2°C above pre-industrial times by cutting emissions of greenhouse gases such as CO₂.

The GCC's regional growth has been largely fuelled by oil and gas, with the demand for both doubling in the past 15 years. But CO₂ emissions from energy increased by 59 per cent over that period and renewables contributed just 0.1 per cent to the energy mix in 2014.

That is about to change in the UAE as the country embarks on an ambitious strategy set out in its Intended National-Determined Contribution (INDC) outline submitted to the United Nations Framework Convention on Climate Change (UNFCCC) ahead of the Paris talks in 2015. This initiative requires clean energy to comprise 24 per cent of the UAE's total energy mix by 2021.

The UAE's approach to lowering emissions reflects the country's economic diversification strategy and its commitment to sustainable development, which harnesses innovation and green growth to ensure prosperity and environmental protection.

The UAE Energy Plan 2050 reflects this approach. By 2050, the UAE aims to cover 44 per cent of its energy consumption with renewables, with gas accounting for 38 per cent, 'clean fossil fuels' for 12 per cent and nuclear for six per cent. Currently, gas covers more than 90 per cent of the country's energy mix. The UAE plans to invest \$163.3 billion by 2050 to boost the integration of renewable, nuclear and clean fossil energy. The first reactor at the \$25 billion Barakah nuclear power plant could start operations as early as May this year and the plant, when fully operational, should cover 25 per cent of the country's electricity consumption.

HH Sheikh Mohammed said at the announcement of the plan: "The UAE Energy Plan for 2050 represents a commitment to international environmental regulations and best practice and is an ideal example of balancing environmental sustainability with economic growth by considering the ratios of production and consumption. Preserving our natural resources means preserving our sustainable development. Sustainable energy secures all our futures. This first Energy Plan is a huge breakthrough and accomplishment for our government."





Masdar is a sustainable eco-city and home to the Masdar Institute of Science and Technology, which is focused on alternative energy, sustainability, and the environment.

The UAE Energy Plan 2050 is based on an expected annual growth of six per cent in electricity consumption. In a previous long-term plan, the UAE wanted to generate 30 per cent of its electricity with clean sources, 14 per cent less than the new target. However, the Dubai Clean Energy Strategy 2050 has set even more ambitious targets: the emirate aims to cover seven per cent of its energy consumption with clean energy sources by 2020 and to raise this target to 25 per cent by 2030 and 75 per cent by 2050. According to HH Sheikh Mohammed the goal is to make Dubai the city with the smallest carbon footprint in the world by 2050.

At the heart of the UAE Energy Plan for 2050 is the sustainability of the UAE's power sector by stimulating economic growth and investment in energy storage, and contributing to reducing power consumption.

The UAE is recognised as a world leader in the field of renewable energy. In June 2009, Abu Dhabi future energy company Masdar inaugurated a 10MW solar photovoltaic (PV) plant in Masdar City, a low carbon development on the outskirts of the UAE capital. The UAE was the only Gulf country that had a renewable energy programme in 2011, and that same year the country was named as the permanent host of the International Renewable Energy Agency (IRENA). In March 2013 Shams One, a 100MW concentrated solar plant (CSP), was inaugurated by Masdar.

A few months later Dubai launched Mohammed Bin Rashid Al Maktoum Solar Park, which is considered the largest PV facility of its kind in the world. The Dubai

Clean Energy Strategy 2050 has allocated \$15.4 billion in total to the Solar Park, which will produce 5,000 megawatts by 2030 – equivalent to about a quarter of the total energy production in the emirate of Dubai. It will eventually save approximately 6.5 million tonnes per annum in CO₂ emissions.

Under Vision 2021 the UAE is on a fast track to develop a knowledge-led economy, investing in its human capital and the potential to develop a competitive advantage in specific sectors such as renewable energy. For example, the Mohammed Bin Rashid Al Maktoum Solar Park also includes a research, development and innovation centre, dedicated to scaling renewable energy technologies and energy-efficiency practices. The centre, set to open this year, will also serve as an academy for renewable energy. The Dubai Green Fund, which is worth \$27 billion, will provide easy loans for investors in the clean energy sector in the emirate at reduced interest rates.

This integrated approach by the UAE towards renewable energy based on local expertise is set to pay dividends. Globally, renewable energy investments reached nearly \$286 billion last year, a six-fold increase from levels in 2004, according to the International Energy Agency. And for the first time ever, this sector made up more than half of all the added power generation globally. Furthermore, the Middle East tripled its renewable energy investment last year.

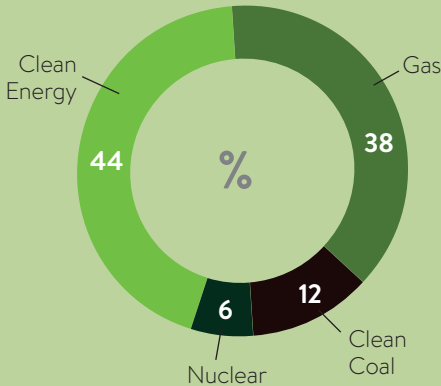
Bloomberg New Energy Finance projects that between now and 2040, renewables will take the lion's share of \$7.8 trillion that will be invested in the energy sector. Last year solar power, for the first time, became the cheapest form of new electricity. There are also many opportunities on the horizon with Saudi Arabia investing up to \$50 billion by 2023 on renewable projects, while India is projecting \$250 billion over the next five years.

The UAE is also taking steps to reduce energy usage. To this end, local governments have taken measures to encourage energy efficiency in buildings through legislation, mandatory and voluntary guidelines and other catalysts such as green building codes. In 2014, Dubai's Green Building Regulations and Specifications became mandatory for all new buildings in the emirate. The Dubai Integrated Energy Strategy 2030 aims to reduce energy demand by 30 per cent by 2030, while the UAE Energy Plan is targeting savings of \$190 billion.

At the federal level, the Emirates Authority for Standardisation and Metrology (ESMA) promotes the use of efficient electrical equipment, and this has already resulted in the elimination of inefficient air-conditioning units. Such measures are expected to cut energy usage by 500MW a year.

It is clear that the UAE is already well on the road to ensure that the goals of the Energy Plan will be met by 2050 through an integrated approach that also bolsters the country's renewable energy sector. †

UAE 2050 ENERGY GOALS



RENEWABLE ENERGY PROPORTION OF POWER GENERATION BY 2040

GERMANY

77%

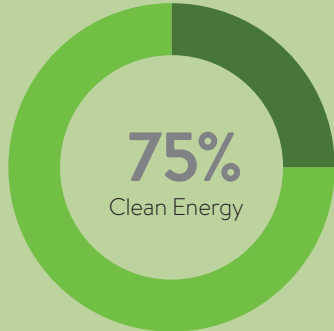
UK

63%

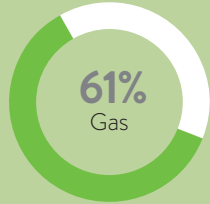
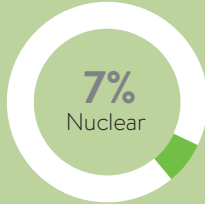
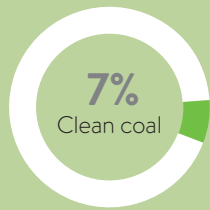
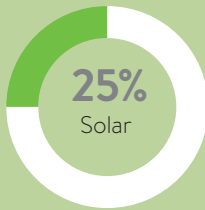
AUSTRALIA

52%

DUBAI'S ENVIRONMENTALLY FRIENDLY ENERGY MIX BY 2050



ENERGY MIX BY 2030



RENEWABLE ENERGY BENEFITS FOR HEALTH, ENVIRONMENT AND ECONOMY



Global health-related costs can be reduced up to \$200 billion annually



Doubling the global share of renewable energy would create a net gain of 900,000 jobs in the energy sector in 2030



Demand for oil and natural gas can be reduced by around 15%



Demand for coal can decline by 26% resulting in reduced carbon emissions and cleaner air

SOURCE: IRENA

INNOVATIVE POWER TECHNOLOGIES

In the quest to reduce CO₂ emissions researchers are coming up with both big and small ideas in the field of power generation

Countries such as the UAE are committed to tackling global warming by reducing emission of greenhouse gases such as CO₂. Since the Industrial Revolution, atmospheric carbon dioxide levels have risen 42 per cent. As a result the earth is 0.8 degrees Celsius warmer today than it was in 1880, and climatologists say temperatures could increase by 3C to 4C by 2100.

The Paris Climate Agreement, which was signed by 195 nations including the UAE, aims to phase out fossil fuels in favour of renewable energy in the second half of the century. In order to limit the rise of global temperature to 2C above pre-industrial levels by 2100, global greenhouse gas emissions will need to be cut by an estimated 40-70 per cent by 2050, and by 2100 the planet must be carbon-neutral.

Technology will play an important part in reducing CO₂ emissions. Technological innovation has allowed us to extract carbon fuels deep underground, but now we need to reinvent the energy system those fuels created. Some of the current innovations are remarkably low tech, while others verge on the edge of science fiction.





The UAE has committed to reducing greenhouse gas emissions under the Paris Climate Agreement.

HARNESSING THE POWER OF THE SUN

The longstanding joke about fusion - that it's the energy source of the future, and always will be - may yet be proven wrong.

Fusion power refers to energy generated by nuclear fusion. In the nuclear reactors we've had since the 1950s atoms are split in half to produce energy in the form of heat that is used to drive steam-powered turbines. Nuclear fusion sees the fusing of two hydrogen isotopes to produce a great deal more energy. In order for a fusion reactor to work the plasma (a cloud of protons, neutrons and electrons that's considered the 'fourth state' of matter) needs to be heated to at least 100 million degrees and forced to collide using electromagnets. Unlike fission, fusion relies on readily available materials, it produces low levels of radioactivity and there is no danger of meltdown.

The basic challenge, as physicists first learned in the 1950s and 60s, is that fusion plasmas - free-flowing soups of protons and electrons in which atomic nuclei collide and release energy - do not like to be contained, which is necessary in order to create more energy than is needed to start the fusion process.

The sun contains plasma with its immense gravity, but here on Earth we need powerful magnets or lasers to

do so. And the margins for error are small as a minuscule amount of escaped plasma can scar the wall of a fusion reactor, causing the machine to shut down.

The world record for fusion power - 16MW - was set in 1997 at the JET reactor in the UK. The longest fusion run - six minutes and 30 seconds - was achieved at France's Tore Supra in 2003.

In France the \$18 billion International Thermonuclear Experimental Reactor (ITER) project is aiming for 500MW and 50-minute runs. Leaders representing half the world's population - through the ITER partners of the EU, China, Russia, the US, India, Japan and South Korea - are confident that fusion can deliver.

To achieve that breakthrough, ITER will use a donut-shaped magnetic cage called a tokamak to trap the plasma and force it to travel in a large circle. The reactor itself will weigh 23,000 tonnes, and contain more than 2,800 tonnes of superconducting magnets. ITER's schedule is to create the first plasma in 2025, then start firing tiny 5mm frozen pellets of heavy hydrogen - deuterium and tritium - into the plasma to generate energy. The aim is to reach its maximum power output by 2035 and, if so, ITER will be the foundation of the first fusion power plants.

BIOFUELS

VEGETABLE OIL



Straight unmodified edible vegetable oil is generally not used as fuel, but lower-quality oil can and has been used for this purpose. Used vegetable oil is increasingly being processed into biodiesel, or (more rarely) cleaned of water and particulates and used as a fuel.

BIODIESEL

Refers to a vegetable oil-or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, or propyl) esters. Biodiesel is typically made by chemically reacting lipids with fatty acid esters.



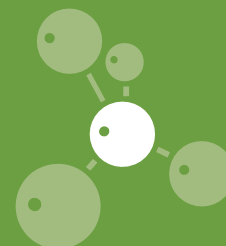
GREEN DIESEL



Is produced by hydrocracking vegetable oils and animal fats. Hydrocracking is a refinery method that uses high temperatures and pressure with a catalyst to break down larger hydrocarbon chains used in diesel engines.

