

FLASHES

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

SEPTEMBER 2017
ISSUE 33

#YearOfGiving

Expo 2020 Dubai

The importance of youth participation



ARAB INVENTORS

A MAJOR FORCE BEHIND
AMERICAN INNOVATION

THE LEARNING CHALLENGE

HOW ROBOTICS INSTILLS
A LOVE OF TECHNOLOGY

OUR PLASTIC WORLD

A GROWING WASTE PROBLEM



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خشب العود

KHASHAB AL- OUD

HERITAGE



سادة العطر الملكي



عبد الصمد القرشي
ABDUL SAMAD AL QURASHI



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FOREWORD

Dear readers,

In July this year an accidental breakthrough was announced by the US Army Research Laboratory, which could have far reaching consequences for the energy sector. The team discovered that adding water to a nano-galvanic aluminium-based powder caused a nearly 100 per cent efficient reaction that produced huge amounts of energy in the form of hydrogen. Hydrogen is one of Earth's most abundant elements. However, extracting and storing it is difficult and expensive. That is why this breakthrough is so exciting as it could lead to hydrogen finally fulfilling its promise as an environmentally friendly, efficient and abundant energy source.

The willingness to try new things and approach problems from different angles is at the heart of innovation. That we have the necessary talent in the Middle East was recently highlighted by a joint study from *The Harvard Business Review* and INSEAD that found Arabs made a major contribution to the United State's innovation. Of the total US patent applications from 2009 to 2013, 3.4 per cent had at least one Arab inventor, despite the fact that they represent only 0.3 per cent of the total population. Furthermore, the number of Arab patents in the US increased 62 per

cent over 10 years, from 1,826 patent applications from 1999-2003 to 2,962 from 2009-2013.

Retaining such talented innovators is crucial for all countries. In 2014 His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, launched a National Innovation Strategy with a seven year plan to make the UAE among the most innovative nations in the world. As a result, The Global Innovation Index 2017 cited the UAE for showing strengths in tertiary inbound mobility, innovation clusters and ICT-driven business model innovation.

This means the UAE's young innovators have all the means at their disposal to fulfill the country's aspirations. As HH Sheikh Mohammed said on International Youth Day: "The youth are our present and future hope. They are the UAE's most valuable asset. Nations are built by developing the youth. We are proud that our youth have achieved tremendous successes, not only at home but also abroad."

Jamal Bin Huwaireb

CEO of Mohammed bin Rashid
Al Maktoum Knowledge Foundation



Mohammed bin Rashid visits Expo 2020 Dubai Site

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, visited the Expo 2020 Dubai site office and said he was encouraged by the developments. During the visit, His Highness was accompanied by His Highness Sheikh Maktoum bin Mohammed bin Rashid Al Maktoum, Deputy Ruler of Dubai.

His Highness was received by His Highness Sheikh Ahmed bin Saeed Al Maktoum, Chairman of the Expo 2020 Dubai Higher Committee; President of Dubai Civil Aviation Authority; and Her Excellency Reem Al Hashimy, the UAE Minister of State for International Cooperation and Dubai Expo 2020 Bureau Director General.

Sheikh Mohammed conducted a helicopter tour of the Expo site to see its progress. His Highness was also briefed by department heads and directors on the considerable progress made by the Expo team in the areas of Real Estate and Development, International Participants, Legacy, Business Development and Integration, and Youth Connect.

Sheikh Mohammed underlined the importance of youth being integrated in the Expo journey and the key work being carried out to involve them in planning both for Expo 2020 itself and the social, economic, physical and reputational legacy that will follow.

His Highness added that he was pleased to see the progress made by RTA in the construction of the Metro link to a new station on the Expo site, Route 2020, which will

be one stop from the Al Maktoum International Airport.

He concluded by emphasizing the role of thousands of volunteers who will be recruited to ensure that the culture and values of the UAE will be reflected throughout the Expo, which is expected to attract 25 million visitors including an unprecedented 70 per cent from overseas.

His Highness Sheikh Ahmed commented: "His Highness was a driving force behind our successful campaign to win the right to stage the next edition of the World Expo in 2020. He has continued to be extremely supportive of our mission on our journey since then towards October 2020 and is always interested in our progress."

"We have had private and public commitments of participation from more than 120 countries and have recently announced our seventh commercial Premier Partner. His Highness's visit and continuing guidance is a source of great encouragement and inspiration as we work towards a World Expo that will have a long and meaningful impact on both the UAE and wider region."

Expo 2020 Dubai will be a celebration for all, which, through its theme 'Connecting Minds, Creating the Future', will provide a platform to encourage creativity, innovation and collaboration. This is underpinned by the Expo's three pillars: Opportunity, Mobility and Sustainability.

Expo 2020 Dubai opens on 20 October 2020, and closes six months later on April 10, 2021. It will be the first world Expo to be held in the Middle East, Africa and South Asia (MEASA) region and the Arab World.



Determination of Emirati Youth Praised

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, and His Highness Sheikh Mohamed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces, have expressed their pride in the UAE's youth and their role as the nation's promising future.

In their statements to mark International Youth Day, Sheikh Mohammed bin Rashid and Sheikh Mohamed bin Zayed again emphasised that the youth are the nation's promising future, who have embraced their key role in realising the national agenda and achieving the country's aspirations.

"The UAE is a success story, whose champions are the youth. They are in the driver's seat when it comes to development, in both the government and private sectors. With their spirit, we can always be number one," said Sheikh Mohammed bin Rashid.

"The youth are our present and future hope. They are the UAE's most valuable asset. Nations are built by developing the youth. We are proud that our youth has achieved tremendous successes, not only at home but also abroad. They have presented their success to the entire world," he added.

Sheikh Mohammed bin Rashid further stressed that the UAE's youth has become a global role model.

"The UAE government has created the best model for youth empowerment. We have appointed a young minister who, along with her team, is working for the youth. Youth circles were created in the cabinet, the ministries and other departments. Policies and platforms were established for the youth, to make their voices heard everywhere. Building the youth is a priority. The UAE's future is in their hands, and with them, we will create a better future," he added.

Sheikh Mohamed bin Zayed said, "A nation rises through the determination of its people and the energy of its youth. We are proud of the achievements of our youth in all fields."

"We are confident that our youth, who adhere to their identity and values and believe in their own capabilities, will write an inspiring success story in the history of our nation," he added.

"The secret of the UAE's success story is one that empowers the youth to contribute to the nation's development efforts, and provides them with the opportunity to show their loyalty and gratitude to their forefathers, who had left us a legacy of determination and giving," he further added.

Sheikh Mohamed bin Zayed called on the nation's youth to double efforts and shoulder their responsibilities.

Personal Message to UAE Youth

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, and His Highness Sheikh Mohamed bin Zayed Al Nahyan, Abu Dhabi Crown Prince and Deputy Supreme Commander of the UAE Armed Forces, sent a personal SMS to the Emirati youth on the occasion of International Youth Day, which is celebrated on August 12 every year.

The message read, "On International Youth Day, youth is the foundation of every nation. Build on that foundation, reach new heights. Make your nation proud".

Mohammed Bin Rashid Al Maktoum Knowledge Award Winners to Be Announced at the Knowledge Summit 2017

Winners of the fourth annual Mohammed Bin Rashid Al Maktoum Knowledge Award (MBRKA) are set to be announced at the Knowledge Summit 2017, held in Dubai on November 21-22 under the theme "Knowledge and the 4th Industrial Revolution".

Recognising individuals and organisations with significant contributions to the knowledge sector and the knowledge economy, the Award ceremony is a key event of the Summit, which is organised by the Mohammed Bin Rashid Al Maktoum Knowledge Foundation (MBRF), under the patronage of His Highness Sheikh Ahmed Bin Mohammed Bin Rashid Al Maktoum, Chairman of MBRF and Chairman of MBRKA's Board of Trustees.

The nomination deadline for candidates – including previous MBRKA winners – who met the necessary criteria to register for consideration, was August 31. Following this, a shortlist will be announced in September and the winners will be confirmed in October. The awards will then be presented at The Knowledge Summit 2017 on November 21. Candidates can be individuals (in the UAE or abroad); government departments; or local, regional, and international companies and organisations; and the Award cannot be granted posthumously.

"The Mohammed Bin Rashid Al Maktoum Knowledge Award has added significant momentum to the Knowledge Summit and its activities," said His Excellency Jamal Bin Huwaireb, MBRF CEO and the Award's Secretary-General. "It reflects the vision of HH Sheikh Mohammed Bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, who never fails

to encourage creativity and innovation at the local and international levels with prestigious awards across various sectors."

In 2016, the Mohammed Bin Rashid Al Maktoum Knowledge Award was granted to Melinda Gates, Co-Chair of the Bill & Melinda Gates Foundation, for her role in expanding education opportunities and access to information technology, as well as in developing solutions that alleviate poverty and help individuals improve their living standards. The Abu Dhabi Future Energy Company (Masdar), was also recognised for its achievements in commercially viable renewable energy projects, which included training the sector's human resources at the Masdar Institute of Science and Technology. The Arab Thought Foundation also won the award for its efforts to strengthen the Arab cultural identity and reinforce its openness to other cultures.

In 2015 the winners were National Geographic; Hiroshi Ishiguro, Professor at the Department of Innovation Systems in the Graduate School of Engineering Science at Osaka University; and Ahmed Alshugairi, presenter of the *Khawatir* television programme. Prior to that, in 2014, the inventor of the World Wide Web Tim Berners-Lee took home the Award, as did Jimmy Wales, co-founder of Wikipedia.

Applicants can submit a written application (in Arabic or English) to the Award's website www.knowledgeaward.com. The website has been witnessing significant interest from participants, both local and international, including several eminent individuals and knowledge leaders who have made commendable contribution in disseminating knowledge.



Melinda Gates



Tim Berners-Lee



Jimmy Wales



Ahmed Aishugairi



Hiroshi Ishiguro





229 Million Twitter Views for MBRF's 'Youth Circles'



The Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) organised a youth networking seminar on Twitter titled "How to Make Arabic the Language of Science and Knowledge?" that registered a staggering 229 million views worldwide.

The event was the first of its kind to be held on the micro-blogging website, and counted prominent and influential UAE figures among the participants, including Her Excellency Shamma bint Suhail Faris Al Mazrui, Minister of State for Youth Affairs; and MBRF's CEO HE Jamal bin Huwaireb; along with representatives from the Ministry of Education, as well as Dubai Media Inc., Abu Dhabi Media Inc., CNN Arabic TV, Al Arabiya News Channel, Al Oula Radio, Al Bayan and Al Roeya newspapers, and Forsan UAE, besides other representatives of

government, private and media institutions.

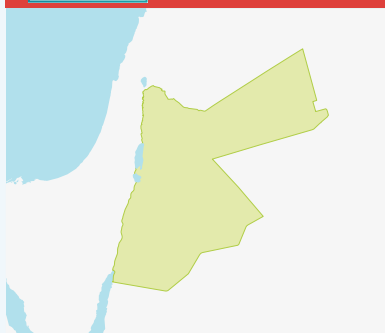
"This is the first time that a youth seminar has been held on social media," noted HE Al Mazrui. "We are delighted with the massive interaction from the local community and the wider Arab audiences, who poured in to respond to questions raised during the episode. This demonstrates the essential role of social media when it comes to interacting with the youth. The topic of the episode comes at a critical juncture – at a time when the need to adhere to our Arabic language is critical if we truly wish to develop it to suit modern inventions and studies."

HE Jamal bin Huwaireb said: "We are grateful for the remarkable participation that our Youth Circle has witnessed. This is a great opportunity for us to promote our beloved Arabic language and to better support intellectual and cultural activities, as well as scientific and academic content."

A number of fresh initiatives were launched during the session, seeking to support the Arabic language, adapt it to science and technology, and encourage young people to develop and use it across the board. MBRF announced that it will be launching the Arab Youth Knowledge Council, which seeks to support knowledge production and dissemination in the Arab world, while the Ministry of Education announced the social media-centred 'Tweeting in Arabic' initiative to encourage students to use the Arabic language across social media channels. †

Above: The Youth Circle was the first of its kind to be held on social media

Left: Her Excellency Shamma bint Suhail Faris Al Mazrui, Minister of State for Youth Affairs



Reading Rank Overall: 5th
Total Reading Time Per Year: 50 hours
2016 Sample Size: 16,095
Number of Arab Countries Sampled: 22

The Arab Reading Index (ARI) was first released in 2016 and 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.



74%

EXTENT OF
READING



68%

ACCESS AND
AVAILABILITY

Reading matter
sourced from



74%
Family



75%
School



56%
Society



50

AVERAGE TOTAL
READING HOURS
(ANNUAL)

Made up of



27 hrs
Electronic
documents



22 hrs
Printed documents



19 hrs
Work related



31 hrs
Not work related



70%

PERSONAL
ATTRIBUTES



98%
Skills and abilities



69%
Motivation



79 %
Attitudes



21

AVERAGE
NUMBER OF
BOOKS READ

ابت

15
In Arabic

أ

8
In foreign languages



8
Work related



13
Not work related

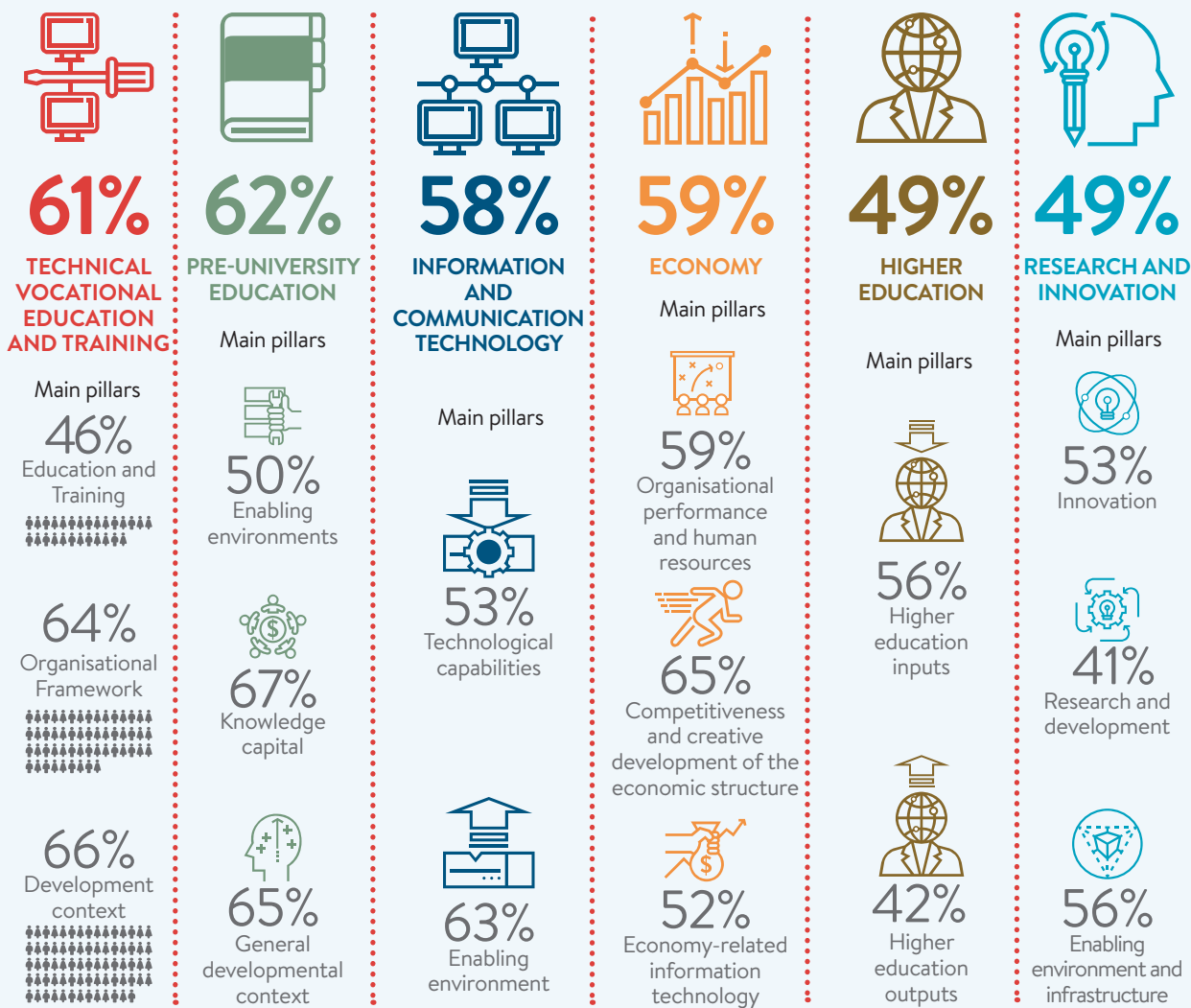
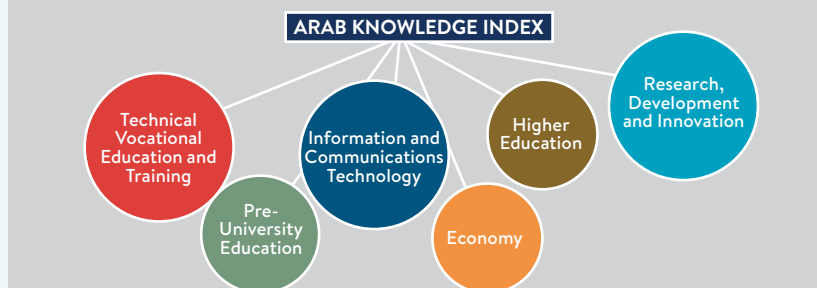
The Arab Reading Index is done in partnership by the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

Source: www.knowledge4all.com

Number of Arab Countries
Sampled: 22

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 SIX MAIN SECTORAL INDICES OF THE ARAB KNOWLEDGE INDEX



The Arab Knowledge Index is a joint initiative between the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

Source: www.knowledge4all.com

MADE IN THE UAE

Zarooq Motors' \$450,000 SandRacer GT500 is the first car designed and produced in the UAE.