BIOETHERS

Bioethers (also referred to as fuel ethers or oxygenated fuels) are cost-effective compounds that act as octane rating enhancers. They also enhance engine performance, whilst significantly reducing engine wear and toxic exhaust emissions. They contribute to air quality by greatly reducing the amount of ground-level ozone.



BIOGAS



Biogas is methane produced by the process of anaerobic digestion of organic material by anaerobes. It can be produced either from biodegradable waste materials or by the use of energy crops fed into anaerobic digesters to supplement gas yields. The solid byproduct, digestate, can be used as a biofuel or a fertiliser.

SYNGAS

Syngas is a mixture of carbon monoxide, hydrogen and other hydrocarbons that is combustible and often used to fuel internal combustion engines. The resulting gas mixture is more efficient than direct combustion of the original biofuel because more of the energy contained in the fuel is extracted.





Despite improvements in solar efficiency on the ground on advanced photovoltaic cell could operate for more effectively in space.

Last year, Germany completed a new design called the Wendelstein 7-X nuclear fusion reactor. This amazing piece of technology uses a complicated design called a stellerator. Unlike the tokamak, the stellerator is intended to add more stability to the plasma circle by using a different configuration that adds several more rings to contain the plasma. Scientists spent the last year doing tests to ensure that the W7-X reactor was working the way it was supposed to and they found an incredibly small error rate of less than 1 in 100,000. That means successfully containing the plasma in the nuclear fusion reaction is closer to reality.

There are also private companies, such as Canada's General Fusio and California's Tri Alpha Energy that are taking the Elon Musk approach with privately financed science projects.

Many scientists are hopeful that a breakthrough moment is getting closer. Fusion ignition has already been demonstrated. The problem is that it still takes more energy to create an ignition than the energy produced, and the race is on to demonstrate net energy gain - getting more power out than went in to create the ignition.

STELLAR POWER

Solar power has improved in leaps and bounds with solar panels now providing 40 to 50 per cent efficiency, but that doesn't change the fact that they produce no energy at night. However, a satellite in geosynchronous orbit could solve that problem.

In space you take the earth's atmosphere out of the equation, which means solar panels can intercept rays 35 to 70 per cent more intense than midday sunlight on the ground. Moreover, a well-positioned satellite can avoid the shadow of night for all but 44 hours a year, so there is no need to store energy. An advanced photovoltaic cell in space can deliver up to 40 times the annual

amount of reliable 24/7 energy that the same cell would generate on the ground.

Naturally there are problems, the first being how to transmit the energy to an earth-bound electric grid. Two workable solutions have been proposed. The electrical current generated by an orbiting array can be sent to Earth by converting it into a broad infrared laser beam, or as a wider cone of microwaves. In each case the satellite would focus its transmitter on a large receiving station on the ground that would reconvert the energy into electricity.

NASA, the US departments of Energy and Defense, the European Space Agency, the Japanese Aerospace Exploration Agency (JAXA) and a handful of companies have concluded that space-based solar power, or SBSP, is technically feasible. The insurmountable problem has been cost.

It currently costs around \$4,600 for each kilogram of payload lofted into low orbits, and an SBSP facility could need up to 10,000 tonnes of components. For stellar power to compete with other kinds of renewable energy, it is estimated those costs need to drop to around \$400 a kilogram. The reason why getting cargo into space is so expensive is due to the simple fact that rockets are not reusable.

However, Elon Musk's Space X company has designed and successfully used a reusable booster that returns to Earth after launch and lands on an offshore platform. According to Musk this means that launch costs will fall by up to 99 per cent, which could make SBSP feasible. If that happens the last stumbling block will be to convince investors that they will get a return on their investment.

GENETICALLY-ENGINEERED ALGAE

In 2014 an Etihad Airways Boeing 777 took off in Abu Dhabi for a 45-minute flight to Al Ain. The remarkable

part of this seemingly standard flight was that the fuel for this trial flight consisted of 10 per cent biofuel.

The biofuel, which was made from algae, was the result of research by the UAE-based Masdar Institute. Algae are perfectly suited for the extraction of biofuels as they are full of natural oils (lipids) that can be refined, much like petroleum. Algae also efficiently use CO_2 , and are responsible for more than 40 per cent of the global carbon fixation, with the majority of this productivity coming from marine microalgae. Simply put, algae use photosynthesis to convert sunlight and carbon dioxide from the atmosphere into hydrocarbons.

However, scientists have struggled to find a way to upscale production and process algae cheaply enough to compete with petroleum fuel. That's despite the fact that algae produce biomass very rapidly, with some species doubling their numbers in as few as six hours.

The answer, which is a direction that Masdar and several other research institutions are pursuing, is using genetically engineered algae. For example, scientists with the Scripps Institution of Oceanography figured out how to curb an enzyme that breaks down the lipids in algae that are crucial for making biofuel. Typically, algae growers "starve" the algae to boost lipid production, but that inhibits growth. The genetically engineered algae have the advantage of growing quickly while still accumulating a sizeable amount of lipids.

Algae can also be used for bio-manufacturing, a process where microscopic algae are turned into living machines that can be genetically programmed to produce molecules such as lipids and hydrocarbons that are ideally suited for biofuels. Research is ongoing, but the biggest obstacle to using algae as biofuel is the current low oil price. Biofuel becomes a lot more competitive when a barrel of oil breaks the \$100 mark.

PUTTING CO_2 TO WORK

Carbon dioxide is being used as a refrigerant in domestic appliances such as fridges and air-conditioning units, as well as on an industrial scale. CO_2 is effective at heat exchange, a property scientists are now using to enhance and expand geothermal energy. Carbon sequestration, where CO_2 is captured from factories and power stations and pumped underground so that it doesn't enter the atmosphere, is cost-prohibitive without government incentives. However, by using CO_2 in geothermal plants the increased efficiency pays for the sequestration.

Underground heat is typically utilised by pumping water deep into the earth, where it is heated and then brought back to the surface to power turbines that generate electricity. But CO_2 outperforms water as the greenhouse gas extracts heat about two to four times more efficiently. In a computer simulation, researchers found that compared to an average geothermal plant, a carbon dioxide-fed geothermal plant could produce 10



times more power while also locking away the annual CO_2 emissions from as many as three midsize coal-fired power plants. Preliminary tests of the technology, called carbon dioxide plume geothermal (CPG), are underway.

The UAE is also putting CO_2 to good use. Abu Dhabi National Oil Company (ADNOC) is capturing CO_2 from the Emirates Steel factory in a pilot project and pumping it into oil wells. This results in carbon sequestration and boosts the underground pressure to increase the amount of oil that can be recovered. Normally, only around 40 per cent of the available oil is recoverable, but by using this enhanced oil recovery (EOR) technique ADNOC will be able to reach up to 70 per cent oil recovery from its fields while sequestering 800,000 tonnes of CO_2 annually.

ENERGY IN A PIPE

US-based startup Lucid Energy has come up with the deceptively simple idea of putting turbines into municipal water mains that are fed by gravity. The turbines' svelte aerodynamic blades, that work on the same principle as a wind turbine, skim off surplus pressure from the moving water rather than impede it the way a conventional hydropower turbine would. The company installed four such turbines in Portland, Oregon, that produce enough renewable energy to power about 150 homes.

Gravity-based water systems can meet 10 to 15 per cent of their power needs with this system and at an attractive price. LucidPipes generate power at 5.6 cents per kilowatt-hour in Portland, less than half the average US residential power rate. Plus there is zero environmental impact. ↑

Biofuel made from algae is being researched by the UAE-based Masdar Institute.

A UNION OF PAST AND FUTURE



The Etihad Museum proudly documents the UAE's founding, which laid the foundation for the modern and dynamic country of today

"Our existence is deeply rooted in history, just as an ever-growing date palm," said His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, when he visited the Etihad Museum in March last year. It was a work in progress back then – all construction and finetuning – but within six months would be back, this time to inaugurate what is billed as a dynamic museum for the 21st century.

Visually stunning, architecturally bold, and historically significant, what has emerged from two years of

construction is an expansive exploration of the most important moment in the UAE's history – its formation.

There is a defining sense of pride within the experience-driven exhibitions, interactive programmes and educational initiatives that form the bulk of the museum's offering, with photographs, films, historical documents and interactive pavilions exploring the events that culminated in the unification of the Emirates in 1971.

"Our shared duty towards our country is to contribute to the documentation of this historical milestone, which >





The Etihad Museum features the personal belongings of the UAE's founders.

marks the very beginning of the UAE's glorious march towards progress," said Sheikh Mohammed upon the museum's inauguration during the 45th National Day celebrations on 2nd December last year. "In addition, we should collectively support the effort to showcase historical objects related to the establishment of the Union of the United Arab Emirates."

The museum was opened to the public on 7th January, with emphasis placed on the key period between 1968 and 1974, and the entire project includes a refurbished Al Diyafa Palace and Dar Al Etihad (Union House). A new 123-metre flagpole has also replaced the previous one, which was built in 2001.

It is the museum building itself, however, that is the source of much admiration. It is also initially deceptive. The majority of the museum lies underground, including the permanent and temporary galleries, theatres, event spaces and archival facilities, and the only visible aspect of the museum upon arrival is the relatively compact entrance pavilion.

Formed in the shape of a manuscript, the pavilion's parabolic curves represent the parchment upon which the unification agreement was written, while its seven tapering golden columns symbolise the pens with which the document was signed. It is an impressive building. Even more so because of the sense of light and space that it conveys.

This sense of openness is enhanced by terraced viewing platforms and the delicate latticework of bronze jali screens. Downstairs, lightwells of varying shapes and sizes illuminate the expansive underground space, its subterranean galleries and theatres stretching off towards the circular and refurbished Dar Al Etihad, the historic site where the UAE declaration was first signed in 1971.

Its scope is impressive and much thanks must be given to Canadian firm Moriyama & Teshima Architects for the building's design, although overall responsibility for the development and construction of the project lay in the hands of the Roads and Transport Authority. Now, however, it is to Dubai Culture & Arts Authority (Dubai Culture) to whom the baton of responsibility has been handed.

It is with one of Dubai Culture's staff that I am given a tour of the 25,000-square-metre facility. We pass quotes from the UAE's founding fathers and a monumental painting by the Emirati artist Abdul Qader Al Rais. There's an inner garden surrounded by glass partitions where a tree first planted by Sheikh Mohammed in 2012 has been relocated, and a library with 3,000 political, social and historical books. Not far away stand images of the UAE's founders. Beside each is a selection of personal belongings.

There's a cane, a pair of sunglasses and the prayer beads of Abu Dhabi's late leader Sheikh Zayed bin

Sultan Al Nahyan and a pocket watch given to him by HE Abdulrahman Al Sayed al Hashimi. The passport, smoking pipe, eye glasses and head-gear of Dubai's Sheikh Rashid bin Saeed Al Maktoum are also on display, as are the personal guns of Sheikh Saqr bin Mohammad al Qasimi of Sharjah and Sheikh Mohammed bin Hamad Al Sharqi of Fujairah. Nearby is an interactive screen featuring biographies, family trees, photographs and videos.

One of the contributors to this part of the museum was His Highness Sheikh Rashid bin Saud bin Rashid Al Mualla, Crown Prince of Umm Al-Quwain, who donated historical items that belonged to his great grandfather the late Sheikh Ahmed bin Rashid Al Mualla, Ruler of Umm Al-Quwain at the time of the UAE's union. His passport, pocket watch, dagger, official seal, and rare gold and silver coins issued by the Government of Umm Al-Quwain in 1970 are situated in a glass cabinet beside his photograph.

So too are the personal dagger, passport, official seal, pocket watch and eyeglasses of the late Sheikh Rashid bin Humaid Al Nuaimi, Ruler of Ajman and Member of the Federal Supreme Council of the UAE at the time of the Union. All were given to the museum by His Highness Sheikh Ammar bin Humaid Al Nuaimi, Crown Prince of Ajman and Chairman of the Ajman Executive Council.