The fastest snake in the desert is the Schokari Sand Racer, known as a Zarooq in Arabic. It is also the name of the UAE-based startup company that has designed and built the country's first supercar.

"It was born in the sands of Arabia but can go anywhere in the world.

It is the fruit of the love of driving and racing," says Zarooq Motors' CEO Mohammed Al Qadi of the SandRacer GT500. It is dubbed the Formula

One racer for the sand dunes that was designed to give its reptilian name-sake a run for its money in all-terrain capability.

Al Qadi, a motorsport enthusiast and a former COO of the Yas Marina Circuit in Abu Dhabi (the venue for the annual Abu Dhabi Grand Prix)

explains: "As many happy motorsport stories, the idea of Zarooq started in the pits of a race during the Formula One Grand Prix in Abu Dhabi a couple of years ago." It was there that the three initial founders gathered in November 2014.

Frenchman Bruno Laffite has 25 years of racing experience behind him. Iannis Mardell, who hails from Britain, has 20 years of experience in strategy consulting in international top-tier firms, especially in sport. Al Qadi has been a pillar of motorsport in the UAE for more than 15 years. Together, with their deep experience of the local motorsport scene, they saw an opening and suggested bringing a single make racing series from the tarmac to the true soul of motor passion in the UAE, the sand, and to build the first ever supercar which can go off-road.

"Since the car of our dreams did not exist, we decided to build it," says Al Qadi. "The off-roader has been designed keeping the UAE's terrain in mind, and can legally be driven on-road as well. There's a huge demand today for a potent sand racer that's tailored for our desert. You have big 4x4s which







Top: A SandRacer on the roads of Monaco, home of an ultra-wealthy customer base.

Above: The production run of the limited carbon edition of the SandRacer is 35 units.

are bulky, you have buggies that are open and not the safest or the most practical, and you have recreational ATV-type vehicles that are not initially made for racing.”

“The inspiration was basically a car a lot of people wanted, a supercar that you can take where other supercars can’t go, in other words where everyone wants to go – the desert,” explains Mardell, who oversees the company’s finance, strategy and marketing.

“We found that the local motor sports needed something new and one thing leading to another we decided to build a car that didn’t exist that we saw was quite suitable for the local market.”

With initial funding of \$2m, the three had their basic specifications for the vehicle in place by March 2015 and the following month they secured Spain’s GP2 Campos

Racing team as a key engineering partner. The time that followed saw initial sketches made of the body and the first chassis welded, and in September the three settled on a brand name – Zarooq Motors.

The result of their labour is the \$450,000 SandRacer that BBC’s Top Gear called a “mutant cross between a BMW X6, Range Rover Evoque and a Dakar racer”. The first limited carbon edition of 35 vehicles is scheduled to start delivery in the fourth quarter of this year. The company aims to ramp up production in the future but keep it at under 100 units per annum.

On paper, the SandRacer boasts eye-watering specs. Its 6.2L V8 pushes out 525hp and 660Nm of torque, and despite the SandRacer’s rugged, aggressive exterior, it weighs only 1,200 kilograms. Clever features such as removable rear diffusers will aid its transition from on-road speedster to off-road terrain-eater. The chassis was fine-tuned by Spanish company Campos Racing to ensure the two-seater is as capable on the pavement as it is in the dunes.

“We started with motor sport in mind and building on first our technical trials, and using the feedback that we were getting from customers and potential customers who clearly wanted something more upmarket, more powerful, we went through a lot of improvements and changes,” Mardell explains of the process.

“That’s why it took us a little bit of time before we thought we were in a position to come out and say here it is we’re finished – this is what we’re putting in the market.”

According to Al Qadi the response has been positive. “There’s a strong demand for luxury off-road vehicles



in the region," he says, adding that the company had already received "enquiries from high-profile customers" before the prototype was even finished.

The finished product is described by the company as a two-seater, rear-wheel drive, mid-engine supercar with fixtures and fittings to match including a luxury hand-stitched leather interior by Mansory in Germany and a carbon fibre body made in Belgium.

Production of the initial batch of the SandRacer series is taking place both in the UAE and Europe with the more complicated parts shipped in from the continent and final assembly occurring locally.

In the coming years, the startup wants to develop its manufacturing capabilities both in the UAE and in Europe, and after sales and distribution networks in the US, Europe, Russia and China. "We believe in targeted innovation. If it matters, we design it, if others are better positioned than us, we procure and, most importantly, we partner. We have developed a series of partnerships to make sure that we extend our network and multiply our innovation potential," says Mardell. "Our objective is to localise as much as possible in the UAE."

However, he is pragmatic about the fact that this will take some time.

"Let's take simple things like engines, there are some key components that would be very difficult to completely manufacture here. At the end of the day completely building the chassis and the body, I see that

as something very feasible in a fairly short amount of time, whereas building local dampers and stuff like that I don't see it happening for quite a while."

According to Mardell, the actual market size of the Middle East is smaller than Japan's and there is a lack of skilled local talent and supporting educational institutions or apprenticeships. Zoroq Motors' aim is to contribute to the growth of both areas through working with young nationals alongside experienced engineers.

"The solution will be through apprenticeships and through raising and breeding our own people rather than hoping," Mardell says.

Apart from building off-road supercars, the startup is also considering brand diversification in mobility products, clothing lines and creating a specially designed circuit where the drivers will enjoy homemade hot wheels. The design and feasibility studies are completed, and Zoroq Motors is negotiating with potential investors, according to Al Qadi. "The track will read as 'Dubai' in Arabic from the sky, making it a great landmark for the emirate."

For now, though, the company remains focused on the SandRacer by looking at new models, new powertrains and brand expansion.

"Zoroq Motors makes supercars that are unique since you can take them on a weekend track day or for a luxurious commute in the city but also on any off-road terrain, even the toughest dunes of the Arabian Desert where they were born," says Al Qadi. ♪



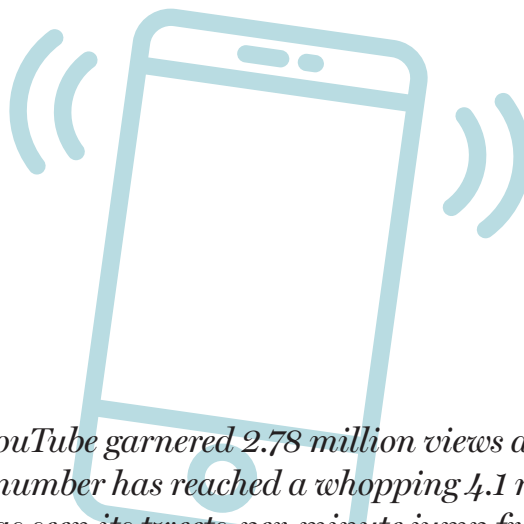
Above:

Mohammed Al Qadi, CEO of Zoroq Motors; racing drivers Bruno Laffite & Laetitia Laffite and Iannis Mardell founded Zoroq Motors.

2017

WHAT HAPPENS IN AN
INTERNET MINUTE





Last year YouTube garnered 2.78 million views a minute. Now, that number has reached a whopping 4.1 million. Twitter has seen its tweets-per-minute jump from 347,222 to 452,000. More than 70,000 hours of Netflix are watched around the world every minute. The internet is still growing rapidly, which makes one wonder whether it will ever reach 'peak internet'?

GROWING APACE

342,000 APPS
DOWNLOADED

46,200 POSTS
UPLOADED

452,000
TWEETS SENT

Before we start, here's a quick lesson on the term "peak internet". The term is an alteration on geologist M. King Hubbert's theory of "peak oil". His theory argues that at some point, the world will run out of oil and that we'll have to somehow deal with its scarcity or nonexistence. In the same vein, "peak internet" considers that at some point, the world will reach its internet saturation point. The idea is that as great as the internet is, its bubble must pop – that's just how bubbles work.

Try and think of the last time you weren't as dependent on the internet as you are now. You'll probably notice that you've gone back to the year 2010, further even. Here's the best part though, even back then, your work life still revolved around the internet through emails, Google searches and the like. The internet's greatest game changer was the dawn of the smartphone era.

You started out with a Nokia and no internet in it and by 2010 you had a smartphone by Apple, Samsung, or Sony that is not only connected to the internet but relies on it to update its firmware.

The internet has promised us a social life by disconnecting us from a real one. That's just how it works. Thing is, we know all of this. We know the price we're paying by staying connected all through the day and yet, we need more.

Using the internet is like being in a relationship: you start out being self-sufficient, but the longer you're together you become co-dependent and seemingly incapable of making decisions without each other. You could, of course, cut yourself off, but that would just make you a pariah. Imagine not being able to talk about James Corden's newest *Carpool Karaoke* video or missing out on the joy of bashing the next "Despacito" video that YouTube churns out.

The truth is, you wouldn't even have to go back a decade to see how much the internet lords over your life. According to research, internet users have grown by 82 per cent or about 1.7 billion people since January 2012 – that's five years ago. To put that growth rate into perspective, that essentially means that there are about 1 million new users each day or 10 new users each second.

Since 2012, about 1.3 billion people have started using social media. An 88 per cent rise in five years. In case you're not good with numbers that translate to more than eight new users every second.

Despite major media houses claiming that we're going to reach peak internet soon, the numbers simply don't add up. As of right now, only half the world's population is using the internet. That's about 3.75 billion people. It's a lot but there's still a long way to go. That figure increases at a rate of more than 11 new users every second. As a collective unit, mankind is so dependent on the internet that in countries like Costa Rica, Estonia, Finland, France, Greece and Spain, internet access is a legal right.

It's no surprise then that, according to a United Nations report, Europe made up for the highest number of internet users in any geographic region at 79.1 per cent. In second, came the Americas with 66.6 per cent and in third the Commonwealth of Independent States (a regional organisation comprised of a number of former Soviet Republics, including Russia).

GLOBAL MOBILE USERS & MOBILE CONNECTIONS

COMPARING THE
NUMBER OF UNIQUE
INDIVIDUALS USING
MOBILE PHONES
TO THE NUMBER OF
SUBSCRIPTIONS IN USE

TOTAL NUMBER OF
MOBILE USERS



4.960BN

MOBILE
PENETRATION



66%

TOTAL NUMBER OF
MOBILE CONNECTIONS



8.066BN

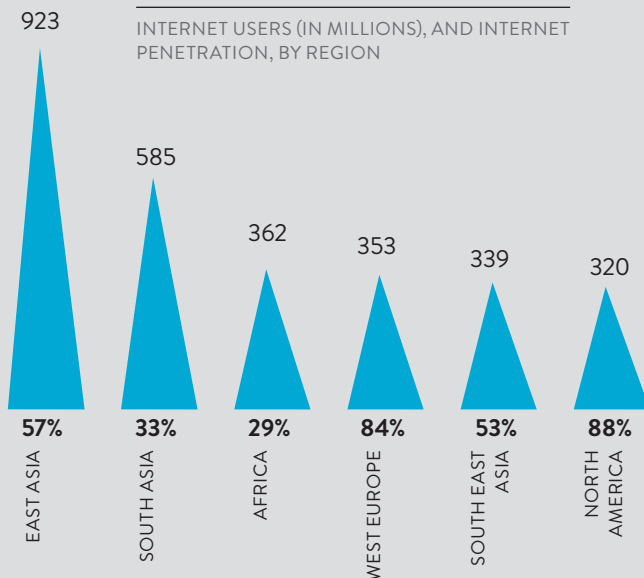
SMARTPHONE
CONNECTIONS

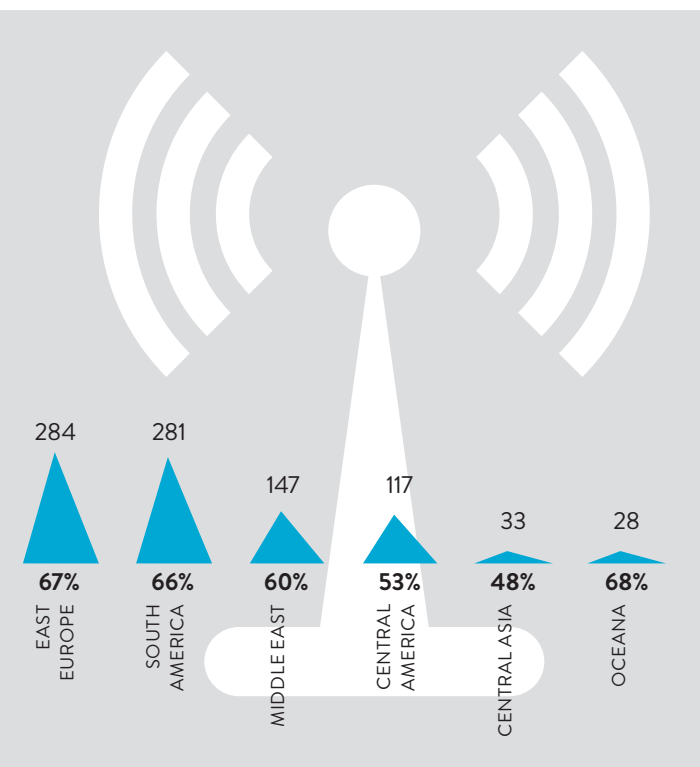


55%

INTERNET USE: REGIONAL OVERVIEW

INTERNET USERS (IN MILLIONS), AND INTERNET
PENETRATION, BY REGION





There's a case to be made that America could be experiencing peak internet. According to reports, about 87.9 per cent of the region is already connected to the internet. There isn't much of an audience left to tap into. As of 2017, the United States is currently the third highest internet consuming country in the world, preceded by China and India respectively. The difference, however, lies in internet penetration – the number of people using the internet as compared to the total population. While 87.9 per cent of the United States is already online, only 52.7 per cent of China is connected, while India is lesser still with only 34.4 per cent.

Perhaps unsurprisingly, the report found that richer countries tend to use the internet more than poorer nations. Eighty-one per cent of the population in developed nations were internet users, versus just 15.2 per cent of the population of the least-developed countries. In addition to being poorer, they tend to be disproportionately less educated, rural, elderly and female.

The way things stand peak internet is not remotely close. There's actually a good chance it will never come simply because we will learn to perfect the art of internet usage before we hit a saturation point. Early last year, writer Richard Watson, podcast host PJ Vogt and the Creative Director of Google's Creative Lab in Sydney, TL Uglow, attempted to address some of the big questions arising from our fast-moving internet age.

Uglow put forth the fact that we have always been hungry

GLOBAL SHARE OF WEB TRAFFIC BY DEVICE

BASED ON EACH DEVICE'S SHARE OF ALL WEBPAGES SERVED TO WEB BROWSERS

LAPTOPS AND DESKTOPS



43.4%

MOBILE PHONES



51.4%

TABLET DEVICES



4.9%

OTHER DEVICES



0.13%

for information, from the man riding on horseback to deliver news from a neighbouring town to reading about news at least 24 hours after it happened in your morning paper, and nothing has ever beaten the internet in terms of speed for gathering this information.

But how much information is too much? How much information turns into distraction? Ultimately, "is it making us better or worse people?" That's what Richard Watson wanted to know.

Uglow claims we haven't been taking in too much information, for the clear reason that we filter it. We filter what we receive and we filter what we contribute. When you consider it realistically, our method of taking in information from the internet will probably heighten rather than dull in the future, by learning how to filter even outside of staring at our screens.

While enlightening, Uglow referenced the most millennial thing ever: Memes. He states memes are a collection of two or three complicated thoughts, feelings or ideas placed upon an image that we gather immediate information from. Who knows how we'll synthesise ideas in the future, via the internet? It's hard to not, suddenly, feel very optimistic.

PJ Vogt wrapped up with a reflection on the internet as it affects us in the present, and how, at first, we didn't know how to control it, or when to stop. Is it all right to text someone a meme at 3 am? Probably not, and we're obviously now learning how to move outside of that.

We are, at this very moment, developing internet etiquette, and finally figuring out how to use it to improve us – like installing apps to monitor glycemic influences in diabetics – and that's even more exciting. Essentially, we are finally learning how to cater the internet to do exactly what we want, and we're only going to be fine-tuning that to work in even more practical ways in the future.

It's only been 25 years since Tim Berners-Lee gave us the gift of the World Wide Web. In that short amount of time, we've already made it an integral part of our lives. If we are to apply regular ageing rules to the internet, it's lifespan has only just begun. Forget peak, the internet is just getting started. †

AN OUTSIZE CONTRIBUTION

A study by INSEAD and The Harvard Business Review has revealed that inventors of Arab origin make a disproportionately large contribution to US innovation.

The United States of America has a long history of attracting international talent in the form of immigrants. Although the US isn't the world's largest destination for foreign immigrants, it does take in 57.1 per cent of the world's inventor community according to the World Intellectual Property Organization. This has a major effect, as a 2011 report by the Partnership for a New Economy found that 76 per cent of the patents earned by the top 10 patenting American universities listed a foreign inventor.

In fact, many of the inventions that make the US as American as apple pie came directly from immigrant inventors. The German immigrant Charles Feltman invented the ubiquitous hot dog in 1867. The brain behind denim jeans was another German immigrant, Levi Strauss, in the 1870s. Jerry Yang, the founder of Yahoo! arrived from Taiwan. Steve Chen also came from Taiwan, while his partner in the founding of YouTube, Jawed Karim, came from East Germany. Sergey Brin, the co-founder of Google, was born in Russia. Apple founder Steve Jobs' biological father was a political migrant from the Syrian city of Homs.

A BIG CONTRIBUTION

Jobs isn't the only person with Arab roots on the roster of people who contributed to the US. From Hassan Kamel Al-Sabbah, a Lebanese-born American serial inventor, to Ahmed Zewail, the 1999 Nobel laureate in chemistry, to Farouk El-Baz, a NASA and MIT scientist who helped plan the Apollo landing, to Elias A. Zerhouni, the 15th director of the National Institutes of Health, Arab immigrants have made major contributions to American science and technology.