"Since the UAE's inception it has been led by honest men who have stayed true to their words and carried the torch of the Union forward, including the late Sheikh Zayed bin Sultan Al Nahyan, who first ignited the flame of the Union in the company of the late Sheikh Rashid bin Saeed Al Maktoum," said Sheikh Ammar. "Successfully following in the same path today is His Highness Sheikh Khalifa bin Zayed Al Nahyan, the President of the United Arab Emirates.

"Our support for the creation of this national landmark stems from our belief in the leading role that the museum will play in documenting the history of the UAE, which reflects the level of development, progress and sophistication that the country has reached today. Museums play an important role in maintaining national culture, and developing and encouraging Emirati culture amongst the public is a national responsibility.

"The Union has a special meaning for each and every UAE citizen, as it empowers them with feelings of pride and dignity. The date of the Union's signing marks a pivotal change in the lives of Emiratis, as it represents the foresight, honesty and patience of the Union's Founding Fathers, who laid the foundations to a modern state, from which we have collectively built upwards to the upper echelons of progress and development."

Further into the tour we are joined by one of the museum's guides and led into a temporary exhibition hall where elements of the Trucial States' postal history are displayed. Stamps dating from 1909 to 1971



predominate but there is also a sprinkling of letters and official correspondence. The oldest item is an envelope from 1910. Posted in Dubai on 23 July, it arrived in Mumbai a week later.

Amidst the temporary exhibition is also a copy of a letter dated the 28th November 1940 from Captain R.D Metcalfe, political agent, Trucial Coast, to the Honourable Lieut-Colonel C.G Prior, political resident in the Arabian Gulf, discussing the opening of a post office in Dubai. "As long ago as 1936, the Sheikh of Sharjah asked for a post office," wrote Metcalfe. "Correspondence ensued and later it was decided, for obvious reasons, that any post office should be established at Dubai. More correspondence followed, the Sheikh of Dubai promised to be most helpful and then, as far as I remember from the Bahrain files, the matter developed into a dispute between the Political Agent and the Karachi Division of Post Offices and the question was shelved."

It is arguably the museum's constitution section, however, that will be of the most interest to Emiratis. Here lies a copy of the constitution signed by the Founding Governors, in addition to the Treaty of Friendship between the United Arab Emirates and the United Kingdom signed by Sheikh Zayed on the same day he announced the establishment of the Federation of the United Arab Emirates.

At the end of the tour we walk towards Dar Al Etihad and the recreation of Jumeirah Beach's 1971 shore-line. It is tranquil and beautiful and, like the museum itself, representative of both the past and future. ↑

The Etihad Museum opened to the public on 7th January.





TACKLING FOOD WASTE

The UAE's Year of Giving began with a comprehensive plan to waste less food through the creation of an official food bank, which is leading the way in addressing a global problem.

The 2015 Gulf Forum to Enhance Food Security conference estimated that countries in the Middle East waste 1.3 billion tonnes of food worth more than a trillion dollars annually. Every day, nearly 40 per cent of the food the UAE cooks is thrown away. According to green company Dubai Carbon, the UAE ranks among the top nations for per capita waste generation in the world at 2.7kg per day as compared to 1.2kg in Europe. Given these statistics, the UAE's food bank announced earlier this year is definitely a step in the right direction.

Launched as part of the 'Year of Giving' initiative, the food bank will partner with hotels, restaurants, supermarkets and other food related enterprises for efficient storage, packaging and distribution of excess food. Saving excess food is not just a matter of humanitarian concern, but also an economic one – each year, UAE residents dump food worth \$4 billion or AED14.69 billion into landfills.

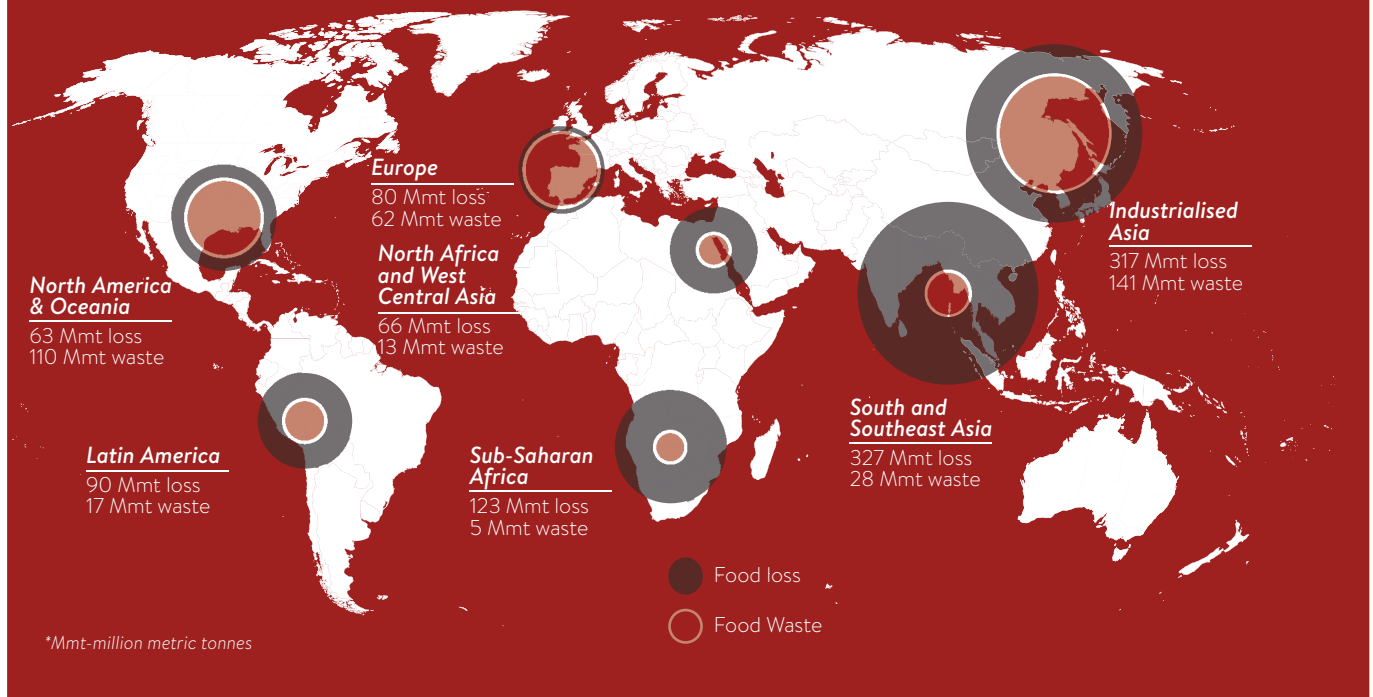
In the past few years there have been other charitable efforts to curtail food wastage but the UAE food bank is the first institutionalised one. Before the food bank was announced, 10 per cent of Dubai's hotels, restaurants and hypermarket chains already had programmes in place to distribute excess food to the needy. This contribution is bound to increase manifold with the national food bank. Within a week of its launch, 85 hospitality companies and over 100 supermarkets had pledged their support to the food bank.

The UAE's effort is being lauded globally. The Food and Agricultural Organisation (FAO) of the United Nations has praised the nation's decision to regulate efforts to minimise food wastage and particularly the government's attempt to adapt the initiative to suit the UAE's unique cultural



FOOD WASTE AND FOOD LOSS AROUND THE WORLD, MILLIONS OF METRIC TONNES*

Unlike consumer driven waste in the developed world, over 90% of all wastage in developing Asia and Africa occurs during production, postharvest, processing, and distribution



fabric. “The beauty of this initiative is that it is home-grown. It will look at other countries’ experiences, but it will also identify how it could address elements pertaining specifically to the UAE,” the FAO said in a press statement.

GLOBAL HUNGER

A 2011 Global Food Loss and Waste study commissioned by the FAO reported that over a billion tonnes of food produced around the world is wasted each year. Even if just one-fourth of it could be saved, it would be enough

to feed 870 million hungry people in the world. The glaring inefficiencies of the global food system are proving to be very costly in terms of nutrition, economy and even the environment.

In developing nations most of the food is lost postharvest for lack of adequate storage facilities, good roads, and refrigeration. In comparison, developed nations waste more food further down the supply chain, when retailers order, serve, or display too much and when consumers ignore leftovers in the back of the fridge or toss perishables before they’ve expired.



Global quantitative food losses and waste per year are roughly 30 per cent for cereals, 40-50 per cent for root crops, fruits and vegetables, 20 per cent for oil seeds, meat and dairy plus 35 per cent for fish.

Per capita waste by consumers is between 95-115 kg a year in Europe and North America, while consumers in sub-Saharan Africa, south and south-eastern Asia, each throw away only 6-11 kg a year. The most salient point is that the most technologically and economically advanced cultures in the world have the highest rates of food waste on the planet – and that's even without including the astonishing amount of packaging and carry-out containers associated with our dietary habits.

By 2050, the world will need about 60 per cent more calories per year in order to feed nine billion people. Cutting current food loss and waste levels in half would shrink the size of this food gap by 22 per cent.

ENVIRONMENTAL IMPACT OF FOOD LOSS

Wasting food also means wasting resources such as water, land, energy, labour and capital. Globally a year's production of uneaten food consumes as much water as the entire annual flow of the Volga, Europe's most voluminous river. This amount of water would be enough for the daily needs of nine million people.

The amount of land needed to grow all the food wasted in the world each year would be the size of Mexico.

Emissions from thrown away food make a significant contribution to global warming and climate change. The FAO says food loss and waste accounts for about 3.3 gigatonnes of greenhouse gas emissions. To put that in perspective, if food loss and waste were its own country it would be the world's third-largest emitter, only exceeded by China and the United States.

WHY WE NEED FOOD BANKS

Finding good use for food that would otherwise be thrown away is the study's most important

recommendation and this is where food banks play a crucial role. The Global Food Banking Network (GFN) is the largest global, non-profit organisation tackling food waste and loss.

Food waste and loss is not just limited to individuals or industries throwing away excess food, says the GFN. Harvested fruits and vegetables falling off trucks, or supermarkets rejecting produce because it doesn't look 'good' also constitute food waste. GFN's member food banks – present in 32 countries around the world – address the loss of food at every stage: production, harvest, post-harvest and processing phases. In 2016, GFN's global network distributed 928 million pounds of food to more than 6.8 million people in need.

In rescuing perfectly edible food before it is discarded, food banks form a vital link between food waste and hunger. They also have the potential to be a powerful tool to fight economic and environmental damage caused by loss of food. Through their community networks, they are able to reach the right people at the right time breaking the vicious cycle of poverty, food insecurity and poor health.

Although there is awareness, it will take the world some more time to adopt a more conscientious approach towards food. Until then, food banks seem to be the best approach to curtail the damaging repercussions of food waste and loss.

The UAE is committed to sustainable development and tackling global warming. The UAE became the first Arabian Gulf country to ratify the Paris Climate Agreement on 7 September 2016, which is due to take effect in 2020. The UAE Energy Plan 2050, which was announced in January this year, aims to cut carbon dioxide emissions by 70 per cent, increase clean energy use by 50 per cent and improve energy efficiency by 40 per cent.

In light of this, the creation of an official food bank is a small part of a much grander long-term vision. †



45%
ROOTS & TUBERS
FOOD LOSSES

In North America & Oceania alone, 5,814,000 tonnes of roots and tubers are wasted at the consumption stage alone.



20%
DAIRY
FOOD LOSSES

In Europe alone, 29 million tonnes of dairy products are lost or wasted every year.



35%
FISH & SEAFOOD
FOOD LOSSES

8% of fish caught globally is thrown back into the sea. In most cases they are dead, dying or badly damaged





With technology becoming ubiquitous in our daily lives, is it becoming harder for individuals to actually take time away from work?

DO EMPLOYEES HAVE THE RIGHT TO DISCONNECT?

It is no longer rare to see people scrolling through their work emails while stretching out on a beach during a holiday. Nor is it unusual for an evening meal with the family to be interrupted by an “urgent” office phone call.