The Harvard Business Review and INSEAD recently revealed just how great this contribution to the US' innovation system is in a joint study. The researchers ran an exercise matching Arabic first names with international patent applications filed under the Patent Cooperation Treaty (PCT). This data includes patents by people residing in the US and around the world.

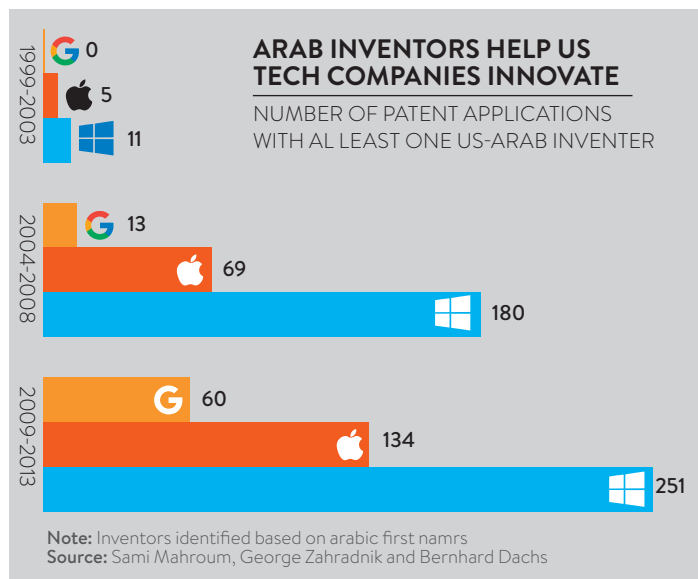
The results revealed that the US is a major home for Arab inventors. In the five-year period from 2009 to 2013, there were 8,786 US patent applications in the data set that had at least one Arab inventor. Of the total US patent applications, 3.4 per cent had at least one Arab inventor, despite the fact that Arab inventors represent only 0.3 per cent of the total population. As patents usually have multiple inventors, and Arab inventors often patent jointly with non-Arabs, 2,962 patents, or 1.2 per cent, can be contributed exclusively to Arab inventors. California alone, with 1134 patents, had more patent filings by Arab inventors than any country outside the US. It serves as a home for more than one-third of PCT patent applications from Arab inventors in the US, and about 16 per cent of all Arab patents worldwide. Furthermore, since 2000, their share of Californian patent applications has increased 137 per cent.

Europe is home to far fewer Arab inventors: There were only 1,424 patent applications from EU-28 countries that had an Arab name associated with them. Among countries other than the US, the order was the following: France (513 patent applications), Canada (361), Germany (342), Saudi Arabia (307), Japan (279) and the UK (273).

Furthermore, the number of Arab patents in the US increased 62 per cent over 10 years, from 1,826 patent

Right: Farouk El-Baz helped plan the Apollo landings.





Below: Mo Gadwat is the chief business officer for Google X.

applications from 1999-2003 to 2,962 from 2009-2013. This growth rate was about 2.6 times higher than the respective growth rate of 40 per cent for total US patenting in the same time period.

The research team also found that Arab inventors show some technological specialization in information and communication technologies. They are overrepresented in electrical and communication technology, computing, calculating, and counting. Another large field is medical and veterinary sciences.

INSTRUMENTAL IN THE TECH SCENE

Arab inventors also contribute significantly to America's tech scene, in Silicon Valley, Boston, and elsewhere. Tech entrepreneurs such Amr Awadallah, cofounder of Cloudera, Ayah Bdeir, founder and CEO of LittleBits, Rana El Kaliouby of Affectiva, Sharif El Badawi of TechWadi, Mo Gawdat of Google, and Oussama Khatib, director of the Stanford Robotics Lab, are but a few examples of Arab immigrants making major contributions to America's innovation scene. This is evident in the patent data: Arab inventors' contributions to major US tech companies have been increasing dramatically over the last 15 years.

Looking at visa patterns, the INSEAD and Harvard team found the bulk of Arab inventors settle in the US through immigration channels such as family reunion and as refugees. In 2013, there were approximately 1.02 million immigrants from Arab countries residing in the US, representing 2.5 per cent of the nation's 41.3



million immigrants. They also found that Arab immigrants had a higher level of education. About 43 per cent of Arab immigrants age 25 and over had a bachelor's degree or higher, which was more than the 28 per cent of all immigrants and 30 per cent of native-born adults who did.

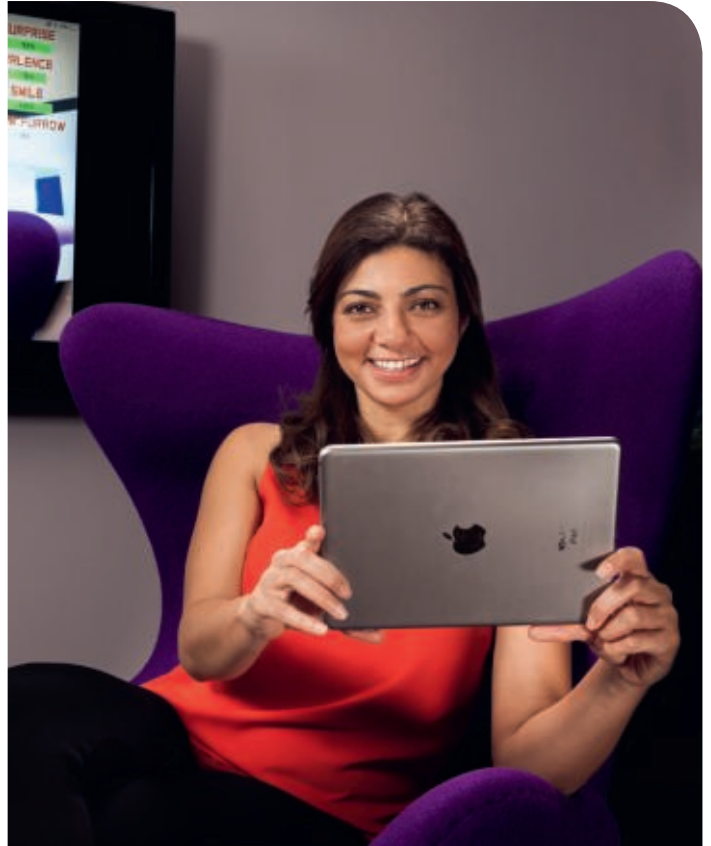
It is clear that the US is benefitting from its inflow of Arab inventors, but it is a loss for the countries they leave behind. Switzerland, Sweden, the Netherlands, the USA and the UK are the world's most-innovative countries according to the Global Innovation Index 2017, which is co-authored by Cornell University, INSEAD and the World Intellectual Property Organization (WIPO).

The Global Innovation Index 2017 cited the US as showing particularly sophisticated financial markets and intensity of venture capital activity, which help stimulate private-sector economic activity. The US strengths also include the presence of high-quality universities and firms conducting global R&D, quality of scientific publications, software spending, and the state of its innovation clusters.

NURTURING LOCAL TALENT

However, the competition to attract and nurture Arab inventors is growing in the Middle East. The





UAE ranked 35th in the Index overall and third in the Northern Africa and Western Asia region. The UAE was cited for benefiting from increased data availability and showing strengths in tertiary inbound mobility, innovation clusters and ICT-driven business model innovation.

What is clear from *The Harvard Business Review* and INSEAD study is that there is no shortage of innovative talent originating in the MENA region. Efforts are now underway, spearheaded by the UAE, to capture, nurture and benefit from this talent pool.

In 2014 His Highness Sheikh Mohammed bin

Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, launched a National Innovation Strategy with a seven year plan that aims to make the UAE among the most innovative nations in the world. In 2015 the UAE Science, Technology and Innovation Policy was launched that heralded the start of a new era of sustainable innovation, based on science and technology, impacting seven priority sectors – education, health, water, renewable and clean energy, space, technology and transportation.

Dubai has also developed the 10X initiative that aims to catapult the emirate well ahead of global counterparts to become a leader in innovation within the next ten years. Government bodies are playing an instrumental role in realising this vision, and are encouraged to set in motion a series of mechanisms to contribute in shaping the city's future. Disruptive technology and innovation remains the focal point in the 10X initiative and is regarded as the means to make the city future-ready.

This all adds up to numerous excellent opportunities close to home for Arab inventors. It is feasible that in the near future, especially with the current US immigration debate, the UAE will become the destination of choice for the region's inventors. That will clearly be the US's loss. ↑

Above: Egyptian-born Rana el Kaliouby, who co-founded Affectiva, is one of the pioneers of affective computing.

Above left: Ousama Khatib is the current director of the Stanford Robotics Lab.

Left: Ayah Bdeir started littleBits to democratize hardware.

TOWARDS A CASHLESS SOCIETY?

Change is seldom comfortable. Despite the fact that we as a species understand that change is the constant in our lives, we're never really ready for it to take place. Breaking old habits is an admission to loopholes in a system we've used for a long time, and if there's one thing we dislike more than change, it's being proved wrong.

Cash has been the basis of the world's economic activity right from China's Zhou Dynasty issuing promissory notes over 2,000 years ago. Methods have changed but the overarching principles have not: the exchange of a clearly identifiable object of value that is accepted as payment for goods and services. The world is primed for that model to change with the introduction of a digitalised payment system but there are hurdles in the way.

As of right now, about 75 per cent of all transactions in the UAE are done in cash. However, digital commerce and cashless payments were identified as top government priorities in UAE Vision 2021. The UAE government has implemented a number of initiatives to support it, such as the wage protection system, which ensures that 4.7 million migrant workers get paid electronically every month. In 2016, there were 38.6 million cashless transactions via e-Dirham, a rise of 6.94 per cent compared to 2015.

While it may seem convenient to pay for services with a tangible substance, it's actually expensive to sustain. Economists state that the 'cost of cash' is somewhere between 1.25 and two per cent of the GDP of a nation. By contrast, a cashless society – one where digital payments are at the helm – would not only negate the cost of printing and distributing physical money but also bring down costs related to criminal activity and grey market economics.

EMIRATES DIGITAL WALLET

In the short span of a couple of months, UAE's banking sector will be ready to take the plunge into the digital realm of payments with the introduction of the Emirates Digital Wallet. For the uninitiated, the Emirates Digital Wallet is a company owned by 16 shareholding banks and fully sponsored by the UAE Banks Federation (UBF). The project aims to introduce a society-wide cash transformation to digital, and mark a major milestone in the country's push towards a cashless future.

Under the project, the whole banking sector of the country will join forces to create a dedicated entity for the benefit of all citizens, residents and visitors. In launching a secure mobile phone app to replace traditional cash payments, Emirates Digital Wallet is offering consumers >



The UAE's banking sector is about to take a giant digital leap with the launch of the Emirates Digital Wallet. The UAE has a tech-savvy population, and if a cashless society will ever exist, it could be here.



DIGITAL IN THE MIDDLE EAST

KEY STATISTICAL INDICATORS FOR THE REGION'S INTERNET, MOBILE, AND SOCIAL MEDIA USERS



TOTAL POPULATION

246M

URBANISATION

86%

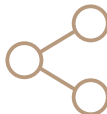


INTERNET USERS

147M

PENETRATION

60%



ACTIVE SOCIAL MEDIA USERS

93M

PENETRATION

38%



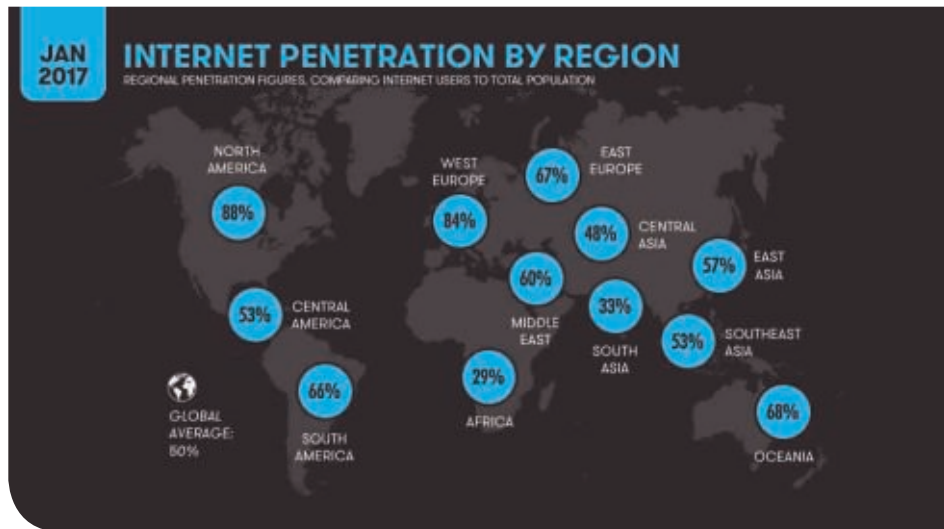
ACTIVE MOBILE SOCIAL USERS

83M

PENETRATION

34%

Source: Hootsuite



and businesses in the UAE an effective and convenient way to receive, store and transfer money, while setting the path for the country's transition to a digital future.

The movement is fully supported by the country's banking sector. In fact, banks in the UAE are setting aside about AED500 million to drive the digital movement forward. You only need to look at how much of a success e-banking has been in the last few years to understand what a marked improvement these changes will bring to the region.

According to research by eMarketer, there were more than 1.6 billion e-commerce shoppers worldwide in 2016, spending a combined total of close to \$2 trillion. Based on these figures, the average e-commerce shopper spent roughly \$1,189 over the course of 2016. This is just the start.

The UAE – which hopes to be a cashless society by 2020 – has shown a 25 per cent year-on-year growth in the total number of e-commerce users. In fact, the UAE ranked in the top 25 countries in the world when it came to growth rates based on the e-commerce user metric. With those numbers only continuing in their upward trajectory, it's no wonder Amazon acquired local e-commerce firm Souq.com for \$600m to \$1 billion.

In many ways, the UAE is at an advantage compared to other countries when it comes to the possibility of a cashless society. With the country's ambitions to become a smart city, the digital revolution feels imminent.

In Europe, many people are averse to the idea

of a cashless society. There's the fright of a new beginning, but also the fear of a potential economic singularity. A singularity is defined as the point at which technological advancement will "radically change human civilization and perhaps even human nature itself". It is impossible to know if this will actually happen, but a cashless society would certainly give governments unprecedented access to information and power over citizens.

In Germany, 82 per cent of transactions are still made with cash, while in the US it is 46 per cent. Reasons cited for the popularity of cash is psychological attachment, easier to keep track of spending and anonymity – a transaction without a record is much harder for the government to tax. Seeing the UAE doesn't have tax that is a mute point here.

At the other extreme is Sweden where only three per cent of transactions are made with currency. In fact, the decline in cash use has become so pronounced in the Scandinavian country that homeless beggars have been given card readers by Situation Stockholm to sell freely distributed newspapers and to receive alms, since potential donors no longer carry cash.

THE UAE IS READY

The UAE has the world's highest penetration of smartphones according to Google, with 73.8 per cent of mobile consumers carrying one. Mobile phone usage in the UAE increased until March 2017 to 228.3 phones per 100 people, according to the most recent statistics issued by the



Telecommunications Regulatory Authority, TRA, which regulates this sector. Almost 100 per cent of households in the country have internet access, and there are 150,000 point-of-sale (POS) terminals in use – 50 per cent of which are already equipped to handle contactless payments.

Furthermore, the UAE is one of the top three countries in the world that are most prepared for change, according to this year's edition of KPMG's Change Readiness Index (CRI). The global audit, tax and advisory firm ranked 136 countries around the world in terms of their ability to manage or adapt to change and nurture opportunity. This means, technologically speaking, that the UAE is more than ready for the Emirates Digital Wallet programme. All the country needs is the consumer's buy in.

"While we are still some way off from being a totally cashless society, we do believe that e-wallet and mobile banking will replace cash transactions to a significant degree," says Subroto Som, Head of Retail Banking Group at Mashreq. "Two factors will drive this. One is convenience and simplicity for the customer, and the other is the high cost of handling cash."

The latest McKinsey Global Institute (MGI) report states that digital finance could boost the GDP of all emerging economies by as much as six per cent versus the traditional scenario, or \$3.7 trillion, by 2025 – the size of Germany's economy, while generating up to 95 million new jobs across all sectors of the economy. An estimated two-thirds of the growth would be from increased productivity of businesses and governments, one-third from the additional investment from inclusion of people and micro, small, and medium-sized businesses and the small remainder would come from time saved by individuals, enabling additional hours spent on work.



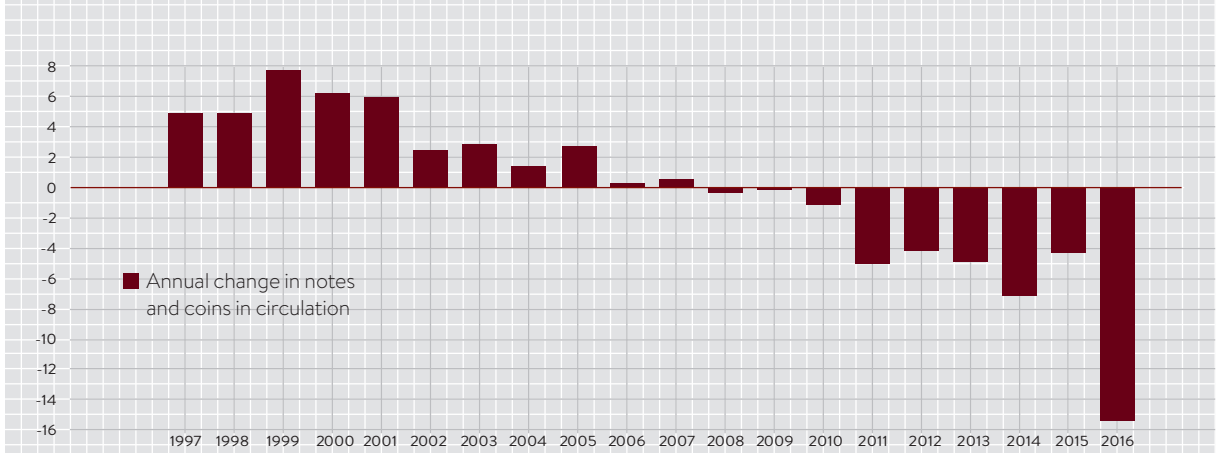
As per MGI estimates, by switching to digital financial services individuals in emerging economies could save 12 billion hours a year and enable the sustainable release of \$2.1 trillion in new loans to individuals and small businesses. Financial service providers could save almost \$400 billion in direct costs by shifting from cash to digital payments as the cost of offering customers digital accounts can be 80- 90 per cent lower than using physical branches. This would expand their balance sheets by as much as \$4.2 trillion.