The internet has enabled us to live in an “always on” mode, with lines now blurred between work and personal time. Traditional 9 to 5 job roles are being replaced by flexible working hours, but more likely than not, employees are expected to remain answerable at all hours.

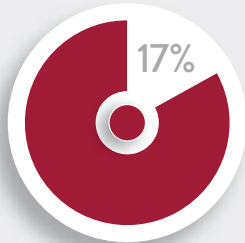
According to a report by US-based technology research firm Radicati, over one-third of the world’s population will be using emails by the end of 2019.



HOW MUCH TIME SPENT ON WORK EMAILS IS A WASTE?

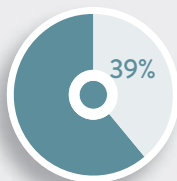
2,200 CEOs were asked, "What is the percent of time you spend on work-related emails that you consider to be wasted?"

The mean response

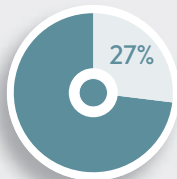


CEOs were also asked, "What is the primary time-waster when it comes to email?"

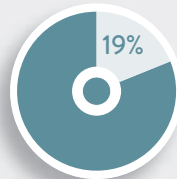
Responses



Spam



Being copied on irrelevant messages



Receiving messages that could be better delivered another way



Long rambling messages

The firm found that the number of emails sent and received per day totalled over 205 billion in 2015. That figure is anticipated to grow at an average annual rate of three per cent over the next four years, reaching over 246 billion by the end of 2019.

More specifically, the number of business emails sent and received per user per day alone equalled to 122 billion emails in 2015, and is set to rise to around 126 billion by the end of 2019, Radicati found.

With businesses becoming more and more global, several of those emails are sent in one time zone and received in a different one. However, the responses are demanded immediately, and this in turn has put immense pressure on executives.

Employer expectations that emails will be monitored and responded to during non-work hours are the main reason employees are unable to disconnect from the workplace, a recent study found.

William Becker, a Virginia Tech associate professor and one of the study's co-authors, said that such expectations alone create "anticipatory stress" in employees.

"Such expectations – whether real or imagined – cause more problems, including burnout and work-life balance problems, than the actual time it takes to read and respond to after-hours emails."

The study noted that even during times when there are no actual emails to act upon, "the mere norm of availability and the actual anticipation of work create a constant stressor."

"An 'always on' culture with high expectations to monitor and respond to emails during non-work time may prevent employees from ever fully disengaging from work, leading to chronic stress and emotional exhaustion," the study said.

Those hardest hit by such organisational expectations are employees who prefer to keep work and family separate, it found.

The study also stressed that managers need to be cognizant of the

negative impact such expectations have on individual perceptions and well-being, which may also ultimately impact the functioning of the organisation.

"Accordingly, managers need to enforce organisational practices that will help to mitigate these negative effects and protect their employees in the long run," it cautioned.

In a bid to tackle this challenge, the French government took a rather bold move at the start of this year with its radical "right to disconnect" law.

The new law allows people working in companies with more than 50 employees to ignore emails after work hours and during vacations. The government hopes the new move will "ensure the respect of rest time and vacation, as well as personal and family life."

Introducing such laws can help raise awareness among employers regarding the importance of employee work/life balance and wellness, says Elias Dib, partner and study director from Aon Hewitt Middle East.

"It is definitely something that would not affect productivity and hence, it is something that all organisations can afford. Ultimately it would encourage a culture of effective time management and employee wellbeing," he says.

IN REALITY, DOES WORK/LIFE BALANCE REMAIN ELUSIVE?

The latest Willis Towers Watson Global Benefits Attitudes survey found that the 'lack of work life balance', and 'availability of technology that expand the working day', are seen by employers as the number one and three causes of stress respectively.

"A lot of people are having a difficult time finding meaningful balance in their lives. There is no perfect, one-size-fits-all guide to achieving work-life balance. It varies for each person because we all have different priorities and lead different lives," explains Steve Clements, director, Health and Group Benefits at Willis Towers Watson.

“The concept of work-life balance does not necessarily mean having an equal prioritisation between ‘work’ (career and ambition) and ‘life’ (health, pleasure, leisure, family and spiritual development).

“Trying to schedule the same number of hours for each of your various work and personal activities is usually unrewarding and unrealistic. Life is and should be more flexible,” he adds.

For some employees, the constant connection to work might not affect their work/life balance, opines Aon Hewitt’s Dib.

“This depends heavily on the level of engagement the person has with the organisation and how much the organisation motivates him/her to contribute more than the required to complete the work,” he states.

He cites some regional examples – 82 per cent of the employees working for Aon Middle East Best Employers 2016 believed that the balance between their work and their personal commitments is right for them as compared to 61 per cent of the employees in the general market.

Similar stats were reported when it came to managing work-related stress.

“It is safe to say that some organisations have more effective practices than others,” adds Dib.

Looking ahead, any governmental regulation in regards to allowing people to “disconnect” must consider the variations based on the nature of the job, for example, essential services that require 24-hour support and roles in multinational firms that require working with colleagues across the world, he asserts.

“Moreover, the aspect of individual preference should be considered, for instance, there are many employees who might prefer having flexible working hours as against a stipulated time,” he says.

“It is an increasingly global world and Dubai is a global centre. With a time difference of 12 hours with the United States and six to seven hours difference with Australia, it is virtually impossible to find slots during regular working hours with colleagues in other parts of the world.”

From an organisational perspective, companies are already recognising the need to support their staff.

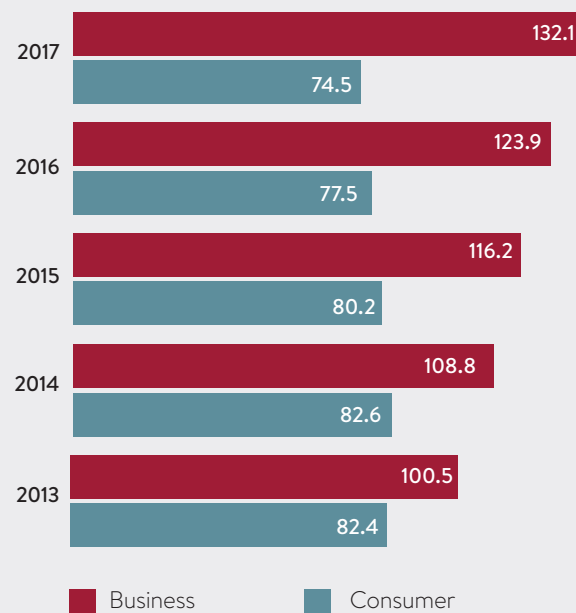
Willis Tower Watson’s latest *Staying@Work* survey found that almost half (45 per cent) of GCC employers currently have a workforce health and productivity strategy in place, above the global average of 37 per cent.

“This study shows how investing in workforce health isn’t just a nice-to-do, it actually makes good business sense and can be a win-win for employers and employees alike. Employers can get a healthy return on their investment from more engaged and productive employees, and employees get the support they need to improve their health status,” emphasises Clements.

On an individual level, he urges people to build

PRIVATE EMAIL TRAFFIC IS DECLINING

The estimated number of emails sent and received each day worldwide (in billions)



Statista

downtime into their schedules when planning the week.

“Make it a point to schedule time with your family and friends and activities that help you recharge. Drop activities that sap your time or energy. Focus your time and attention on things you can control. Don’t be a robot on weekdays – be flexible. It helps to be proactive about scheduling,” he advises.

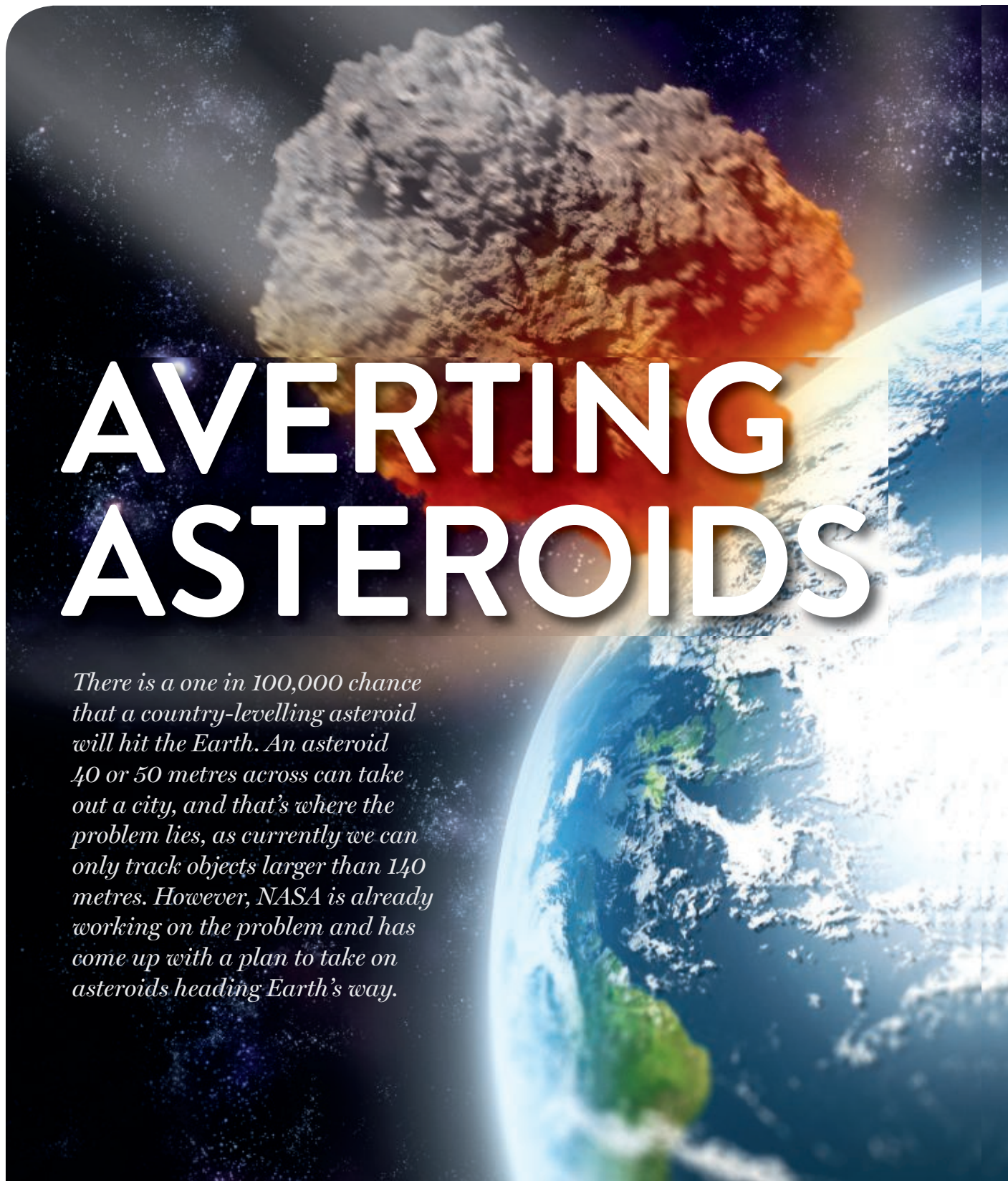
Ultimately, remaining connected to work/emails, even after leaving the office, highly depends on the nature of the work, says Dib.

“We always encourage employees to understand the difference between urgent emails such as approval requests, clients’ communication, etc. and the important business matters i.e., setting direction, strategy.”

At the end of the day, individuals should recognise what matters most to them and what their priorities are.

Clements elaborates: “At the core of an effective work-life balance definition are two key everyday concepts which are relevant to each of us. They are called daily achievement and enjoyment, ideas almost deceptive in their simplicity.

“Achievement and enjoyment answer the big question ‘Why?’ Why do you want a better income, a new house, to send the kids through college, to do a good job today, to come to work at all?” ↑



AVERTING ASTEROIDS

There is a one in 100,000 chance that a country-levelling asteroid will hit the Earth. An asteroid 40 or 50 metres across can take out a city, and that's where the problem lies, as currently we can only track objects larger than 140 metres. However, NASA is already working on the problem and has come up with a plan to take on asteroids heading Earth's way.