This means that although going cashless remains an individual choice, its broad-based acceptance would make a significant positive contribution to the UAE's economy. ↑

Above: The UAE has 150,000 point-of-sale terminals in use, 50 per cent of which can handle contactless payments such as the Emirates Digital Wallet.

DWINDLING CASH

SWEDISH NOTES AND COINS IN CIRCULATION DROPPED THE MOST ON RECORD LAST YEAR



Source: Bloomberg



THE PLASTIC SCOURGE



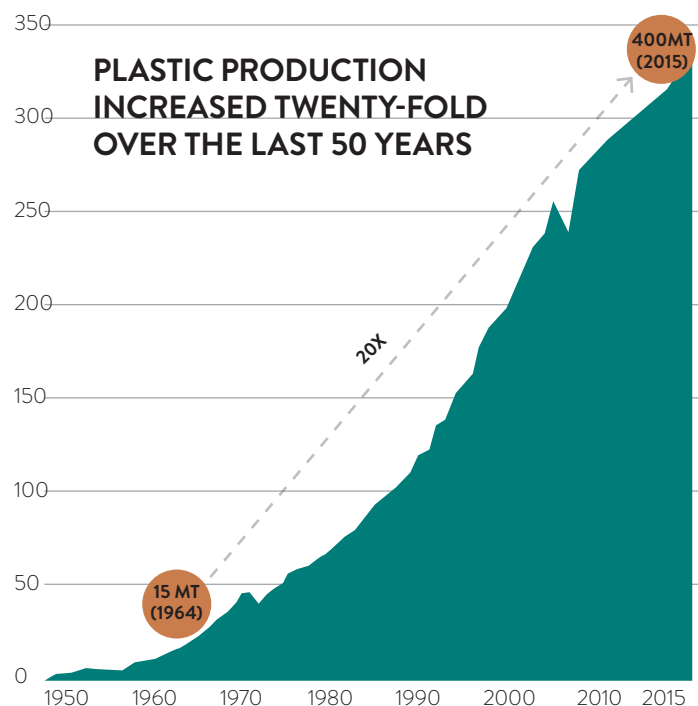
The large-scale production of plastics began around the 1950s. Since then we've produced enough to cover the entire country of Argentina. Most of this plastic has been dumped in landfills or clutters the natural environment. If current trends continue, we will eventually bury the planet in plastic says a new report.



Above: Plastic pellets are melted to create plastic products.

Above right and centre: Roland Geyer and Jenna Jambeck headed the first study of global plastic production.

Last month, researchers at the University of California, Santa Barbara, released the first global analysis of the production, use and fate of all plastics ever made. The results are extremely grim. Since the 1950s humans have created a whopping 9.1 billion tonnes of plastic including resins, fibres and additives. Led by Roland Geyer, an industrial ecologist and associate professor at UC Santa Barbara's Bren School of Environmental Science & Management, the study highlights that the global production of plastic resins and fibres increased from two million metric tons in 1950 to more than 400 million metric tons in 2015.



After steel and cement, plastic is the most manufactured man-made material. While half of the world's steel production goes into construction where it has decades of use, half of all plastics produced become waste within four years of use. Packaging was found to be the largest market for plastics where the material was used just once and then discarded.

UNINHIBITED PRODUCTION

Despite the alarming statistics, the pace of plastic production remains unrestrained. In fact, of the total amount of plastics produced from 1950 to 2015, roughly half has been manufactured in the past 13 years. The researchers also found that by 2015, humans had produced 6.3 billion tons of plastic waste. They also highlighted another harsh reality – of all the plastic produced, only nine per cent was recycled, 12 per cent was incinerated while 79 per cent of the production was relegated to landfills, lying simply buried and forgotten. A large percentage of this waste makes its way into the oceans as well – approximately eight million ton annually.

The researchers believe their global analysis of all the plastic produced to date will become instrumental in creating the foundation for sustainable materials management. “Put simply, you can’t manage what you don’t measure, and so we think policy discussions will be more informed and fact-based now that we have these numbers,” said Geyer.

“This paper delivers hard data not only for how much plastic we’ve made over the years but also its composition and the amount and kind of additives that plastic contains. I hope this information will be used by policymakers to improve end-of-life management strategies for plastics,” he added.

Given the extensive use of plastics in our daily lives, Geyer’s team says it would be naïve to think of an existence without them. What they are asking for is a more critical examination of plastic production, use and disposal.



NOT JUST RE-USE, BUT REDUCE

Although there are ways to mitigate the crisis, such as recycling and using biodegradable plastics, these are not enough. Only a negligible 4.5 million tons of biodegradable plastics are produced every year. Producing such plastics entails other tradeoffs such as diverting the corn used to make it from food supplies and greater energy expenditures.

Apart from finding sustainable methods to dispose of plastics, the need of the hour is to significantly reduce the demand and production of new plastic. “Most plastics don’t biodegrade in any meaningful sense, so the plastic waste humans have generated could be with us for hundreds or even thousands of years,” said co-author Jenna Jambeck, an associate professor of engineering at the University of Georgia. “Our estimates underscore the need to think critically about the materials we use and our waste management practices.”

If things carry on as they are, we will eventually bury the planet in plastics. Based on current trends, the research team predicts that by 2050, 38 billion tons of plastics will have been produced and roughly 13 billion metric tons of plastic waste — weighing more than 36,000 Empire State Buildings — will be in landfills or the natural environment.

ENVIRONMENTAL EFFECTS

A recent study by the Institute for Marine and Antarctic Studies, Australia, found high concentrations of micro plastics embedded in almost every part of the seafloor along the southeast coast of Australia. In 2016, the Ellen MacArthur

Foundation reported that an astonishing 95 per cent of plastic packaging is lost to the economy every year after single use, costing an estimated \$80-120 billion, and that by 2050 plastic rubbish in the ocean will outweigh sea life.

Plastics have a deadly effect on the planet’s animals. Large pieces kill by entanglement and ingestion. Lost fishing nets can drift through the oceans for years as deadly “ghost nets”, entangling creatures even as big as whales. Smaller pieces are ingested, as the recent death of a Cuvier’s beaked whale in Norway proved. Scientists found more than 30 plastic bags and other plastic waste inside the stomach of the whale, which was severely malnourished.

A necropsy done on 13 sperm whales that washed up on German shores found that four of the giant marine animals had large amounts of plastic waste in their stomachs. The garbage included a nearly 13-metre-long shrimp fishing net, a plastic car engine cover, and the remains of a plastic bucket. More than 200 animal species have been documented consuming plastic, including turtles, whales, seals, birds, and fish. Land animals are equally affected. In the UAE, for example, one in two camels die from swallowing plastics according to Dubai Municipality.

All known species of sea turtles, about half of all species of marine mammals, and one-fifth of all species of sea birds are affected by entanglement or ingestion of marine debris. The frequency of impacts varies according to the type of debris; but over 80 per cent of the impacts were associated with plastic debris while paper, glass

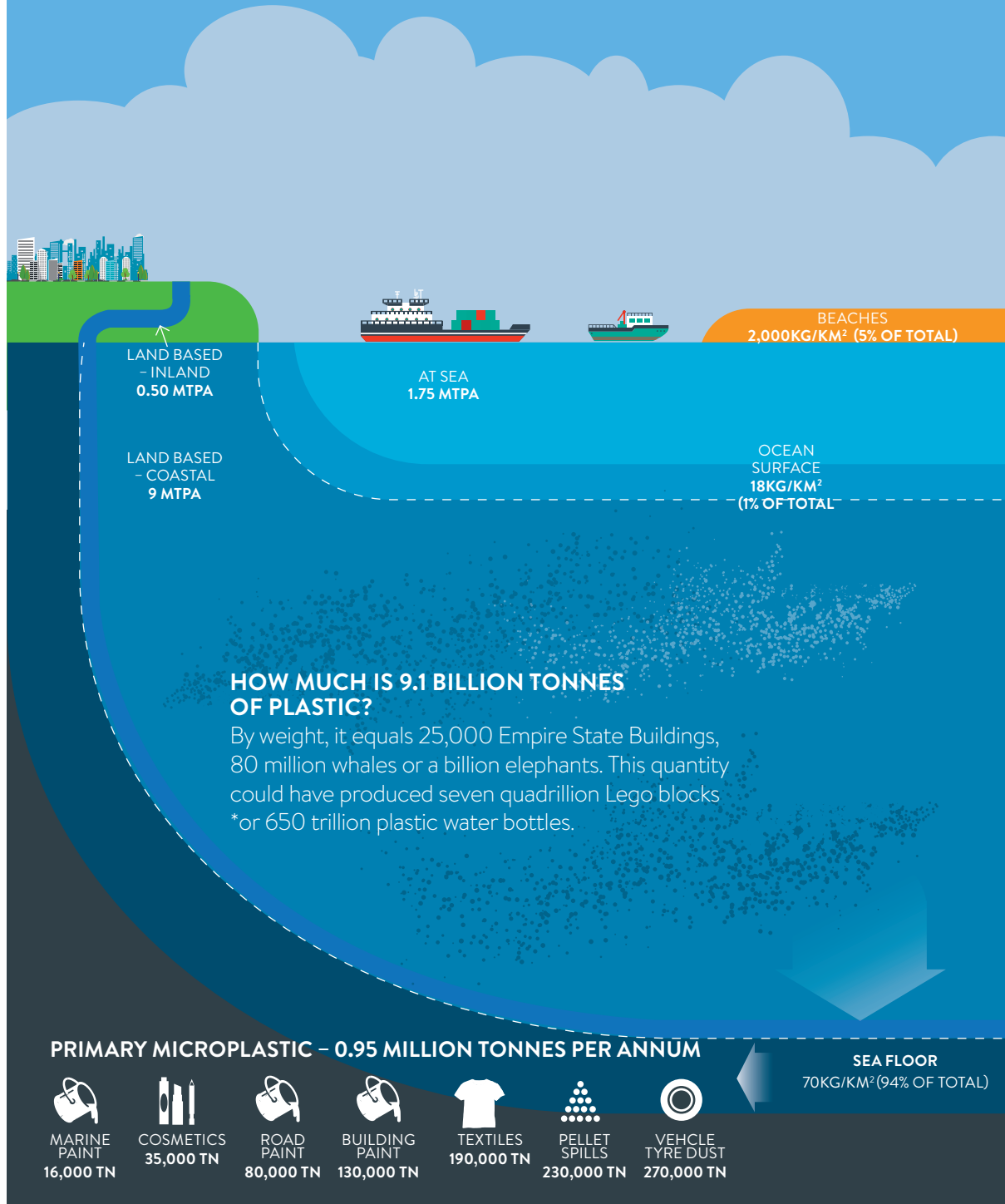


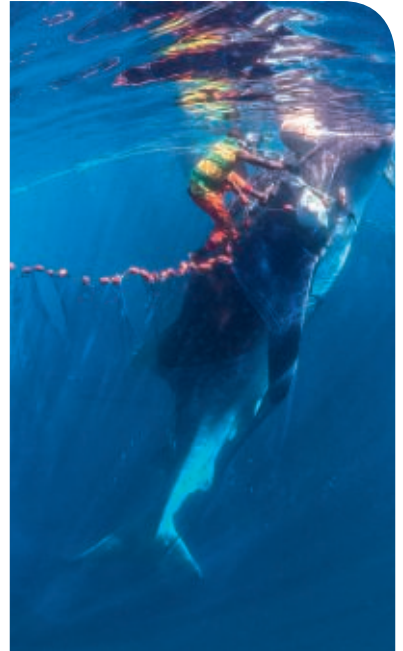
Top: In 2015, 400 million metric tons of plastic was produced. In the US, 50 billion water bottles are discarded annually.

Above: Currently, only nine per cent of plastics are recycled.

PLASTICS IN THE MARINE ENVIRONMENT

WHERE DO THEY COME FROM? WHERE DO THEY GO?





and metal accounted for less than 2 per cent. About 15 per cent of the species affected through entanglement and ingestion are on the IUCN Red List.

A study by Qamar Schuyler of the University of Queensland estimates that 52 per cent of sea turtles worldwide have eaten plastic debris. A further study by Australia's Commonwealth Scientific and Industrial Research Organisation found that 90 per cent of seabirds eat it now and virtually every one will be consuming it by 2050. In 1960, plastic was found in the stomachs of fewer than five per cent, but by 1980, it had jumped to 80 per cent.

In 2014, a global analysis measured ocean plastic at a quarter of a billion metric tons, much of it suspended in small rice-sized particles.

The rise of plastics in shallow sea waters does not bode well for marine life along coastal countries such as the United Arab Emirates as microplastics are mistaken for food by small fish still in development, according to a new study published in *Science*. The study by Uppsala University in Sweden revealed that fish "reared in different concentrations of microplastic particles have reduced hatching rates and display abnormal behaviours. The microplastic particle levels tested in the current study are similar to what is found in many coastal habitats in Sweden and elsewhere in the world today".

Many animals ingest plastic with their food. While all kinds of animals that feed on plankton also unintentionally ingest microplastic, birds and turtles often deliberately eat pieces of plastic, as they mistake them for food. Depending on the form of the animals'

gullets and stomachs and the way they function the indigestible pieces cannot be excreted, leading to the animals starving with full stomachs, choking, or suffering internal injuries (perforation or laceration of the intestinal walls.)

Plankton-eating organisms ingest microplastic along with their natural food. Studies of water samples taken from the North Pacific have shown that in the upper seawater column there is, at places, 46 times as much plastic as plankton.

The harsh truth is that as useful as plastic is, it is taking its toll on the planet. Since there seems to be no way to live without plastics, it is imperative we undertake a more critical examination of plastic production, use and disposal.†

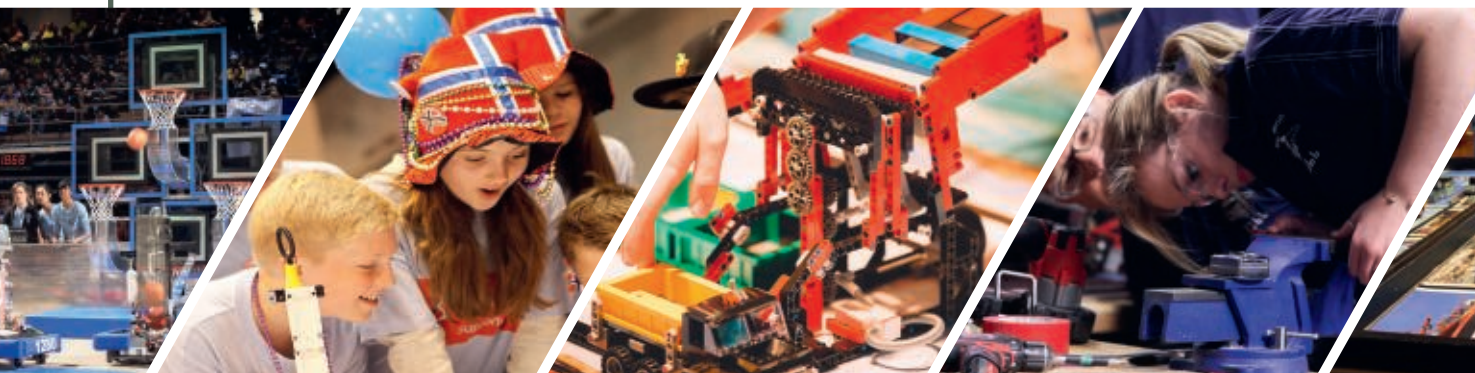
Above and below:

Plastics are finding their way into the world's environments, where they are eaten by or entangle animals. More than 200 animal species have been documented consuming plastic.



FIRST, an organisation started by renowned inventor Dean Kamen, highlights the virtues of science and technology.

THE LEARNING CHALLENGE



Dean Kamen might not be a household name, but the Segway PT definitely is. This beloved icon of Silicon Valley hipsters is an electric, self-balancing human transporter with a computer-controlled gyroscopic stabilisation and control system. The device balances on two parallel wheels and is controlled by moving body weight.