To some, the idea of Earth being hit by an asteroid may seem far-fetched and something suited best to sci-fi movies and novels. Although the probability is one in 100,000, NASA isn't leaving anything to chance and is lobbying to put forward measures that can stymie the event should it threaten to happen.

Recently, a coalition comprising of US federal agencies such as the Federal Emergency Management Agency (FEMA), the Department of Defense, and the Department of Homeland Security started working with NASA to lay out a multi-faceted, long-term blue print to defend our planet from the celestial rocks.

Last year they released their first report based on the results of an asteroid impact response simulation and put forward a case to increase support for detection and deflection efforts.

POTENTIAL IMPACT

In 2013, the Chelyabinsk asteroid exploded over Siberia, injuring hundreds of people. Prior to this, the 1908 Tunguska asteroid (some say it was a meteor) exploded levelling over 700 square miles of forest. The explosion produced about 185 times more energy than the Hiroshima atomic bomb and seismic rumbles were felt as far as the United Kingdom. In both cases, there wasn't an actual impact but the after effects were devastating.

We don't know what an actual impact could do but NASA's simulation paints a chilling picture should an asteroid actually hit Earth. A 40 or 50 metres rock can wipe out a city while a larger asteroid could destroy an entire continent. If history does repeat itself, then we are due for an asteroid encounter at least once or twice a century.

SPATIAL SURVEILLANCE

NASA's Jet Propulsion Laboratory is currently developing a telescope called Neocam to scan space for any incoming intruders. Neocam will sweep across areas of the solar system nearest to Earth to locate and track asteroids within the 20-140 metre range. Upon completion, it will work together with the Large Synoptic Survey Telescope (LSST) that is under construction in Chile. LSST's 3.2-billion pixel camera will be able to identify cosmic objects that changed or moved even in the faintest manner.

The asteroid defence team estimates there are around 10 million near-Earth objects that are 20 metres or smaller in size and about 300,000 which are larger than 40 metres. NASA currently lists only 15,413 near-Earth objects, of which 1,763 are classified as Potentially Hazardous Asteroids. >



Above: Meteor Crater is a major tourist attraction in the US state of Arizona.

Above right: The OSIRIS-Rex capsule will intercept an asteroid in 2018.

THE ACTION PLAN

NASA and its coalition team have laid out a seven-point plan to combat dangerous asteroids and tackle the aftermath of a potential impact. While the whole proposal has not yet been made public, some of the main points of the plan have been announced.

The team suggests building a space-based observatory to improve detection and tracking of asteroids. An international alert system would have to be set up for coordination between national and international

agencies in the event of an impact. The team also wants to put emergency plans in place, along with the establishment of protocols for communication and data sharing between agencies. The report heavily stresses the primacy of international cooperation, where even rival nations will have to work together in the event of an asteroid impact.

The report also discusses various ways to deflect an asteroid from its path including crashing a spacecraft into it; breaking it up with nuclear bombs; vaporising it



DINOSAUR KILLER

The Chicxulub Crater, which is located in Mexico's Yucatan Peninsula, is estimated to have impacted the Earth 65 million years ago. Many scientists believe that the asteroid that left this crater caused or contributed to the Cretaceous–Paleogene extinction event, a mass extinction in which 75 per cent of plant and animal species on Earth suddenly became extinct, including all non-avian dinosaurs. Estimates of the crater's actual diameter range from 170 to 300 kilometres, which if proved right could mean it's the biggest asteroid to ever hit our planet. Scientists believe the asteroid was at least 10 kilometres in diameter.



with explosives and even painting parts of it black or white to allow the sun's light to push it in a different direction.

Finally, the team recommends conducting missions to asteroids to test technologies that will allow asteroid herding and also to bring back rock samples. The coalition already has a head start on this part of the plan: the OSIRIS-REx mission launched in September 2016 is scheduled to come into contact with the asteroid Bennu in 2018. The mission will collect samples from Bennu and return them to Earth as well as put to test some of the protocols required for an asteroid-deflection mission when the need arises.

However, detection remains the first and most vital part of the plan. It would take over a decade

to fully design and equip a mission to coax an asteroid off its path toward Earth. This is why the coalition team is stressing on improving detection facilities for now.

Critics are questioning the amount of time, effort and funds NASA and the coalition is putting into the mission. Ed Lu, a former astronaut and CEO of B612, an advocacy group focused on asteroid impacts, says an asteroid impact is not just another sci-fi notion that should be written off due to funding shortfalls.

"It should not be judged in a pure science competition against other scientific missions with the criteria being how much novel new science you are doing," he says. "This is really something that is not just science, but it's really about protecting life." ♪

5 BIGGEST KNOWN ASTEROID HITS

1

Vredefort Crater

Asteroid impact date: Estimated 2 billion years ago

Location: Free State, South Africa

Detail: Also known as the Vredefort Dome, the Vredefort crater has an estimated radius of 190 kilometres, making it the world's largest known impact structure. This crater was declared a UNESCO World Heritage Site in 2005.

2

Sudbury Basin

Asteroid impact date: Estimated 1.8 billion years ago

Location: Ontario, Canada

Details: The Sudbury Basin is considered one of largest impact structures on Earth, with an estimated diameter of 130 kilometres. Dating back 1.8 billion years, it is also one of the oldest known impact structures in the world.

3

Acraman Crater

Asteroid impact date: Estimated 580 million years ago

Location: South Australia, Australia

Details: Located in what is now Lake Acraman, this impact structure has an estimated diameter of 90 kilometres.

4

Woodleigh Crater

Asteroid impact date: Estimated 364 million years ago

Location: Western Australia, Australia

Details: This crater is not exposed at the surface and has led to many discrepancies regarding its actual size. Reports on its diameter vary from 40 to 120 kilometres.

5

Manicouagan Crater

Asteroid impact date: Estimated 215 million years ago

Location: Quebec, Canada

Details: This impact crater formed what is now Lake Manicouagan. Even with erosion, it's considered one of the largest and best-preserved craters on Earth, with an estimated diameter of 100 kilometres.

IN SEARCH OF A UNIVERSAL FLU VACCINE

The influenza virus kills between 250,00 to 500,000 people every year. Although we do have flu vaccines, they have to be administered annually and only help against certain strains. Scientists are now looking for a universal vaccine that would inhibit all flu strains and for longer periods of time.

Anyone who has suffered the flu knows how debilitating the illness is. Blocked or runny noses, fever, coughing and body aches leave the toughest individual reeling, unable to even get out of bed. A 2007 US study initiated by the Immunization Service Division, National Center for Immunization and Respiratory Diseases and Centers for Disease Control and Prevention in Atlanta, reported that the annual flu results in an average of 610,660 life-years lost, 3.1 million hospitalised days, and 31.4 million outpatient visits. Direct medical costs averaged \$10.4 billion annually while projected lost earnings due to illness and loss of life amounted to

\$16.3 billion annually. The total economic burden of annual influenza epidemics using projected statistical life values amounted to \$87.1 billion – and this was just in the USA.

While some of us get off with a few sick days, there are others who aren't so fortunate and succumb to the flu. It is estimated 10 per cent of the global adult population and between 20-30 per cent of children are attacked by seasonal flu annually. Over the past 100 years, influenza has been the cause of the majority of pandemics the world has seen. The 1918 flu caused nearly 50 million







Above: Bird flu, also called avian influenza, is a viral infection that can infect humans and other animals. H5N1 is the most common form of bird flu.

Below: A team led by Dr Derek Gatherer of Lancaster University claim they have developed two universal vaccines.



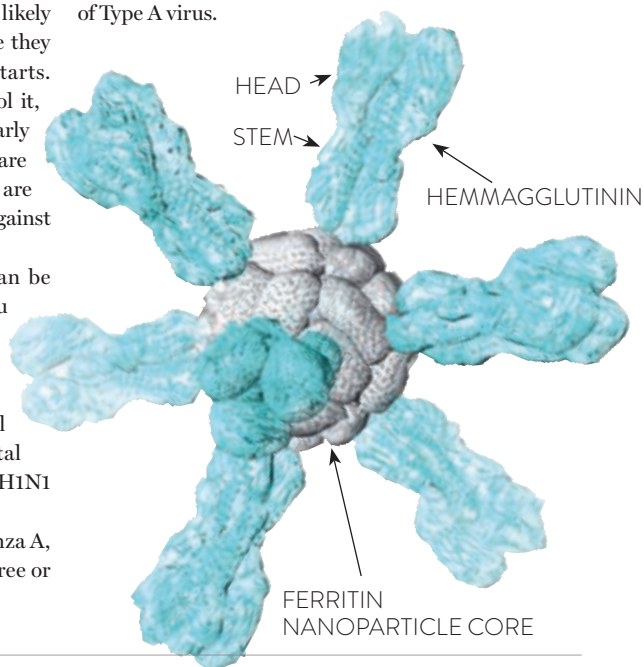
deaths while the more recent H1N1 flu strain caused worldwide panic and over 500,000 deaths. Most of these deaths occur within high-risk groups such as babies and the elderly.

Each year scientists race to produce vaccines capable of protecting human beings against the deadly virus. Centres for Disease Control (CDCs) around the world work together to predict which flu strain is most likely to infect a population in any given season. Once they shortlist the flu strains, vaccine production starts. Despite the global efforts to restrain and control it, the flu remains largely indestructible. While yearly vaccines are safe and work reasonably well, they are not fool proof. Plus the methods to develop them are expensive, labour intensive and give no protection against future pandemic flu.

The long-term ineffectiveness of vaccines can be put down to the ever-changing anatomy of the flu virus. Since it mutates every year, any vaccines are effective only for a short period of time and necessitate a repeat dose every year. And if there are any errors in forecasting which flu strain will be dominant in a particular season, it can have fatal consequences for the human race – such as the H1N1 strain that emerged suddenly in 2009.

There are three main types of flu virus: Influenza A, B, and C, and existing vaccines usually target three or four specific strains within this range.

Type A is of the most concern, and can be carried by humans and some animals including birds and horses. Within Type A are multiple strains, labelled by the numbers of the two glycoproteins hemagglutinin (H) and neuraminidase (N) to give a specific identifier such as H1N1 or H3N5. The H number can be up to 16, while the N number can be up to 9, giving 144 primary varieties of Type A virus.



Type B are human only, usually less severe, and never cause pandemics. Type C are less dangerous still.

The flu's morbidity is pushing scientists to find a universal vaccine for it, which is capable of fighting against diverse strains of influenza and doesn't require annual predictions.

In the past few years, researchers have identified a number of powerful, influenza-neutralising antibodies produced by our own bodies. These antibodies target both the head and the stem of the flu virus, which resembles a lollipop attached to a ball. The head of the influenza virus keeps changing anatomy but the stem remains constant across most viral strains. Scientists believe the stem could be the virus' Achilles heel and antibodies that particularly target that region of the virus can form the base needed for a universal vaccine. They are now studying ways that will push our bodies to produce the antibodies that primarily attack the stem.

Other researchers are looking at the possibility of a class of antibodies that not only identifies and attaches itself to the stalk of the virus but also recruits the body's white blood cells to fight against infected cells. A number of strategies are under analysis and the data collected from animal studies using stem-only immunogens has been encouraging. However, more data on humans needs to be collected prior to validating any of the approaches and scientists are confident that a universal, one-dose flu vaccine is less than a decade away.

In fact, a team of scientists recently announced they had made a breakthrough in flu vaccine research. The collaboration involving the universities of Lancaster, Aston and Complutense in Madrid applied ground-breaking computational techniques to design the vaccine in a study published in the journal *Bioinformatics*. The researchers claim to have developed two universal vaccines – a USA-specific vaccine with coverage of 95 per cent of known US influenza strains, and a universal vaccine with coverage of 88 per cent of known flu strains globally.

Dr Derek Gatherer of Lancaster University said: "Based on our knowledge of the flu virus and the human immune system, we can use computers to design the components of a vaccine that gives much broader and longer-lasting protection."