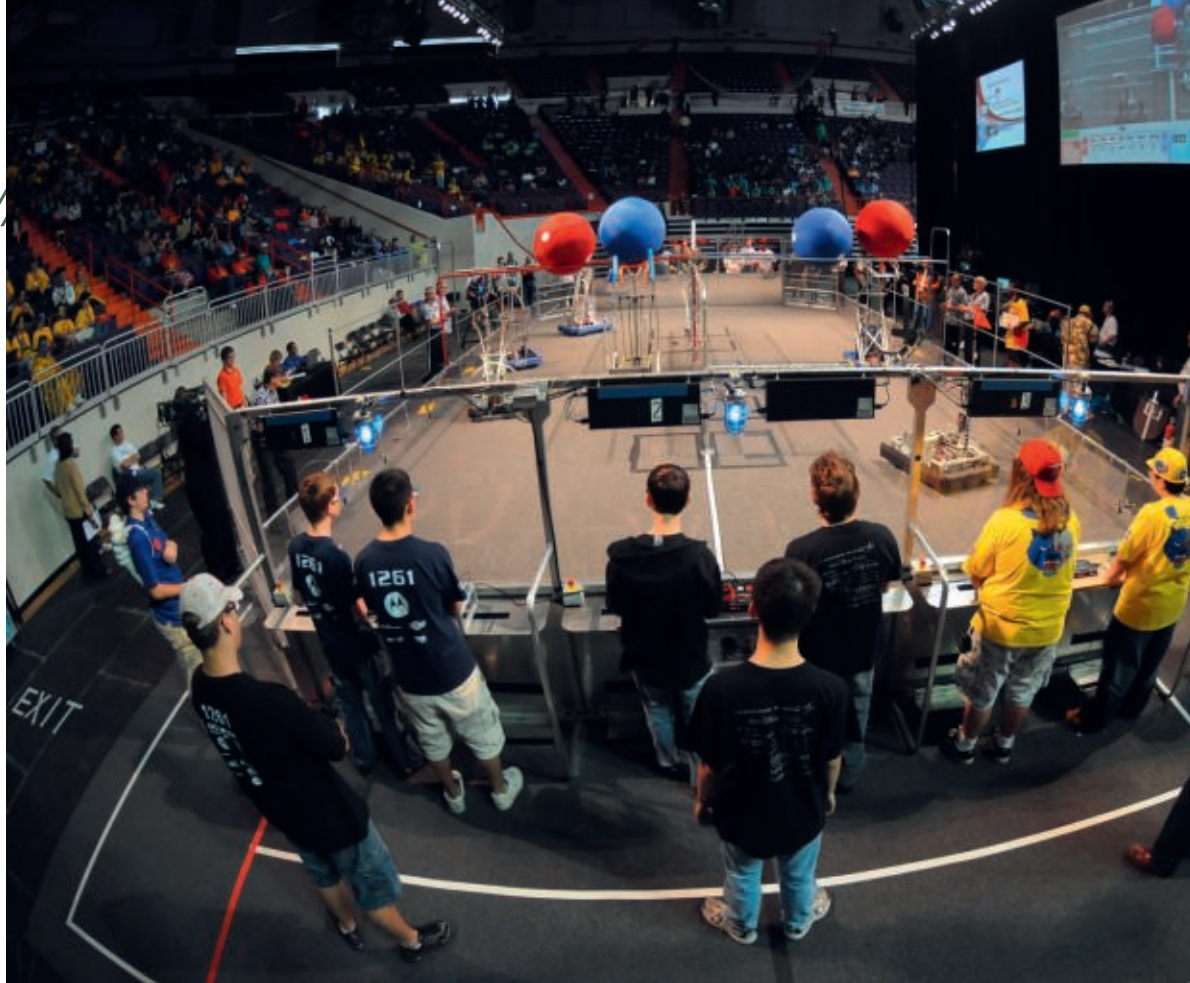
Not that this was Kamen's first invention. He was already a successful and wealthy inventor after creating the first drug infusion pump and starting a company, AutoSyringe, to market and manufacture the pump. His latest company, Dekka Research and Development, also holds patents for the technology used in a portable dialysis machines, an insulin

pump (based on the drug infusion pump technology), and an all-terrain electric wheelchair known as the iBOT, using many of the same technologies that later made their way into the Segway. He also designed a prosthetic arm with superior motor control, a water purification system for developing countries, and this year he launched BioFabUSA, a public-private partnership meant to bring together the technologies needed to create human organ factories. At last count, Kamen held 404 US and foreign patents.

It is clear that Kamen loves science and technology, and he is more than eager to share his passion with others. It is for this reason that he founded the non-profit organisation >



Right: The FIRST Robotics Competition has a new theme every year to keep students interested and challenged.



FIRST (For Inspiration and Recognition of Science and Technology) in 1989. FIRST is dedicated to motivating the next generation to understand, use, and enjoy science and technology as it has its firm belief that the tools of science and engineering will help equip the world's youth to solve the most pressing global challenges. FIRST's vision is "to transform our culture by creating a world where science and technology are celebrated and where young people dream of becoming science and technology leaders."

In order to achieve this goal, FIRST takes a multi-pronged approach, although its core focus is on various mentor-based programmes that build science, engineering, and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership.

In order to achieve this, FIRST hosts four major events: the FIRST LEGO League Jr. Challenge, FIRST LEGO League Challenge, FIRST Tech Challenge and the internationally acclaimed FIRST Robotics Competition.

The FIRST Robotics Competition was inaugurated in 1992 with 28 teams. The idea, Kamen said, was "to compete for the hearts and minds of kids with the excitement of the Super Bowl." In this annual event teams of high school students, coaches, and mentors work during a six-week period to build game-playing robots that

weigh up to 54 kg. Robots complete tasks such as scoring balls into goals, flying discs into goals, inner tubes onto racks, hanging on bars, and balancing robots on balance beams. The game changes yearly, keeping the excitement fresh and giving each team a more level playing field. While teams are given a standard set of parts, they are also allowed a budget and encouraged to buy or make specialized parts.

This edition, the 26th year of competition, 3,357 teams with roughly 83,000 students and 20,000 mentors from 26 countries participated. They competed in 53 Regional Competitions, 65 District Qualifying Competitions, and 8 District Championships. Six hundred teams won slots to attend the FIRST Championship, where they competed in a tournament. In addition to on-field competition, teams and team members compete for awards recognising entrepreneurship, creativity, engineering, industrial design, safety, controls, media, quality, and exemplifying the core values of the programme.

The event has become so popular that this year the FIRST Global Competition was held with close to 1,000 high school students from 157 different countries battling it out in Washington DC. FIRST Global invites one team from every nation to participate in



the event that builds bridges between high school students with different backgrounds, languages, religions, and customs.

A team from South Australia's Trinity College walked away with the honours after their robot bested the competition in numerous events that included navigating a fake river and automatically separating red and blue balls (denoting clean water particles and contaminants).

The FIRST LEGO League Jr. Challenge is aimed at children aged 6 to 10. Guided by two or more adult coaches, teams (up to 6 members) explore a real-world scientific problem such as food safety, recycling and energy. They also construct a motorised model of what they learned using Lego elements. The FIRST LEGO League is a similar event aimed at older children in grades 4 to 8. The FIRST Tech Challenge is aimed at children in grades 7 to 12. They are given a standardised robot kit and are challenged to design, build, program, and operate robots to compete in a head-to-head challenge in an alliance format. Teams also have to raise funds, design and market their team brand, and do community outreach for which they can win awards.

The most important aspect to Kamen is that the events have a permanent and positive impact on the participants, which is why follow up research is conducted. According to FIRST's findings, participants are twice as likely to major in science and engineering, with 33 per cent of women entering the latter field. Eighty-seven per cent of scholars say they are more interested in doing well at school, 87 per cent are more interested in going to university, and 90 per cent plan to take a more challenging math or science course. In total, more than 75 per cent of former participants are in a STEM field as either a student or professional.

The participation numbers are equally astounding. In the 2016-17 season the 2,600 events reached more than 460,000 students, and the 52,000 participating teams built in excess of 40,000 robots assisted by more than 120,000 mentors.



In other words, FIRST's mission to inspire science and technology leadership and innovation in young people from all nations is proving extremely successful.

However, FIRST has another important impact on many young lives. The organisation boasts around 3,500 sponsors, including 200 Fortune 500 companies. The various events allow the sponsors to identify talent and provide \$50 million for nearly 2,000 scholarship opportunities.

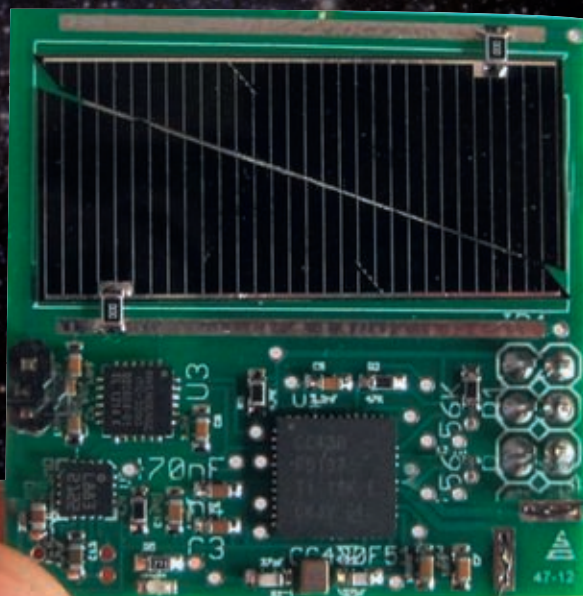
"FIRST is more than robots," says Kamen. "The robots are vehicles for students to learn important life skills. Kids often come in not knowing what to expect – of the programme or themselves. They leave, even after the first season, with a vision, with confidence and with a sense they can create their own futures."†

Above: The FIRST LEGO League challenge is aimed at children in grades 4 to 8.

Above left: Robots have to complete various challenges such as getting balls into goals.

BREAKTHROUGH STARSHOT

A global team of scientists, astronomers and cosmologists are developing miniature satellites to launch on a 100-million-mile per hour mission to the neighbouring star system Alpha Centauri.



Who are we? A mature civilization, like a mature individual, must ask itself this question. Is humanity defined by its divisions, its problems, its passing needs and trends? Or do we have a shared face, turned outward to the Universe?

In 1990, Voyager 1 swivelled its camera and captured the 'Pale Blue Dot' – an image of Earth from six billion kilometres away. It was a mirror held up to our planet – home of water, life, and minds. A reminder that we share something precious and rare.

But how rare, exactly? The only life? The only minds?

Such are the questions posed in an open letter by The Breakthrough Initiatives – the organisation and umbrella of multiple cosmic ventures that was founded on July 20, 2015 – the 56th anniversary of the Apollo moon landing – at the Royal Society in London.

The Initiatives was founded by Yuri Milner, the Russian billionaire, internet entrepreneur and committed philanthropist, to “explore the Universe, seek scientific evidence of life beyond Earth, and encourage public debate from a planetary perspective”.

Milner is joined by a stellar cast of leadership figures responsible for the development and operational implementation of the combined projects, including Dr Stephen Hawking, the iconic British theoretical physicist and cosmologist.

The Initiatives comprise Breakthrough Listen – an epic scientific research programme that's dedicated to discovering evidence of civilizations beyond Earth. Spanning a decade with a budget of \$100 million, the programme scans space to unprecedented levels, searching for signs of intelligence out beyond the Milky Way towards the 100 closest galaxies to our own. The most advanced and powerful instruments are used for a variety of data mining, including spectroscopic searches (which look for the interaction between matter and electromagnetic radiation) that are 1000 times more effective at finding laser signals than ordinary visible light surveys. They could detect a 100-watt laser (the energy of a normal household bulb) from a mind-boggling 25 trillion miles away.

Breakthrough Message is essentially an international competition to work out what we should say to other intelligent life forms should all this energy and investment into finding other life forms prove fruitful. The search for the best possible message is open to anyone and there is a million-dollar prize provided by Milner for the winning representation of humanity and planet Earth. No date has been set for any messages to be sent but this competition serves as a catalyst for debate about interstellar correspondence – to spark a global discussion on the ethical and philosophical issues of sending messages into space.



The Initiative makes it clear that, “we pledge not to transmit any message until there has been a wide-ranging debate at high levels of science and politics on the risks and rewards of contacting advanced civilizations”.

Breakthrough Starshot is the most recent and ambitious of the initiatives and another auspicious date was chosen for the launch of this trailblazing project – April 12th 2016 – the 55th anniversary of the first-ever human spaceflight, made by cosmonaut Yuri Gagarin (Who Milner was named after), as well as the 35th anniversary of the first orbital mission of NASA's space shuttle programme.

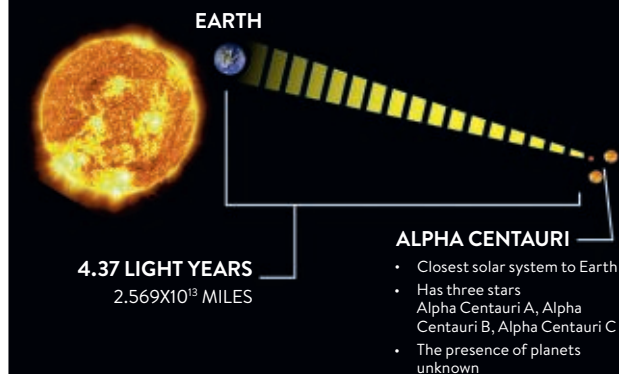
The ultimate goal of Breakthrough Starshot is long-term exploration of the Universe. Why? Dr Hawking answers that, “what makes us unique is transcending our limits”. Dr Hawking has also expressed his thoughts that Earth might not always be here and survival is another reason to explore the infinite expanse of space. “Earth is a wonderful place, but it might not last forever,” he said at the launch of the Initiatives, adding, “Sooner or later, we must look to the stars. Breakthrough Starshot is a very exciting first step on that journey”.

Joining Milner and Dr Hawking on the Breakthrough Starshot Board is Mark Zuckerberg, Founder and CEO of Facebook. The Management and Advisory Committee includes Zac Manchester; a researcher and aerospace engineer; Pete Worden, Breakthrough

Above: Mark Zuckerberg, founder of Facebook, is on the Breakthrough Starshot board. Breakthrough Initiatives was founded by Russian billionaire Yuri Milner.

THE OBJECTIVE

SEND A PROBE TO ALFA CENTAURI



THE IDEA

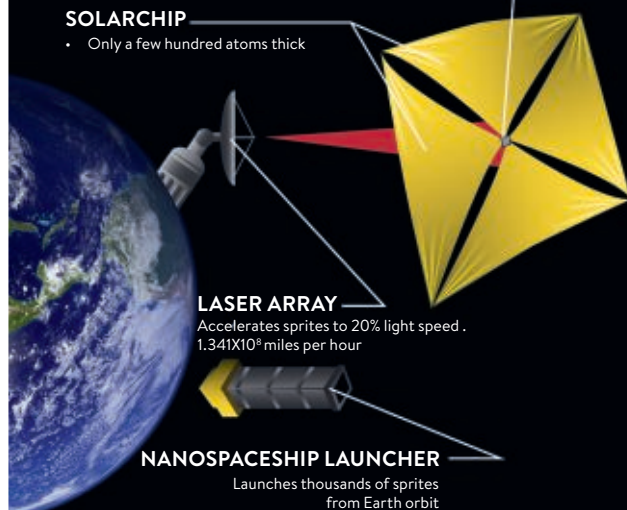
Create thousands of nanospaceships, which the project has dubbed “sprites,” to travel the distance quickly

STARSHIP

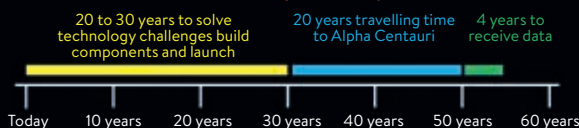
- Equipped with cameras, transmitters, photon thrusters power supply, navigation and communication equipment
- The size of postage stamp

SOLARCHIP

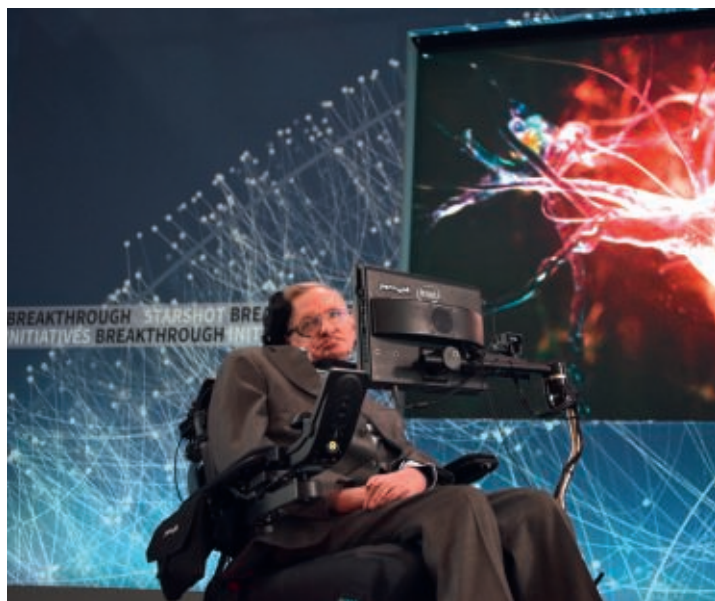
- Only a few hundred atoms thick



THE TIMELINE



WE CAN HAVE A PROBE IN ALFA CENTAURI WITHIN 50 YEARS



Starshot's Executive Director and the former director of NASA's Ames Research Center; and Avi Loeb, a theoretical physicist and Harvard Professor described by TIME magazine as one of the 25 most influential people in space.

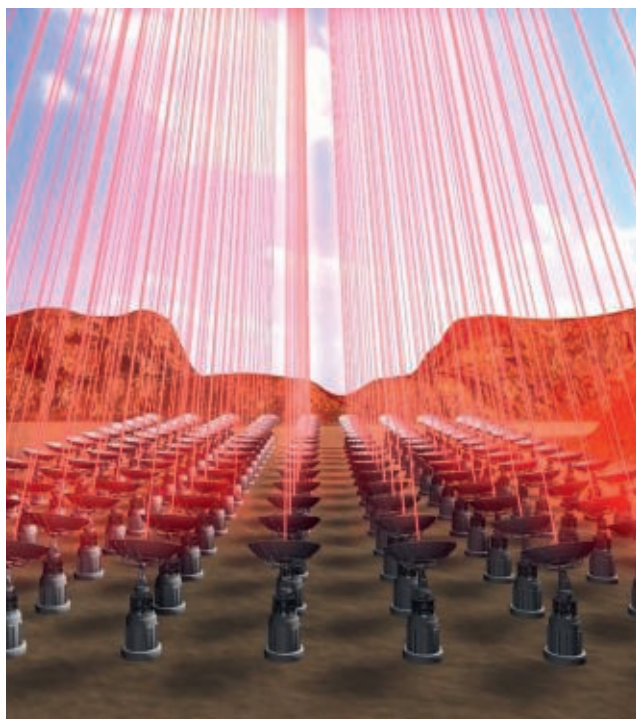
Loeb echoes Dr Hawking's concern about safeguarding the future of humanity and says, “At some point, we must find alternatives to living on Earth, and as with any big journey, this has to start with a first small step – you can't just give up”.