Dr Pedro Reche of Complutense University said: "A universal flu vaccine is potentially within reach. The components of this vaccine would be short flu virus fragments – called epitopes – that are already known to be recognised by the immune system. Our collaboration has found a way to select epitopes reaching full population coverage."

The epitope-inspired vaccine remains a computer design only for the time being, but Dr Gatherer's team is actively seeking a pharmaceutical industry partner to synthesise the molecule for a laboratory test. He is optimistic: "We think our design has a better chance than other universal vaccines that have performed poorly in the past. Quite what that chance is, however, remains to be seen."

Dr Gatherer believes that evolution will still allow the virus to get around the vaccine, "but this would take decades. Currently, vaccines are obsolete within a year or so." †

FLU VACCINE MYTHS VS. FLU FACTS

FACT
Flu Viruses used in FLU SHOTS are inactivated, so they cannot cause infection

MYTH
The FLU SHOT can give me the flu

MYTH
VACCINES are not proven to prevent the flu

FACT
If you get the FLU VACCINE you are about 60% less likely to need treatment

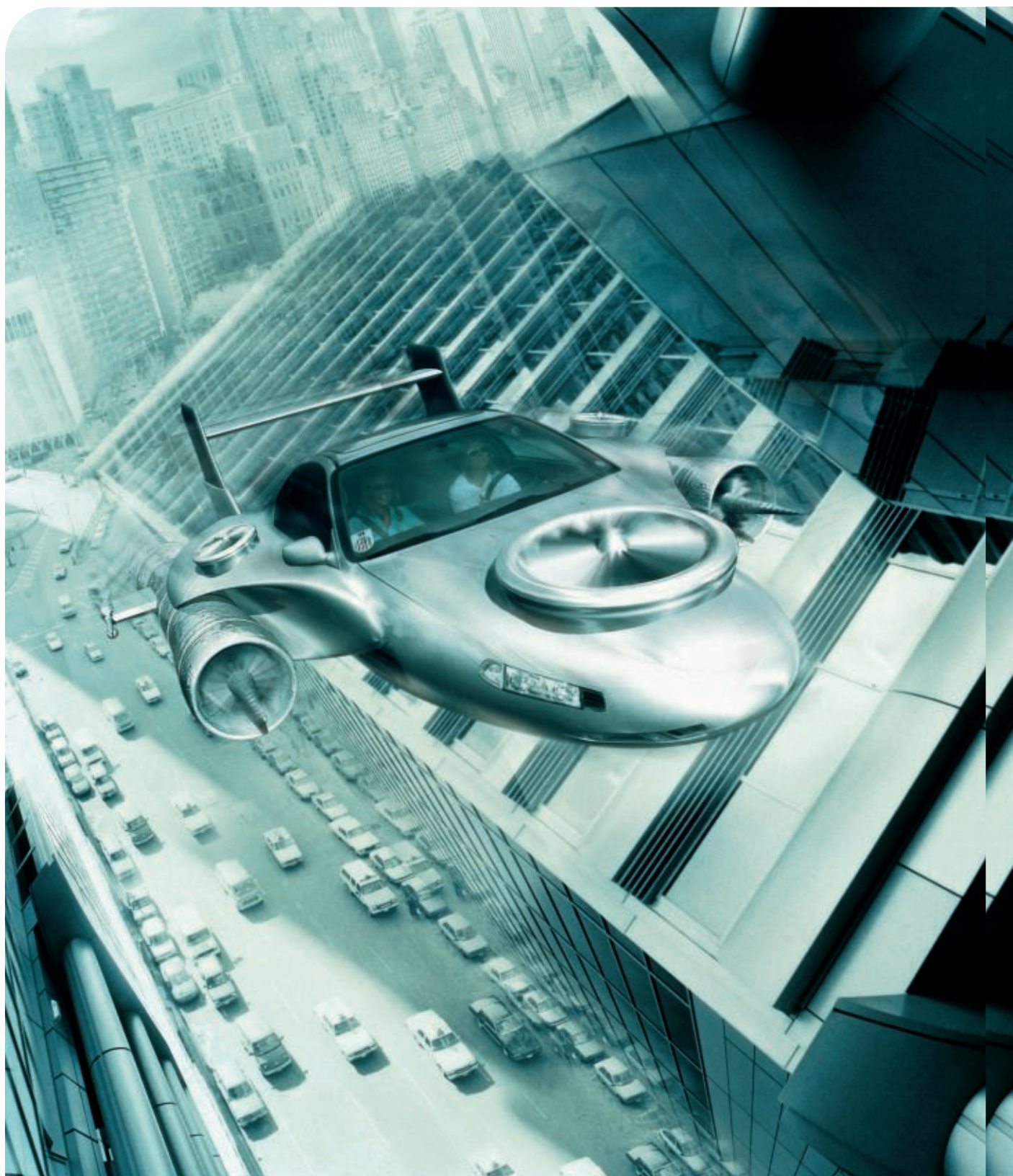
FACT
Should get a FLU SHOT as soon as they are available because it takes two weeks for antibodies to develop

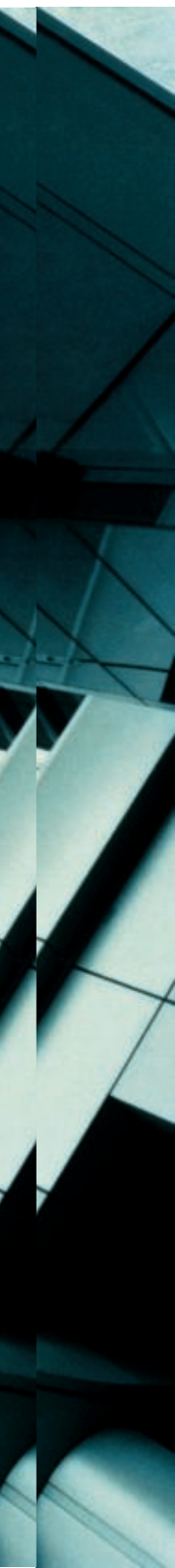
MYTH
I should wait to get VACCINATED so that I'm covered through the end of the season

MYTH
It is better to get flu than to get a FLU VACCINE

FACT
Getting the flu shot provides benefits to reduce illness and prevent time lost from work







FLYING CARS:

ABOUT TO BECOME REALITY?

It may have been running for over a century, but the race for a flying car is still on and we are getting closer than ever to a new era of air mobility

Nothing says sci-fi quite like the image of a flying car. Whether it's the Spinners in *Blade Runner*, Luke Skywalker's Land Speeder in *Star Wars* or the DeLorean DMC-12 in *Back to the Future*, a personal airborne vehicle has always had the wow factor.

But how long must we wait for science fiction to become science fact? From a failed attempt in the 18th century to create a horse carriage capable of gliding, through to the era of the Wright Brothers and Glenn Curtiss and right up to the present day, the enduring vision of a flying car has always tantalised but never materialised.

Curtiss was one of the world's foremost pioneers of flight and a founder of the US aircraft industry. He tried to develop a hybrid craft that would cruise through the clouds and coast along the highway. In 1908, Curtiss joined the Aerial Experiment Association, a pioneering research group founded by Alexander Graham Bell, with one purpose – to build flying machines. And yet no real life *Chitty Chitty Bang Bang* appeared.

Several decades later and the father of the automobile industry was also sure the flying car was just around the corner. In 1940, Henry Ford told a member of the press, "Mark my words. A combination airplane and motorcar is coming. You may smile. But it will come."

The aeroplane and the automobile were developed almost in tandem during the late 19th and early 20th centuries and they took off, literally and figuratively. In 1900 very few people owned a motorcar and no one had ever flown in a plane. Yet only 15 years later and Ford Model Ts were traversing the United States and fighter pilots were battling it out over the skies of Europe.

A merging of the two crafts may have seemed like the next logical step yet it has remained elusive. The mass-produced flying car is an idea that has been on the cusp of becoming reality for more than a century. The renowned futurist and Silicon Valley Billionaire, Peter Thiel says: "We wanted flying cars, instead we got Twitter's 140 characters."



Above: Lilium Aviation's electric Jet prototype.

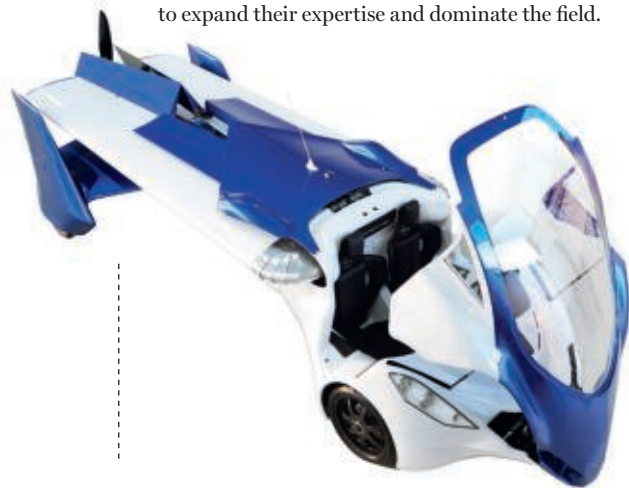
Below: AeroMobil's 3.0 prototype.

For those wanting to see the fruition of over a hundred years worth of effort, the wait may soon be over as the enabling technologies necessary for autonomous or semi-autonomous aerial vehicles are finally maturing. There is a whirlwind of activity in the air mobility market and the protagonists range from dedicated dreamers through to giant corporations eager to expand their expertise and dominate the field.

None come bigger than the Airbus Group – the multinational global leader in aeronautics and defence. Airbus experts across the organisation are working on three ambitious projects: Vahana, Skyways and CityAirbus.

Project Vahana by A3, Airbus' advanced projects partner outpost in Silicon Valley, is aiming to create a self-piloted flying vehicle platform for individual passenger and cargo transport. Officially underway since February 2016, the project's team of internal and external developers and partners has agreed on a vehicle design and flight tests of the first prototype are scheduled for late 2017. "Many of the technologies needed, such as batteries, motors and avionics are most of the way there," says A3 CEO Rodin Lyasoff, adding, "We believe that global demand for this category of aircraft can support fleets of millions of vehicles worldwide".

The Skyways project aims to help evolve current regulatory constraints that are often cited as a major obstacle in the development of flying cars. The project will commence in mid-2017 with a drone parcel delivery system on the campus of the National University of Singapore. Using defined aerial corridors,





an octocopter will carry air transport containers across an automated route and unload at a designated landing pad before alerting end-users of delivery on their mobile phone. Airbus states that: “The goal is to assess the efficiency and economic effectiveness of such a transport system and provide tangible proof to authorities and the general public that commercial drones can indeed operate safely over urban areas.”

CityAirbus is the project overseen for the last two years by Airbus Helicopters. Developers in France and Germany are working on an electrically operated platform concept for multiple passengers with a breakthrough design that could soon become reality without having to wait for too many regulatory changes. The CityAirbus aerial vehicle will resemble a small drone in design with multiple propellers and while initially it would be operated by a pilot, it would switch over to full autonomous operations once regulations are established.

These projects paint a realistic picture of a new era of air transportation in the not-too-distant future. Reflecting on why it has taken until now to get this close, Matthieu Repellin, investment partner at Airbus

Ventures, explains, “The energy density of batteries is increasing. Sensors are becoming lighter. Processing capabilities are improving. And software to make such vehicles is progressing rapidly. The industry expects such technologies to hit a price/performance point that would make autonomous passenger transport technically possible and economically viable. This is a highly attractive opportunity.”

It’s attractive on a global scale and there are an increasing number of companies, organisations and individuals striving to be in the first trench of providers that take us skywards. Google founder Larry Page has invested millions in flying car start-ups,

Flying cars could soon be seen in the skies of cities around the world.





The EHANG 184 is designed for short-to-medium distance travel.

SpaceX CEO Elon Musk has repeatedly expressed his interest in Vertical Take-off and Landing (VTOL) vehicles and Uber is positioning itself to be a key player. Jeff Holden, Uber Products Head said recently that he expected the company to be “launching a flying car service in the next decade”.

The wide range of flying cars currently under development includes those that run on everyday unleaded petrol, whilst others are electronically powered. Definitions for these flying machines already vary. Amongst others, there are VTOLs with electric propulsion systems and zero operational emissions, Personal Aerial Vehicles (PAVS) and

Personal Air Transport System (PATs) for multiple passengers.

Some of the more notable creations include the EHANG184. Unveiled by the Chinese company Ehang in January 2016, the company claims it is “the world’s first safe, smart and eco-friendly autonomous aerial vehicle to provide short-to-medium distance communication and transportation solutions.”

The Transition from US company Terrafugia features folding-wings and two-seats and is effectively a roadworthy aircraft – designed to fly like a standard light sport aircraft in the air and drive like a normal car on the ground. The company, founded in 2006 by five



MIT graduates, claims it is the world's first practical flying car. It runs on premium unleaded petrol, fits in a standard-construction single-car garage and converts between flight and drive modes in less than a minute. The 2012 prototype has logged more than 100 flight hours and over 200 successful takeoffs and landings.

German startup Lilium Aviation has created the Lilium Jet with the backing of the European Space Agency (ESA). A striking VTOL personal flight jet aircraft for consumers, it has been developed by four engineers and doctoral students from the Technical University of Munich. Their enticing vision is "there will be a world in which everyone can fly anywhere, anytime".

It's a vision long shared by Slovakian company AeroMobil. And if things go according to plan, huge numbers of people will be using their Flying Roadster to whizz about in their daily lives. Speaking from the HQ in Bratislava, AeroMobil CCO Stefan Vadocz explains how a major goal of flying cars – solving traffic congestion in megacities – can be achieved alongside other uses.

"We see many possibilities in AeroMobil use – for regular or super-commuters, passengers on medium distances, island hoppers, first response services, law enforcement and those who lack a specific road infrastructure. In some cities and areas of the world a commute takes three hours. One of our ideas is to create 'hubs' or grass strips for take-offs and departures around the large cities. These could be a helpful extension of service areas for highways near cities," he says.

The era of flying cars looks undoubtedly closer than ever before. When prices come down from initial costs

in the \$350,000 region to a less prohibitive amounts the birds may soon have a lot of company. Prompting the question of how ownership of airspace will be managed. Vadocz says, "Our vehicle is designed to use the current airspace and air-traffic management solutions. Many different studies i.e. MyCopter, NASA or Uber Elevate suggest an integrated approach to enable the first viable PATS and PAVs. Such a system will enable travelling between homes and working places and for flying at low altitude in urban environments. PAVs used in this environment should be fully or partially autonomous without requiring ground-based air traffic control."

If passion and belief as well as technological advancement are a measure to judge by, then AeroMobil and contemporaries will soon realise their collective vision. As Vadocz says with confidence and conviction, "AeroMobil can become an inspiration for a new stage in the future of personal transportation. It can bring new opportunities for travel and extend them to a whole new level. It will bring back a very positive experience to traveling. It's going to be a better plane because it's a car, and a better car because it's a plane." ↗

DID YOU KNOW?

The first flying car designed for military use was the Avrocar. Developed by the Canadian and British military in the 1950s The flying-saucer-like VTOL was designed to move troops to the battlefield.

Terrafugia's Transition is designed to drive like a normal car on the ground.





DUBAI'S SINGING SENSATION

Hussain Al Jassmi is a man of many accomplishments: award winning singer, composer, United Nations goodwill ambassador and, most recently, Arab Social Media Awards winner

Renowned Emirati singer Hussain Al Jassmi has always had a calling. From the age of seven his unique voice began to charm audiences on UAE television, but his music career really took off after winning the reality show *Layali Dubai* during the Dubai Shopping Festival in 1997 and 1998. This brought Al Jassmi to the attention of a record company, which resulted in the release of his first album in 2002 when he was just 21. The debut release set him apart from his contemporaries through its unique sound that subtly fused elements of bossa-nova, soul and funk with traditional Khaleeji music.

Six years later, in 2008 Al Jassmi received the coveted Murex d'Or award in the 'Best Male Arab Singer' category, and today he is rightly recognised as an Emirati superstar in the Arab music world and one of the Middle East's top-selling artists. The one thing that connects all his music is a positive message, which reflects his outlook on life.

Al Jassmi attributes his success – he is, arguably, the UAE's biggest ever musical export – to a passing remark made to him by the late Sheikh Zayed bin Sultan al Nahyan, the founding father of the UAE.

"It's my most treasured piece of advice," reminisces Al Jassmi. "Sheikh Zayed, God rest his soul, said to me: 'The artist reflects the culture and civilisation of his homeland wherever he goes.'"

"He said those words to me when I performed in front of him the first time. I didn't know that I was going to meet him, so his words in that moment became symbolic of the start of my journey and, to me, still serve as a beacon to guide me wherever I go."

In February 2010, Al Jassmi became the first Emirati and Arab artist to be appointed as a goodwill ambassador by the United Nations.

The appointment reflected Al Jassmi's dedication to humanitarian activities in the region and his efforts to spread awareness about multiple issues such as world hunger, diabetes and individuals with special needs.

In his capacity as goodwill ambassador Al Jassmi worked for the Intergovernmental Institution for the Use of Micro-Algae Spirulina Against Malnutrition (IIMSAM), which focuses on starvation, malnutrition and related conditions that children suffer from.

"I consider this an honour for the UAE's media and art as I represent my country and we have the chance to lend a helping hand to the needy. I will, in one way or another, be mentioning these children and their suffering during my concerts in the UAE and countries of the African continent such as Morocco and Egypt to raise awareness," Al Jassmi said when he outlined his strategy to help IIMSAM.

That same year also marked the beginning of another journey for the singer when he underwent a gastric bypass operation. Al Jassmi, who at his heaviest weighed 184 kilograms, lost 60 kilograms. With typical

frankness he explains the turning point for him was when he went for Umrah, but was unable to complete it due to his weight and deteriorating health. This galvanised him to change his lifestyle to include daily exercise and healthier, lighter foods and culminated in being made the ambassador of 'Every Step Counts' in 2013, a wellness campaign launched by telecom operator du.

"I hope to be a good example to Emirati society with my interest in my health and how I look," Al Jassmi says of his active promotion of the benefits of a healthy lifestyle among the youth by speaking publicly about his own weight-loss journey and gastric-bypass surgery. "I consider it a noble goal to create an educated, aware society."

"That's why I purposely run in public places to interact with people who may see me and come up to me," Al Jassmi says. Al Jassmi reached another milestone last year when he became the first Arab performer to take to the stage at the newly opened Dubai Opera, and in December he received the Social Media Award in the Arts category at the Arab Social Media Awards.

The Arab Social Media Awards was launched by His Highness Sheikh Mohammed bin Rashid al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, in 2014. The Awards recognise communication within communities, tangible benefits for social development and the contribution of positivity to progress and prosperity.

Few are as influential as Al Jassmi, who has 6.7 million followers on Facebook, 4.8 million on Twitter, 1.4 million on Instagram and 1.2 million on YouTube. He was overjoyed with his award, but with typical candour says "charisma comes not from the tongue, but from actions and ethical behaviour".

"The Emirati people have been known down through the generations for being kind and, in my opinion this is the most important attribute a human being can possess in order to succeed. I ask God to keep this country safe," he says.



Al Jassmi Arab Social Media Award Winner.

Clearly proud of his Emirati culture and heritage, Al Jassmi welcomes the fact that his music helps to spread knowledge of the UAE in different countries around the world. He emphasises the need for artists to be real. "It's important to be real and to project your real image as you represent yourself, as well as your society and country. One should be committed to one's principles," he says. "That is why it is very important to me to show the real me on social media and to represent my country, environment and myself. I have to project my Emirati and Arab morals and beliefs."

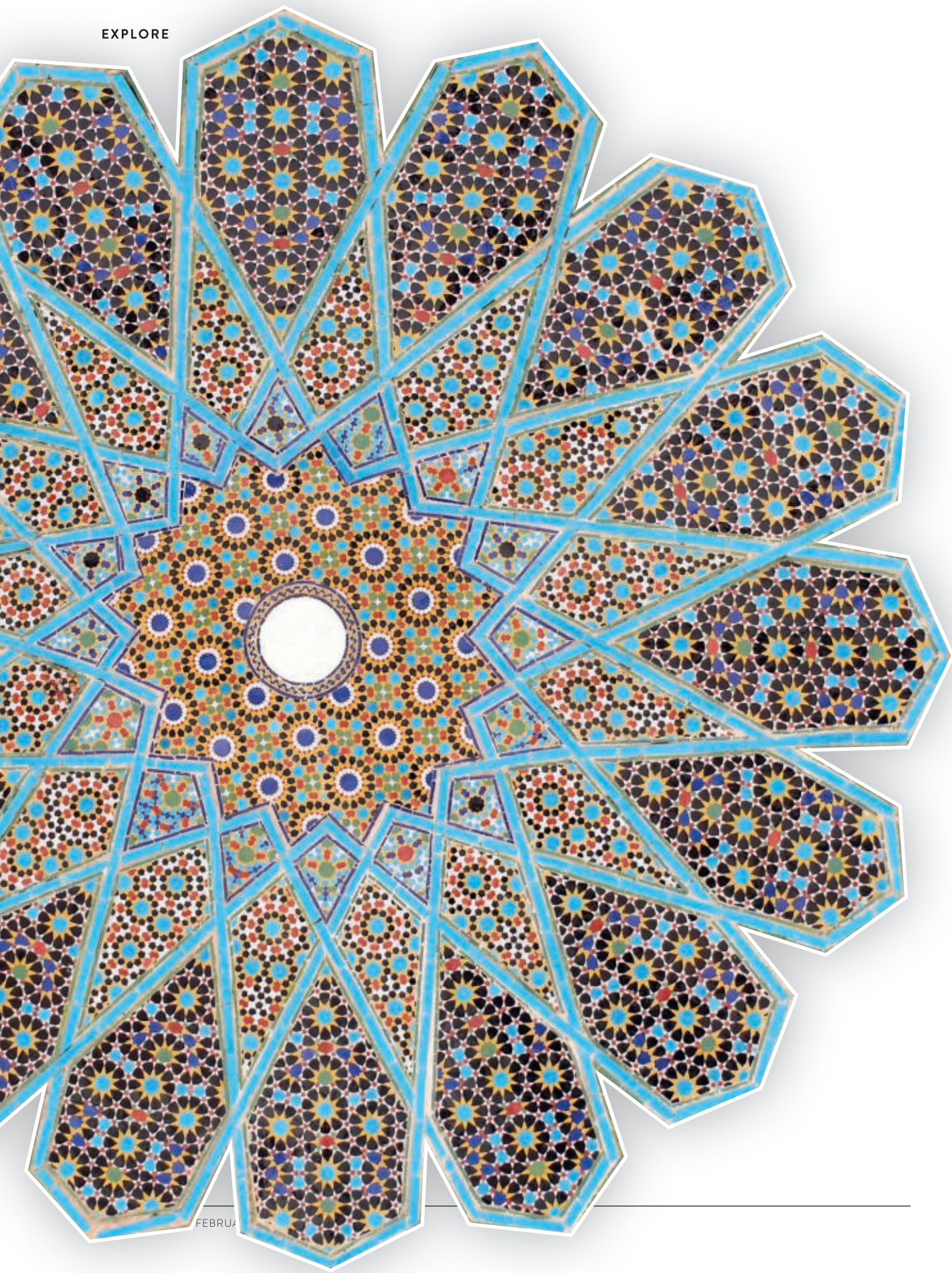
Despite the many accolades, Al Jassmi remains a simple man at heart, and regularly returns to his family home in Khor Fakkan. "I am used to simplicity, and at home, we still live it," he says. "Khor Fakkan is my ideal vacation place. I still go back home to the simple life and simple food with my friends and family and the people I grew up with. I go back every week if I can."