So the search is on and the closest of our cosmic neighbours is the Alpha Centauri star system, which is 25 trillion miles, or 4.37 light years away. In August 2016, a major discovery was made in the planet Proxima b – which orbits the star Proxima Centauri, part of Alpha Centauri. Proxima b may have a “habitable zone” where liquid water might exist, which has made significant waves amongst astronomers and made the planet the primary target of an eventual Breakthrough Starshot interstellar mission.

With present technology, it would take around 30,000 years to get to Proxima b but as technological advances are becoming more exponential this timeframe will eventually be slashed. The first step in this direction is with miniature nanocraft that could travel a thousand times faster. At around the size of a postage stamp, just 3.5cm by 3.5cm and weighing just four grams, these tiny satellites can be sent hurtling into space to eventually send back vital images and information about other star systems, alongside additional astronomical observations, and as well as helping the detection of Earth-crossing asteroids at large distances.

The process involves launching the probes into orbit, where the tiny satellites unfurl delicate sails. At this stage, huge grids of lasers on Earth fire at the same time and these powerful beams propel the floating sprites at 100 million miles per hour into the almost incomprehensible depths of space.

The mini-satellites are called ‘sprites’ and they were

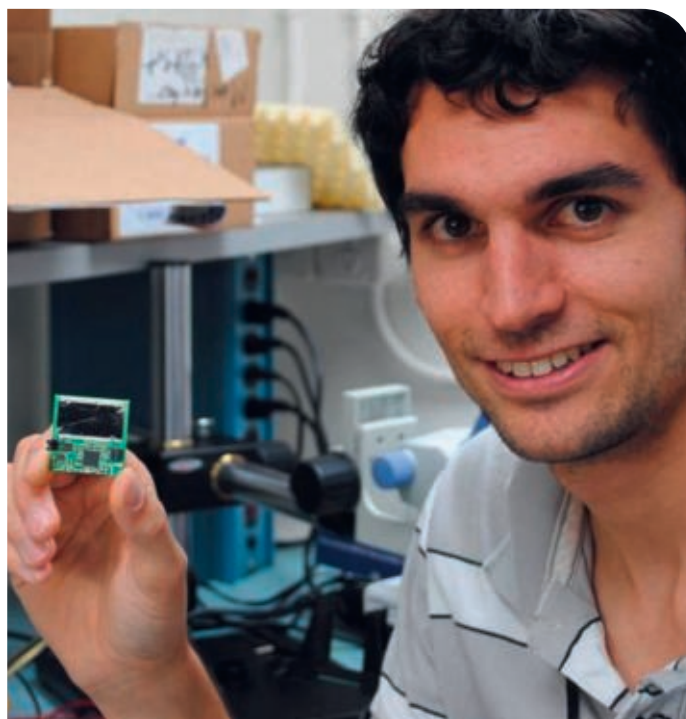


developed by Zac Manchester, a post-doctorate researcher and aerospace engineer at Cornell University. In 2011, Manchester created a crowdfunding campaign to raise \$30,000 to develop the concept. The 'Kicksat' campaign pulled in nearly \$75,000 and in July 2017 the sprites were successfully sent into low Earth orbit, making them the smallest spacecraft ever launched and in contact with systems on Earth. Despite being little more than stamp-sized flakes, each sprite contains solar panels, computers, sensors and radios.

These implausibly small spacecraft are in radio communication with ground stations in California and New York, as well as with amateur radio enthusiasts around the world. The successful launch will test how well the Sprites' electronics perform in orbit and demonstrate their radio communication architecture.

According to Pete Worden, "This is a very early version of what we would send to interstellar distances. In addition, this is another clear demonstration that it is possible for countries to work together to do great things in space. These are European spacecraft with US nano-satellite payloads launching on an Indian booster – you can't get much more international than that".

Commenting on the success of the sprite mission Loeb says, "The launch of the sprite satellites marks the first demonstration that miniaturised electronics on small chips can be launched without damage, survive the harsh environment of space and communicate successfully with Earth. The Starshot Initiative aims to launch similar chips attached to a lightweight sail



that can be pushed by a laser beam to a fifth of the speed of light, so that its camera, communication and navigation devices will reach the nearest planet outside the solar System within our generation".

The reason it could take an estimated 40 or more years – meaning Milner and many other key figures will see the end results if they're lucky enough to become centenarians (medical science is also progressing) – is because it could take 20 years for the final Breakthrough Starshot space probes to be completed, and a further 20 years for a successful flyby mission to the Alpha Centauri system.

The entire duration of the Initiative could command a budget of \$10 billion or more, and the project leaders have their antennae constantly open and engaged for potential investors and patrons.

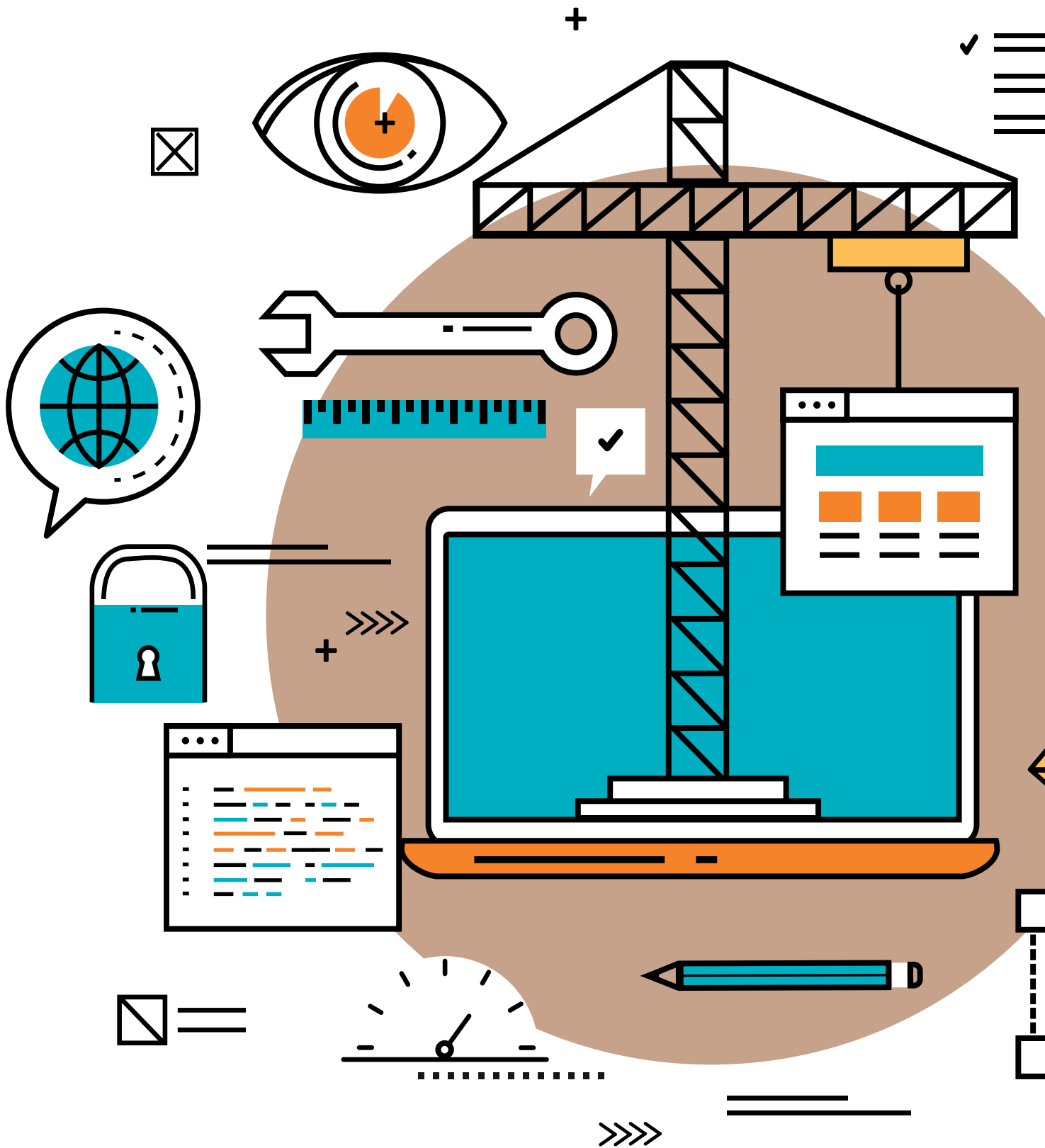
Dr Hawking says, "In an infinite universe, there must be other occurrences of life". As the technologies for propulsion and surveillance develop, the more plausible humanity's vision and eventual intergalactic presence becomes. Is extraterrestrial life out there? If so, maybe we will find it before it visits us here.

"Somewhere in the cosmos, perhaps, intelligent life may be watching these lights of ours, aware of what they mean. Or do our lights wander a lifeless cosmos?" Dr Hawking asks, adding finally, "There is no bigger question. It's time to commit to finding the answer – to search for life beyond Earth. The Breakthrough Initiative are making that commitment. We are alive. We are intelligent. We must know." †

Above: Zac Manchester invented the mini-satellites called "sprites".

Above left: The mini-satellites will be powered by laser arrays fired from Earth.

Opposite page: Dr Stephen Hawking is convinced life exists beyond Earth.



PAYING IT FORWARD

Sandoog Al Watan, or the National Fund, is committed to supporting the government's efforts at diversifying the UAE's economy and providing young Emiratis with opportunities.

The UAE's private sector, which has prospered thanks to the government's business-friendly economic policies over the past few decades, is paying it forward with a massive new initiative.

Never short on ambition, the UAE's blue-chip companies are funding a programme to nurture the next generation of innovative companies.

Sandoog Al Watan, or the National Fund, is a countrywide initiative, launched by prominent Emirati corporations and businessmen, to invest in the country's human capital and support entrepreneurship and innovation.

"Sandoog Al Watan comes as part of the commitment of the UAE's private sector towards social responsibility; and seeks to support the development of nation-building projects by participating in initiatives and adopting entrepreneurial and innovative ideas that contribute towards the comprehensive development of the nation," the company said on its website.

In June, the company unveiled the 'Our Future' initiative, aimed at developing new revenue streams for the UAE beyond the post-oil era by supporting Emirati start-ups and rearing them into world class global companies that will generate massive economic and social benefits for the country.

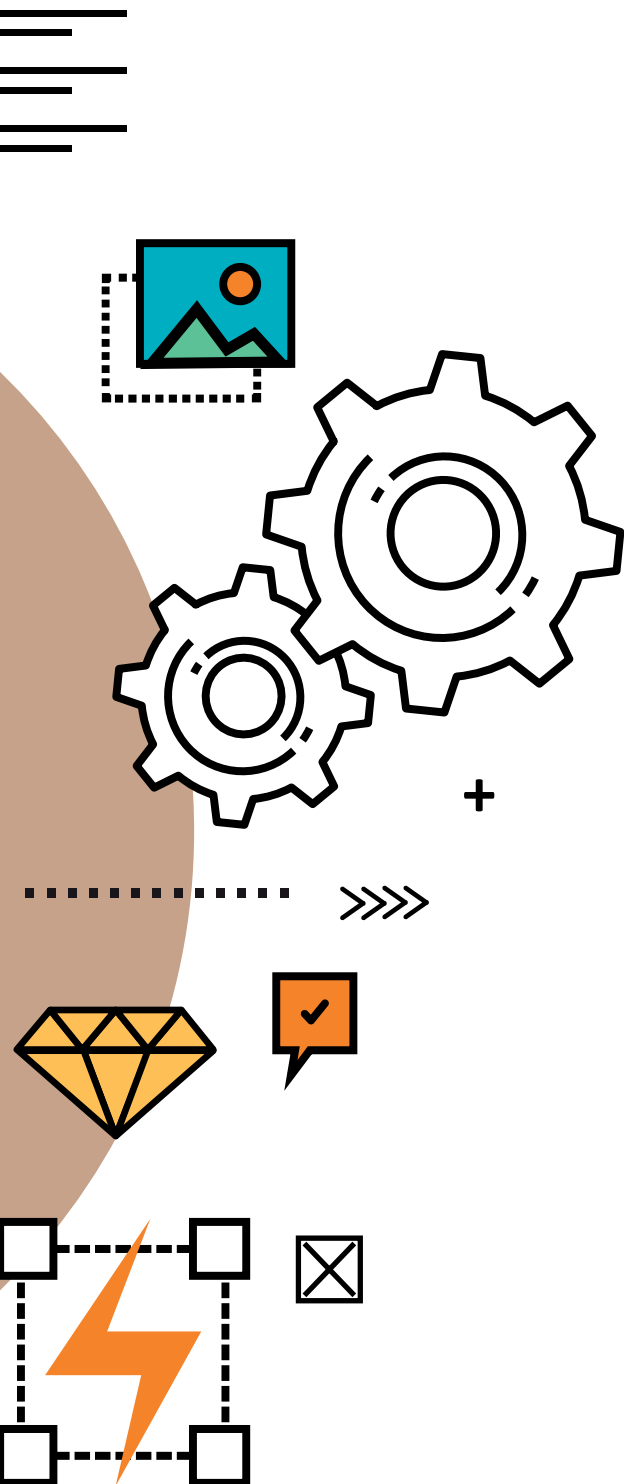
Based on a three-stage programme, the initiative has created an 'Early Fund' to support 20 key-sector start-ups by 2020.

"It is hoped that through this comprehensive three stage programme that brings together academia, industry and entrepreneurs, "Our Future" will help create the next Emirati Google or Tesla by 2071," the company said in a statement.

The response from the UAE's private sector stalwarts has been overwhelming, with prominent Emirati businessmen and corporates pledging funds of half a billion UAE dirhams to the project.

In early July, the company reported that it had raised more than AED548 million, exceeding half its target of AED1 billion for 2020. Fittingly, Emirati entrepreneurs, who themselves have benefitted from the UAE government's economic policies over the past few decades, led the way accounting for 62 per cent of all contributions. Eighteen UAE corporations made up the remaining 38 per cent to date.

Among the 29 individuals, HE Ahmed Juma Al Zaabi, Deputy Minister of Presidential Affairs and Chairman of the UAE President's Initiatives Committee, donated AED20 million, Sultan Bin Rashed Al-Dhaheri pledged AED12 million, Khalaf Ahmad Al Habtoor and Naji Hasan Al Harthi gave





Above: Sandoq Al Watan has the stated goal of discovering 5,000 talented Emiratis in the fields of science, arts and culture by 2020.

Above right: The world's first operational robot policeman joined Dubai Police this year.

AED10 million each, and Abdul Rahman Saeed Ghanim Al Ali with AED6 million — were the top five individual contributors.

Emaar Properties, the region's largest publicly-listed real estate company by market cap, led the corporate drive, pledging two per cent of its annual revenue for the next three years, or approximately AED85 million to AED90 million this year alone. Abu Dhabi's Aldar Properties pledged AED48 million, Union National Bank AED30 million, the Armed Forces Officers Club and Hotel AED25 million, while the Abu Dhabi Co-Operative Society and the International Golden Group have chipped in with AED20 million each.

R&D INITIATIVES

Research and development initiatives are often key to unlocking growth potential and sparking innovation in economies.

Economies at the cutting edge of innovation such as Switzerland, South Korea, United States and Japan have among the highest R&D budgets in the world, of between \$1400 to \$1800 per capita, according to the World Bank. Not surprisingly, these countries are home to some of the world's largest and enterprising companies such as The Swatch Group, Samsung Electronics Co. Ltd, Amazon Inc. and Softbank Group.

The UAE is currently ranked 76th in the world on R&D per capita basis, according to the World Intellectual Property Organization, with per capita allocation of \$470.7.

According to WIPO's 2016 survey, the UAE also ranked 42nd in trademark applications and 79th in



industrial design applications. Civil engineering patents were the most popular in the UAE, accounting for 8.5 per cent of the total, while computer technology patents made up just under seven per cent, engines, pumps and turbines six per cent, and other special machines five per cent.

While the UAE government has been at the forefront of development initiatives and launched a number of programmes to ignite growth, the private sector is now assuming the mantle and leading the innovation charge.

"Our Future signifies Sandoq Al Watan's commitment to support the government's efforts in diversifying our economy and to provide young Emiratis with the opportunity to pursue their ideas and shape the future," said Mohamed Tadjeddine Al Qadhi, Director-General of Sandoq Al Watan.

THREE PHASES

In its ambition to nurture 20 start-ups by 2020, the Early Fund will be rolled out in three phases: Ideation, Commercialisation and Growth.

The 'ideation' phase will zoom in on cultivating ideas and encouraging entrepreneurs to generate bold ideas and develop patents in key areas such as aviation, space, water and genetics. The fund has earmarked AED30 million on research in those key sectors over the next three years.

The 'commercialisation' phase will build on the developed ideas in Phase 1 and incubate start-ups at purpose-built innovation centres that will offer training, mentorship, working space and pre-seed funding. Abu Dhabi will be home to the first innovation centre in early 2018.

The final, 'growth' phase will connect start-ups to venture capitalists and industry experts to develop and grow the enterprise.



SANDOOQ'S GOALS

Sandooq's Our Future initiative is part of an overarching plan to develop an entrepreneurial ecosystem, and complements its broad mission of creating and developing the next wave of world-class UAE companies.

Sandooq's other goals include developing national talent in the fields of science, arts, and culture, with a stated goal of discovering 5,000 talented citizens by 2020.

The programme also aims to increase the graduation rate of students in the fields of science, technology and engineering by 10 per cent within the next three years. The efforts will help raise the average number of annual patent applications submitted by Emirati citizens to 50 applications.

Another goal is to achieve a "50 per cent success rate for projects invested in," according to the fund.

As the various pieces of the innovation puzzle come together, Sandooq aims to play a starring role in the country-wide effort to transform the UAE into one of the 20 most innovative countries in the world.

The private sector project dovetails with the UAE government's own innovation strategy that targets 30 national initiatives in the initial stage.

"These include new legislation, innovation incubators, investment in specialised skills, private sector incentives, international research partnerships and an innovation drive within government," according to the UAE Cabinet.