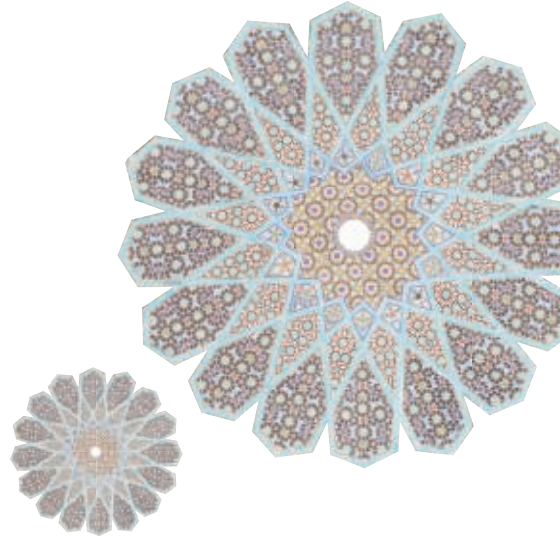
He also has clear ideas about the best way to live life. "Whatever makes you sad, leave it. Whatever makes you happy or makes you smile, keep it. This is one of my favourite English sayings," he says. "If you do work that you are honest about, from your heart, it will achieve success. Maybe the success will not come tomorrow, but it will come." ♪



Al Jassmi became the first Arab performer to take to the stage at the newly opened Dubai Opera.

EXPLORE





THE ART OF GEOMETRY

The complex geometry behind the intricate patterns of zellige tiling takes craftsmen years to master and it remains the artistic expression of the mathematical ability of a great Arab civilisation

When the Metropolitan Museum of Art in New York decided to open a series of new galleries for its Islamic art collection in 2011, it chose to commission a company of Moroccan artisans from Fez to create a medieval Islamic courtyard.

Experts in traditional tile, plaster and ornamental wood work, they laboured for months to recreate elements of the Alhambra Palace in Granada and the 14th century Al-Attarine Madrasa in Fez. The end result was a critical and popular success.

At the heart of their work was zellige, the art of geometric tiling. Intricate, beautiful, colourful and frequently extraordinary, the complex mathematical geometry used in this cuttile mosaic art form is one of the defining features of Islamic art. It is ubiquitous in Fez and Meknes, the centres of production for a tradition dating back centuries, but also in Algeria and Spain to

somewhat lesser degrees. In mosques and palaces, in courtyards and reception halls, zellige represents the infinite possibilities of geometric design.

No one who has ever visited Morocco will remain unmoved by zellige's aesthetic appeal. Mosaic panels and narrow bands of tile-work decorate otherwise blank walls, although not all patterns are complicated, with simpler, less complex designs prevalent. Indeed, to many zellige is, as the New York-based writer and filmmaker Louis Werner once wrote, "best appreciated as an ever-present adornment of everyday life".

Yet it is within the great monuments of the Maghreb and Andalusia that zellige reaches its apogee. In the Alhambra Palace in Granada and the Attarin Madrasa; in the Al-Qarawiyyin Mosque; and in the shrine to Moulay Idriss II, who founded Fez in 809.



Zellige tile designs are used in some parts of Abu Dhabi's Sheikh Zayed Grand Mosque.

"Zellige is a visual architectural memory of our culture," says Jais Zinoun, the owner of New Wave Enterprise, a Casablanca-based company that specialises in the production of zellige. "Zellige has been with us for at least 10 centuries and Morocco continues to preserve this ancestral art form. You can see it in the madrasas, palaces and mosques of the country.

"It is the fruit of a great Arab civilisation that once thrived in geometry and algebra. To me zellige is equal to the mysterious infinity of the universe because there are so many possible combinations of patterns. So many that your head can spin just looking at it."

It is this infinite possibility of design that mesmerises. As the visual artist and designer Bouchra Benhalima says, the numerical order of zellige opposes the chaos of the outside world, creating a deep sense of calm and meditation. Its hypnotic rendering of motifs echoes the infinite greatness of God. It is, in short, one of the most powerful foundations of the artistic and architectural culture of the Islamic world.

"It is an artistic and architectural influence that forms part of my own origin," says Benhalima, who was born in Algeria but grew up in Paris. "While travelling during my youth in the East, or in the Maghreb, these were symbols with which I grew up and in which I found an artistic symbol, even as a very small girl. It was therefore natural that I use it in my own collage work. Having grown up in Paris, I found myself spontaneously mixing two cultures, two influences, and that is how my artistic style was asserted little by little."

The zellige pop art collages of Benhalima represent a continuation, or at least an appreciation, of an art form that, although largely employed for decorating floors and walls, is one of the main characteristics of Berber and Moroccan architecture. Her art is also proof that, although associated with the past, zellige is still alive, even if it is threatened by the march of modernity and its own high cost of production.

For example, the training a zellige craftsman takes years and requires a number of prerequisite skills, not least precision, patience and a body resistant to the countless hours it is necessary to sit cross-legged on the floor. The craftsman's tool is a basic hand chisel, which is used to cut the kiln-baked clay tiles into small and intricate mosaic pieces. It remains a laborious and time-consuming process.

That process has, in fact, changed little since its inception. The baking of the tile is performed by a potter (fkhar) who mixes the clay, sundries the tiles, mixes the colours for the glazes, and bakes the raw materials in a traditional bee-hive-style kiln. The tile pieces are then given to a tile cutter (nakach), with each zellige piece cut by two craftsmen. The first cuts and follows the geometric patterns etched on the raw tile (usually by apprentices); the second trims each individual tile by

hand until it has a perfect, smooth finish.

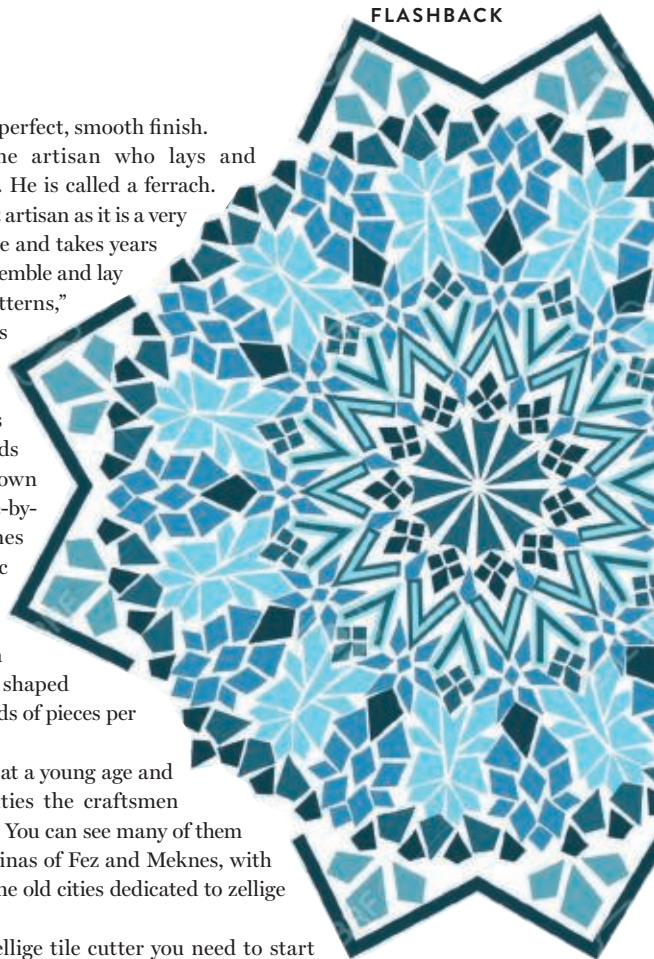
Then comes the artisan who lays and assembles the tiles. He is called a ferrach.

"He is an important artisan as it is a very hard skill to acquire and takes years of experience to assemble and lay complex zellige patterns,"

says Zinoun. "Plus this artisan requires cutting skills to trim excess pieces. He also spends hours crouching down to lay the tiles piece-by-piece in sometimes complex geometric patterns. Just imagine that some patterns contain 10 to 15 different shaped pieces and thousands of pieces per square metre."

Training begins at a young age and by their mid-twenties the craftsmen are skilled artisans. You can see many of them at work in the medinas of Fez and Meknes, with entire quarters of the old cities dedicated to zellige workshops.

"To become a zellige tile cutter you need to start as an apprentice from a young age," says Zinoun. "It is like playing an instrument or wanting to become a professional ballet dancer. To become a mâalem (master craftsman) you need to start very young and work really hard to develop this skill. However, today less and less



Zellige designs
entirely
man-made.

youngsters want to learn and are more interested in social networks. But I have enormous respect for my artisans as I understand the meaning of hard work.”

The maaalem have their own language. Fifty points inside eight. Four clasped hands. A spider’s house. All represent one aspect of a multitude of geometric configurations that have been committed to memory.

Werner, writing in *Aramco World*, once wrote that an encyclopaedia could not contain the full array of complex, often individually-varied patterns and individually-shaped, hand-cut tesserae, or furmah, found in zellige work.

“Star-based patterns are identified by their number of points – ‘itnashari for 12, ‘ishrini for 20, arba’ wa ‘ishrini for 24 and so on, but they are not necessarily named with exactitude,” wrote Werner. “The so-called khamsini, for 50 points, and mi’ini, for 100, actually consist of 48 and 96 points respectively, because geometry requires that the number of points of any star in this sequence be divisible by six. (There are also sequences based on five and on eight.)

“Within a single star pattern, variations abound – by the mix of colours, the size of the furmah, and the complexity and size of interspersing elements such as strapping, braids, or ‘lanterns’. And then there are all the nonstar patterns – honeycombs, webs, steps and shoulders, and checkerboards.

“The more commonly used of the 360 different furmah, according to one scholar’s exhaustive count, run the geometrical gamut from star medallions, which are used as the centre of the star patterns, to chevrons and triangles, hexagons and octagons, lozenges and diamonds, and curvilinear and rectilinear strap-work. Organic shapes go by the names of the objects from which they are abstracted – bottlenecks, ducks, combs, bracelets, cups and hands.”

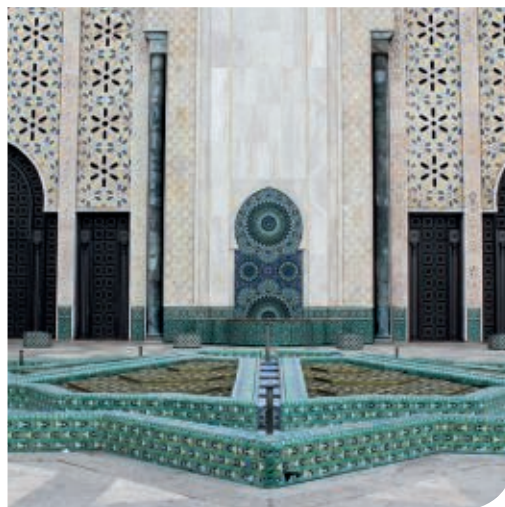
Simple zellige designs, such as those that are just 10cm by 10cm, are increasingly popular in Europe and the United States, largely due to their beautiful variations in colour. The fact that they are not mass produced by machines also plays a hugely significant role.

“The tiles are fired in kilns that have no thermostats and the temperature is not equal within individual kilns, resulting in hundreds of variations in the glazes,” says Zinoun. “Not a single machine-made tile can match this flawless tone disparity.”

Werner described Fez as “an ageless beauty masked by a well-worn antiquity”. Zellige was fundamental to this interpretation.

“The world has changed so much and traditional crafts are dying out very, very fast, but to the credit of the Moroccan government they’ve taken this so seriously over the years that they’ve managed to preserve in Fez and other centres the traditional methods,” says Navina Najat Haidar, curator of Islamic Art at the Metropolitan Museum of Art, of her experience during the creation of the new galleries for the art of the Arab lands, Turkey, Iran, Central Asia, and Later South Asia. “Being so close the moment of creation is something that has an incredible power and is something that profoundly moves you as a curator.”

For zellige that moment must be preserved if Morocco is to remain the only country in world to produce 100 per cent handmade mosaic tiles of such calibre and grace. ♪





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