The National Strategy for Innovation has identified key sectors that will enable the country to reduce its dependence on crude oil revenues in line with the global move towards ecologically-friendly energy resources.

Not surprisingly, renewable energy is a key area of focus, as the UAE aims to be a regional leader in alternative energy developments, with a number of initiatives in solar, wind and nuclear energy.



Air and sea transportation apart from logistics remains a key UAE focus but the country is also among the handful working on hyperloop transportation technology that could potentially reduce travel times between Abu Dhabi and Dubai to 12 minutes.

Education has also been earmarked by the UAE authorities as the country's universities and schools gear up for an upgrade to meet the challenges of the fast-moving global economy. The health sector is also critical as the UAE aims to improve the health standards of the country's population and to emerge as an international medical tourism hub.

The UAE Cabinet has also identified water as another area of innovation as the UAE and other Gulf states rely heavily on desalination plants. Any major innovation that cuts water consumption would likely translate into millions of dollars of savings for the UAE economy.

Finally, technology and space are also target areas. The UAE has already set its sights on sending the world's first "Arab Islamic probe" to Mars by 2021. The unmanned probe is set to travel a distance of more than 60 kilometres for nine months and will be launched in July 2020 to coincide with the UAE's 50th anniversary in 2021.

The multitude of developments and the ecosystem of innovation being nurtured by the government in the targeted sectors should boost Sandooq's prospects of success.

It would also be a fitting way for the UAE's private sector who are, as the Sandooq vision states, "determined to give back to their blessed and prosperous nation." ﷻ

Above:
Hyperloop One is one of the innovative concepts partly funded by the UAE government.

Above left:
Sandooq Al Watan aims to increase students graduating in the fields of science, technology and engineering by 10 per cent.





DEFEATING ALLERGIES

A cure for allergies may be around the corner as a new study narrows down on the specific group of cells that cause allergic reactions.

Most often allergies occur when your immune system reacts to a foreign substance – such as pollen or pet dander – or to a food that could cause a reaction in some people.

“Seasonal allergies are a problem for millions worldwide and the UAE is no exception. The weather changes that occur cause allergens to spread and affect everyone,” said Dr Ishrat Nadeem, General Practitioner, iCARE Multi-Specialty Clinics.

Grass, trees, pollen and dust are some common triggers causing allergies among children and adults alike. While your immune system produces antibodies used to neutralise pathogens such as viruses and bacteria, it helps to identify allergens. However, when you come in contact with the allergen, your immune system’s reaction can inflame your skin, face, sinuses, airways and even your digestive system.

The severity of allergies varies from person to person and can range from minor irritation to anaphylaxis – a potentially life-threatening emergency.

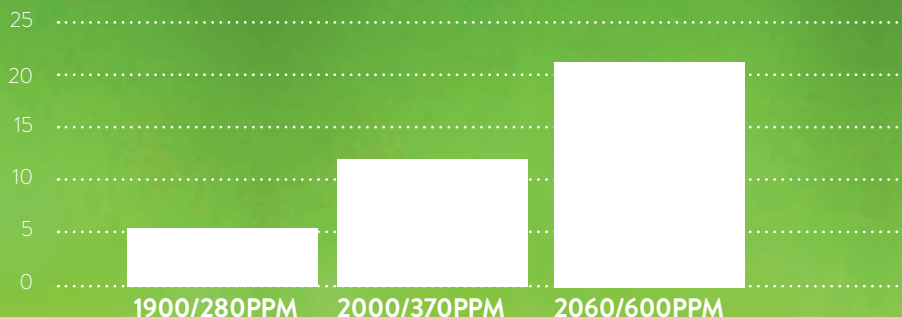
ALLERGIES ON THE RISE

Allergies are on the rise, and have increased dramatically in the past 60 years. The development of allergic disease relates to a complex interplay of genetic and environmental factors. However, since minimal genetic changes occur over a short period of time, such as the last two decades, it is assumed that environmental factors are most likely responsible for this trend.

The reunification of Germany offered tremendous insight into the impact of environmental changes on allergic conditions. These disorders were less common in East Germany than in West >

MORE CO₂=MORE POLLEN

POLLEN PRODUCTION



COMMON
FOOD
ALLERGENSGLUTEN AND
WHEAT

COW'S MILK



EGGS



PEANUTS

SOY
PRODUCTS

TREE NUTS



SEA FOODS

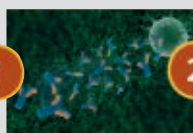


SHELL FISH

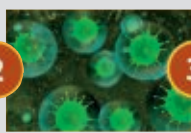
HOW POLLEN MAKES US SNEEZE AND WHEEZE



1 Pollen enters nose and lungs sensitising the immune system



2 Specific antibodies to the pollen are produced



3 Antibodies attach to mast cells found in tissues



4 Pollen enters the body again, attaches to antibodies causing histamine and other chemicals to be released from mast cells.



5 Allergic reaction is triggered resulting in runny eyes and nose, throat and nose itching, sneezing nose and sinus congestion and asthma

Germany before reunification, where as since that geopolitical change occurred, the prevalence of allergic problems (except asthma) has increased among children who spent their early childhood in East Germany.

According to the World Allergy Organisation, allergic diseases are affecting the lives of more than one billion people worldwide. With an epidemic rise during the last 60 years, their prevalence is expected to reach up to four billion in 2050. In the US, allergies affect as many as 30 per cent of adults and 40 per cent of children. Food allergies alone cost about \$25 billion annually in the US. Due to the immense numbers of affected individuals, the general public confronts huge direct and indirect costs with major effects on economics due to health-care, loss of productivity and absenteeism of patients. Unfortunately, high number of unmet needs due to missing scientific knowledge in disease mechanisms, prevention, patient care, and social determinants remain to be resolved.

Asthma is one of the most common allergies. Worldwide, it is estimated that nowadays more than 300 million people have asthma, a figure that is expected to rise by 100 million asthma patients by 2025. The worldwide number of asthma deaths is about 250,000 per year, with a wide variation between continents, regions, age and economic groups. According to the World Health Organization, the world total asthma costs probably exceeded those of tuberculosis and HIV/AIDS combined.

A POTENTIAL CURE

There are still many gaps in our scientific knowledge of asthma. However, it seems scientists at Washington's Benaroya Research Institute have discovered a potential cure for allergies. T cell biologist Erik Wambre and immunologist William Kwok have been researching allergies and are now able to pinpoint the specific group of cells that cause them. This could help determine not only why some people have allergies, but also how to block them.

An allergic reaction happens when our immune cells react to benign substances such as pollen, mould spores and certain foods. These substances activate the body's TH2 cells triggering reactions such as sniffing, wheezing, itching and soreness amongst others. It is worth remembering that not all TH2 cells are guilty. Some guard us against parasites and other invaders. However in allergic patients, the TH2 cells carry receptors or proteins that match allergen's molecules and 'marker' proteins.

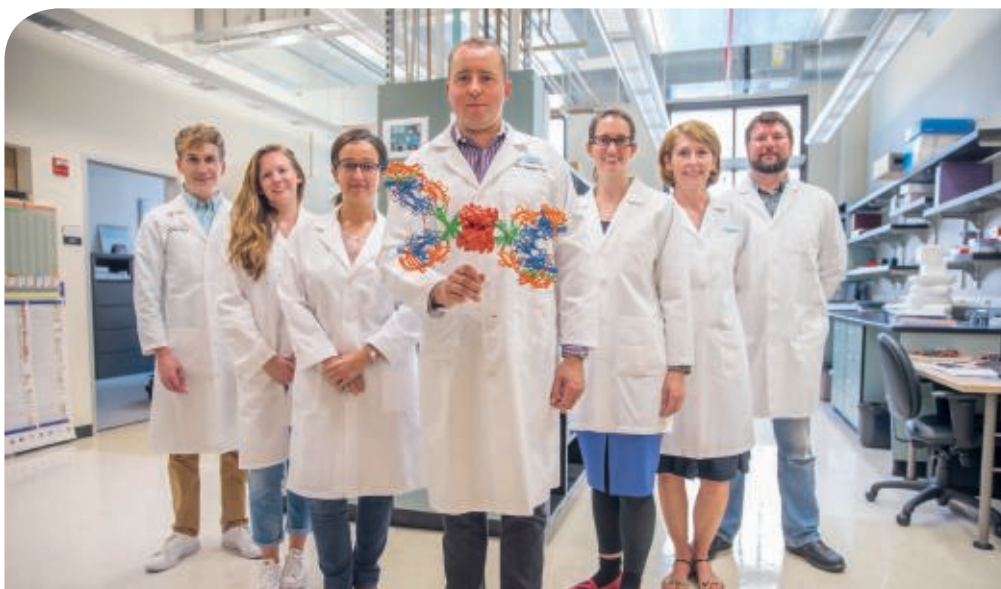
Until now, sorting the beneficial TH2 cells from the rogues has been science's biggest challenge. Results of the new research suggest that the problem may now have been overcome.

For their study, Wambre and Kwok obtained blood samples of patients who were sensitive to pollen from alder trees. Then they added MHCII tetramers or customised fluorescent proteins to the samples to tag the immune cells carrying the receptors for the alder pollen. Further, the duo analysed the tagged cells to determine their combination of markers. One group of TH2 cells sported more copies of two marker proteins and fewer copies of four others compared with other groups of TH2 cells. Although none of the proteins was exclusive to the cells, together they provided a signature for this clique of TH2 cells, which the researchers dubbed TH2A cells. T cells are capable of shifting identities but the TH2A cells were found to be pathogenic and remained that way even after several cellular generations.

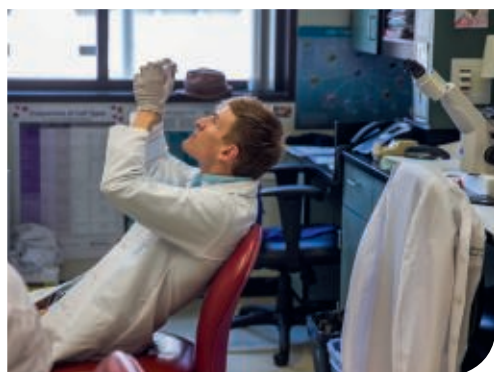
The researchers found that TH2A cells were abundant in the blood of patients with allergies but were absent from the blood of people who weren't allergic.

DID YOU KNOW....

Allergies are the 6th leading cause of chronic illness in the US with an annual cost in excess of \$18 billion. More than 50 million Americans suffer from allergies each year.



Left: Eric Wambre and the team that made an important allergy breakthrough.



The team also tested patients undergoing an experimental treatment called oral immunotherapy – therapy that attempts to quell patients’ allergies with edible doses of food allergens – to alleviate their peanut allergies. Over a period of 20 weeks, the participants were administered increasing doses of allergy-inducing peanut proteins. The researchers reported a dramatic decrease in TH2A cells after the treatment. The number of cells that reacted to peanuts fell by about 90 per cent increasing the patient’s tolerance for peanuts. Kwok says that the evidence he and his colleagues have accumulated suggests that “people with allergies make this specific subset of T cells that probably lead to allergic symptoms.”

Identifying the cells responsible has been tough because there are so few of them, Wambre explained. A millilitre sample of blood can contain more than a million white blood cells, but only a handful fall into the “bad” category. Finding them is like trying to locate an individual among the nearly 700,000 people in Seattle, he said.

Immunologists believe these discoveries could help formulate new treatments and better ways to manage allergies. For instance, scientists can now accurately assess oral immunotherapy trials by tracking which treatments were effective in eliminating TH2A cells. The study will also help them determine what molecular signals drive T cells to convert into TH2A cells. If this is achieved, the very formation of the cells can be prevented, thereby nipping any allergies in the bud.

“I’m pretty optimistic,” Wambre said. “My hope is that we might find a drug that will specifically destroy the (bad) cells, or at least stop them.” ↑



WHAT IS AN ALLERGY?

- The term “Allergy” was first coined on July 24, 1906 as “specifically altered reactivity of the organism.”
- Today, we define allergy as an immunologically-mediated and allergen-specific hypersensitivity.
- Allergies can be seen in almost every organ, most commonly in the skin and the mucous membranes.
- Allergology is the science regarding allergic diseases and their differential diagnoses and mechanisms.

AN ACCIDENTAL FUTURE

An unintentional discovery at an Army Lab in America could revive the possibility for the safe and sustainable use of hydrogen as a clean renewable energy source.

Hydrogen is one of the most abundant elements on Earth – it is a practically unlimited resource. This makes it one of the best possible candidates for clean, green energy and a welcome antidote to fossil fuels.

An engine that uses hydrogen as fuel produces almost no pollution, the only “waste” is water. Hydrogen is also incredibly high in energy, which is why NASA used liquid hydrogen to propel the space shuttle and other rockets into orbit in the 1970s – the crew drank the pure water that was the only by-product. Hydrogen fuel cells also powered the electrical systems that the astronauts depended on.

Yet the cutting-edge application of hydrogen as a highly efficient and non-polluting energy source has not seen such great heights since. The hopes for a truly environmentally-friendly source of energy got off the ground, but fizzled out.

At the turn of the century, “The Hydrogen Economy” was a much-touted prospect that would deliver the world from reliance on the hydrocarbons that contribute to climate change. Iceland set out to be an exemplar to the rest of the world and embarked upon a scientific and engineering quest to achieve a hydrogen energy economy. The ever-progressive state of California, with Arnold Schwarzenegger as governor, promised a “hydrogen highway” with 200 hydrogen filling stations by 2010.

Today, there are no more than a sprinkling of filling stations in the USA and Iceland’s grand aspirations are embodied by three hydrogen-powered buses that trundled

around Reykjavík for a few years before being consigned to the museum and the dust-bin. No great hydrogen industry materialized.

Hydrogen was supposed to transform the entire energy infrastructure but its effective use as an affordable energy source has always been fraught with numerous problems that have hindered and halted its development into a clean, safe and efficient fuel for the future.

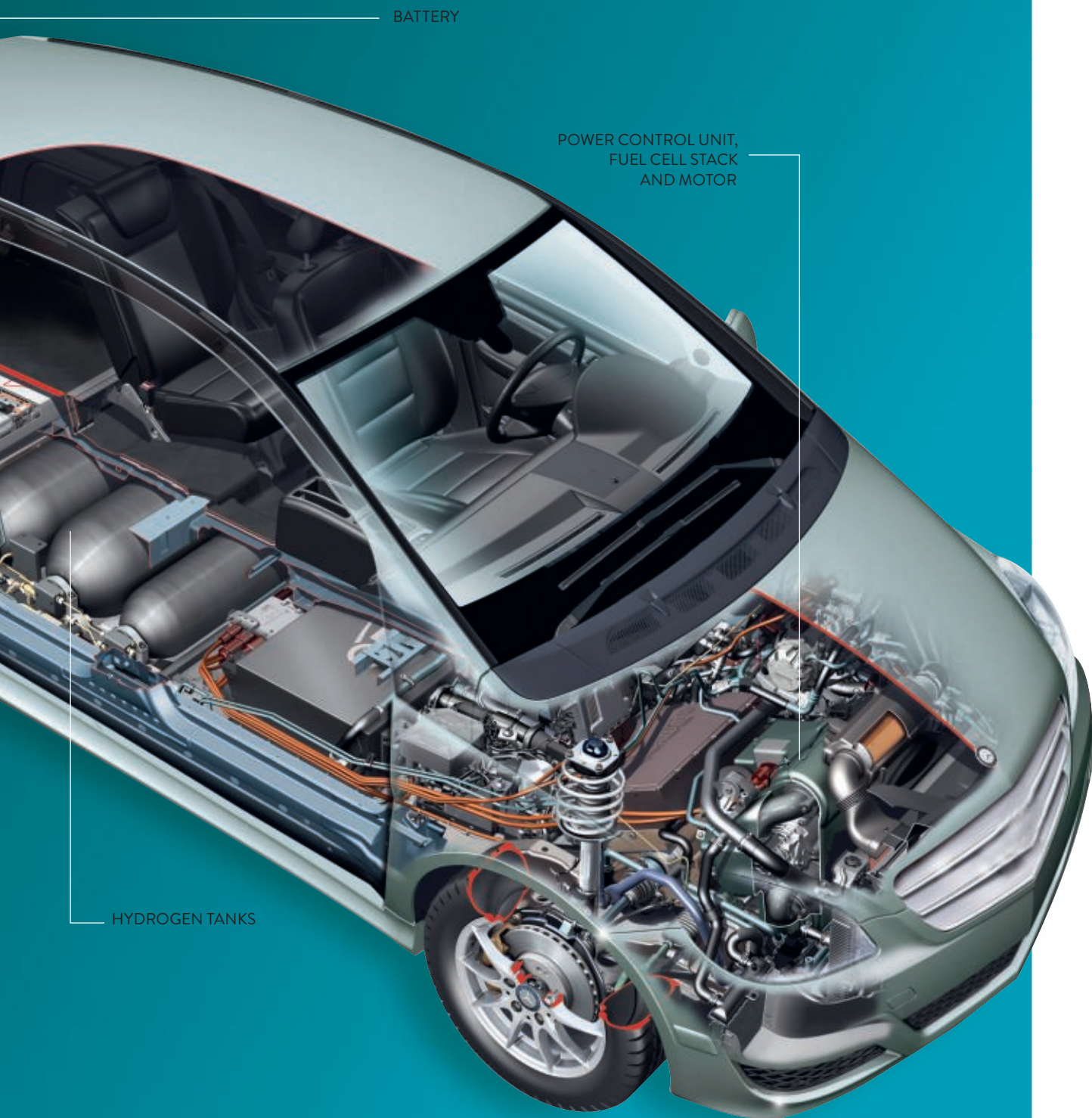
Storage is a significant problem as it is a voluminous gas and requires intense compression or liquification at extremely low temperatures. This pressurisation is both costly and inherently volatile, being susceptible to impact and other potential dangers of transportation. Despite being the most plentiful element in the universe, hydrogen is rarely found in its pure form and it must be extracted from other substances that contain it, for example hydrocarbons or water. Extraction processes, such as hydrolysis for water, can be costly, and with hydrocarbons a catalyst is required, often platinum, and this too can be prohibitively expensive.

A time-worn joke about hydrogen within the energy sector goes, “It’s the fuel of the future... and always will be”.

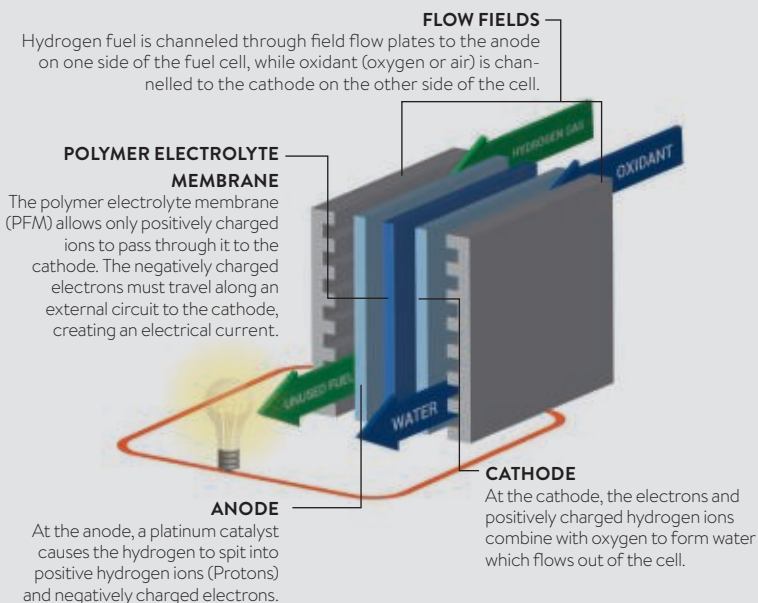
OR WILL IT? THINGS JUST CHANGED.

In July 2017, an announcement was made by The US ➤





HOW DO HYDROGEN FUEL CELLS WORK?



Above middle:

The Honda Clarity has the longest range of any zero-emission vehicle.

Below: Scott Grendahl, from the US Army Research Laboratory, led the team that discovered the hydrogen-creating reaction.



Army Research Laboratory that sent waves of interest around the world, once again reviving the hopes of unlocking the limitless possibilities of clean hydrogen. Army scientists and engineers at the Army Research Laboratory at Aberdeen Proving Ground, Maryland, made a discovery... albeit by happy accident.

During routine materials experimentation, the team noted a bubbling reaction when adding water to a nano-galvanic aluminium-based powder. This aluminium nanomaterial, designed at the lab, produces high amounts of energy when it comes in contact with water, or any liquid containing water. This sparked the idea of a simple “just add water” applicability for energy creation.

Scott Grendahl, a materials engineer and the team leader at the lab says, “The hydrogen that is given off can be used as a fuel in a fuel cell”.

A fuel cell combines hydrogen and oxygen to produce electricity, heat and water. Fuel cells are often compared to batteries as they both convert the energy produced by a chemical reaction into usable electric power. However, the fuel cell will produce electricity as long as hydrogen is supplied, never losing its charge. This makes hydrogen fuel cells a very promising technology for heating and electricity supplied to cities and in finally replacing the centuries-old internal combustion engine with an electrical power train for cars, buses and whole fleets of vehicles.

“What we discovered is a mechanism for a rapid and spontaneous hydrolysis of water,” Grendahl added. His colleague Dr Anit Giri, a physicist with the lab’s Weapons and Materials Research Directorate, says, “We just

take our material, put it in the water and the water splits down into hydrogen and oxygen”.

Clearly excited by the serendipitous discovery and mindful of its potential, Giri adds, “It does not need a catalyst... also, it is very fast. For example, we have calculated that one kilogram of aluminium powder can produce 220 kilowatts of energy in just three minutes”. That’s a considerable amount of power to run electrical equipment and these rates are by far the fastest ever recorded without using catalysts.

With an understandable air of triumph, Grendahl states, “There are other researchers who have been searching their whole lives and their optimized product takes many hours to achieve, say 50 per cent efficiency. Ours does it to nearly 100 per cent efficiency in less than three minutes”.

The team demonstrated the dramatic discovery by adding a small amount of water to their powder. The subsequent reaction created enough hydrogen to power a radio-controlled model – a mini-tank – around the laboratory. Naturally, the team is focused on militaristic application. Such as improving the technology for use by future soldiers on reconnaissance missions.

“These teams are out for a short number of days, three to five days, and a lot of that depends not only on their food supplies, but on how long their supplies last in terms of their equipment and right now that stems from lithium batteries. If we can recharge those batteries, they can stay out longer”, Grendahl explains.

However, if the new discovery can power a miniature tank then there is obvious hope that the happy



accident can be harnessed to revolutionise the automotive sector. Hydrogen fuel cell technology has been a growing concern in the automotive industry and many manufacturers have invested in developing hydrogen powered fuel cell electric vehicles (FCEVs). General Motors has spent over \$1 billion to date and as of October 2016, the manufacturing giant had hit 3.1 million miles of hydrogen fuel cell testing.

Honda is also a market leader for this technology and the newly launched Honda Clarity car, available to lease in 2017, has an estimated range of 366 miles, the longest range of any zero-emissions vehicle. At the start of the year the two automakers announced a collaboration, investing \$85 million to begin mass producing hydrogen fuel cells in 2020.

Speaking at a press conference in June, Dan Nicholson, GM's vice president of global propulsion systems, said, "They are not a science project anymore, they are a mainstream alternative energy source". GM and Honda stated they are sharing intellectual property to create a "more affordable commercial solution" for fuel cell and hydrogen storage technology. BMW, Audi and Mercedes Benz are also developing hydrogen fuel cell models.

Serial entrepreneur and inventor Elon Musk has derided hydrogen fuel cell cars in the past claiming that the very best hydrogen technology doesn't match the energy density of a modern lithium-ion battery pack. However, Musk may not be prone to impartiality on the subject, given he has a vested interest in his Tesla battery powered electric vehicles.

The "just add water" discovery made in Maryland



may well change the landscape for the plausibility of FCEVs, which outperform electric vehicles by approximately three times the range and boast shorter re-fuel times, which will aid consumer acceptance. Until now, the main drawback has been the complexity and expense of producing hydrogen, and accordingly, the acute lack of hydrogen stations to support early adoption and beyond.

Evolution in the energy sector is on the horizon and the discovery made by the American Army team, which is now focused on producing scholarly papers and securing intellectual property protections, may prove to be crucial.

The changes to the transport and heavy industry sectors could be huge. Taking as an example the mining industry in Chile – the sector uses 1.8 million cubic metres of diesel fuel annually, 90 per cent of which is used for transport within the mines. This creates emissions of between five and six million tonnes of CO₂ equivalent per year. Effective implementation of fleets of hydrogen fuel cell trucks could help Chile slash its CO₂ emissions by 2030, which the Chilean President Michelle Bachelet committed to in April this year when she signed the Paris Agreement.

The first Chilean hydrogen conference was held in May in Santiago de Chile and over 150 experts from 15 countries and more than 80 different companies and institutions discussed the newest developments in producing hydrogen with renewable energy sources. Markus Böhm, a specialist for hydrogen production plants at Siemens, offered real hope for hydrogen becoming one of the most important energy sources of the next century, saying, "Hydrogen is rightfully named the fuel of the future not only because it is produced using renewable energies, but also because using hydrogen is sustainable and environmentally sound".

Above: The US Army team powered a toy tank with nano-galvanic aluminum-based powder and water.

Above left: Hydrogen fuel cell vehicles are quicker to refuel and have a greater range than electric cars.

THE SECOND INDUSTRIAL REVOLUTION

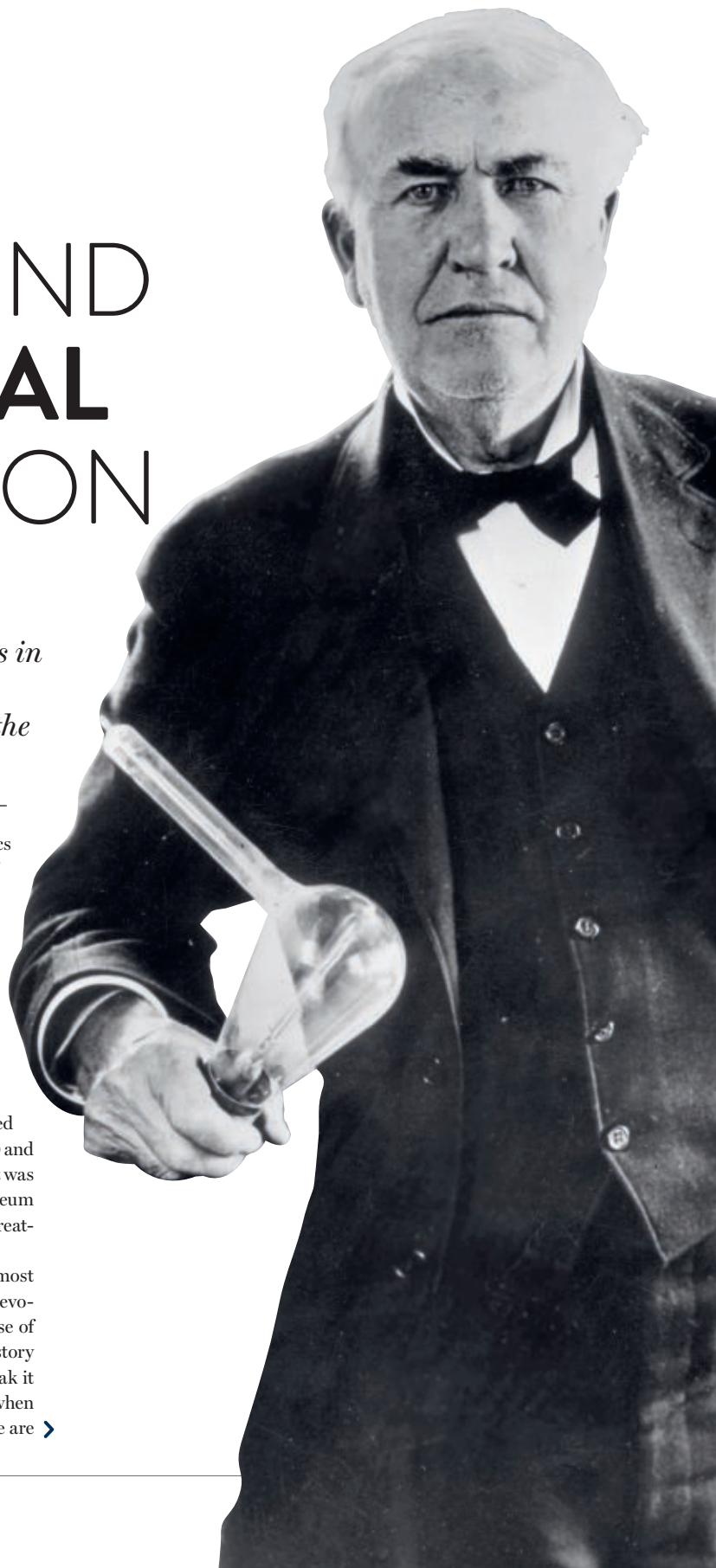
Electricity, fossil fuels, breakthroughs in communication, railroads spanning nations and mass production led to the modern age we are familiar with.

In 1969, David Landes, an American professor of economics and history at Harvard University, published *The Unbound Prometheus*, an influential book on economic history. A pre-eminent work on industrialisation in Western Europe, it is perhaps best known for standardising the idea of a Second Industrial Revolution.

Prior to publication of *The Unbound Prometheus* very few scholars drew such a distinction. The Industrial Revolution was the Industrial Revolution, with demarcation between different chapters within that revolution only perhaps recognised as concepts rather than an actuality.

Now, the belief that a Second Industrial Revolution occurred is almost universally accepted, with it beginning around 1870 and running until the beginning of the First World War in 1914. It was characterised by the expansion of electricity, the use of petroleum and the production of steel, with railroads and steam ships creating a globally integrated economy.

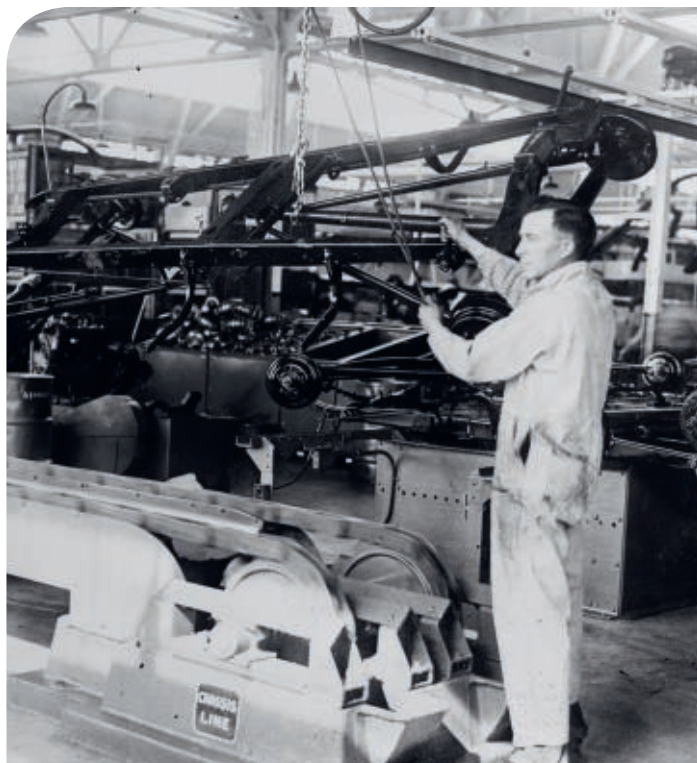
“Historians interpret the Industrial Revolution as the most significant event in human history since the Neolithic Revolution (the domestication of plants and animals and the rise of civilisation),” says James Lockhart, assistant professor of history at the American University in Dubai. “They sometimes break it down into parts (first, second, third etc) to better manage it when studying and/or teaching it. It is an unfinished event that we are >



Left: Thomas Edison counted the lightbulb among his many inventions.

Below: Railroads and steam ships enabled global trade, and opened up the United States interior.





Above: Mass manufacturing using assembly lines was pioneered by Henry Ford.

Above right: Nikola Tesla made many contributions to the design of modern alternating current electricity systems.



with the widespread adoption of preexisting technologies leading to change on a far greater scale.

All of this was made possible by earlier inventions, as Robert C. Allen, a globally distinguished professor of economic history at New York University Abu Dhabi, wrote in *The British Industrial Revolution in Global Perspective*.

“Machinery production was the basis of three developments that were the immediate explanations of the continuation of economic growth until the First World War,” wrote Allen. “Those developments were: (1) the general mechanisation of industry, (2) the railroad, (3) steam powered, iron ships. The first raised productivity in the British economy itself; the second and third created the global economy and the international division of labour that were responsible for significant rises in living standards across Europe.”

The Second Industrial Revolution impacted far more nations. Not only Britain, but much of Western Europe, including Germany and France, the United States and Japan, and key to it all were electricity, petroleum and steel.

“Basically, they [electricity, petroleum and steel] served urbanisation and transportation needs, from skyscrapers to telegraphs, trolleys, and railroads,” says Lockhart. “Americans were branching out and moving around much faster in these years. The meatpacking industry that was growing in Chicago needed things like refrigerated railcars to move their product to faraway cities. It all worked in support of urbanisation and transportation.

“Railroads were central to industrialisation in the US and Britain. They connected people, ports and markets internally, and they paved the way for economic growth and development. The US government assisted this by granting land to railroad companies

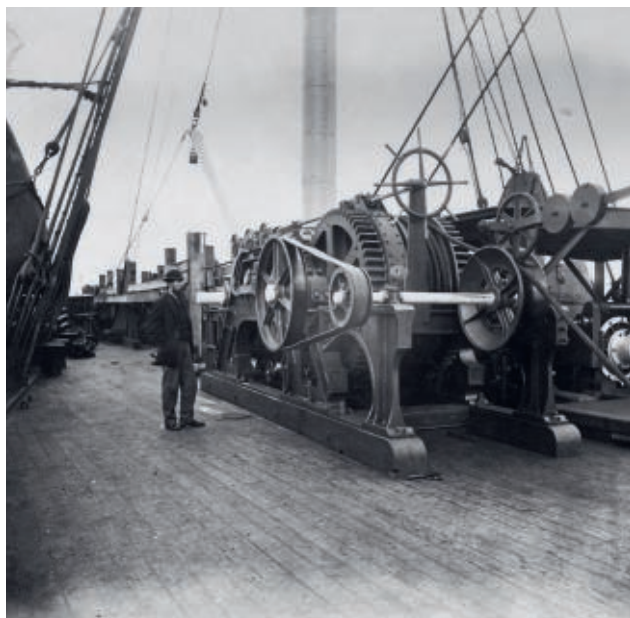
still trying to understand, politically, economically, socially, and environmentally. It continues to change all of us at a staggering pace.

“The First Industrial Revolution usually refers to that which occurred in textiles and manufacturing in Britain, when British firms began turning to machines, which became textile mills, to produce clothes in the late 18th and early 19th centuries. It was the initial turn from human, animal, and wind power to machines.

“The second usually refers to the introduction of higher-tech machines, factory-line production, interchangeable parts, and mass consumption. It also includes the rise of cities, urban life, and modernity as we understand it today. This occurred in the late 19th and early 20th centuries. It also marks humanity’s shift to fossil fuels for energy and the rise of big business and corporations, starting with railroads, then steel corporations, in the US.”

The First Industrial Revolution had effectively changed the face of Britain (and the countries that later embraced it), transforming a nation of farmers and rural craftsmen into a country of factory hands, with new machines revolutionising the wool and cotton industries and leading to rapid urbanisation.

The second was a sustained period of growth and innovation that enabled globalisation. Cars, planes, telephones, electricity; many of the recognisable components of the modern age emerged during this period,

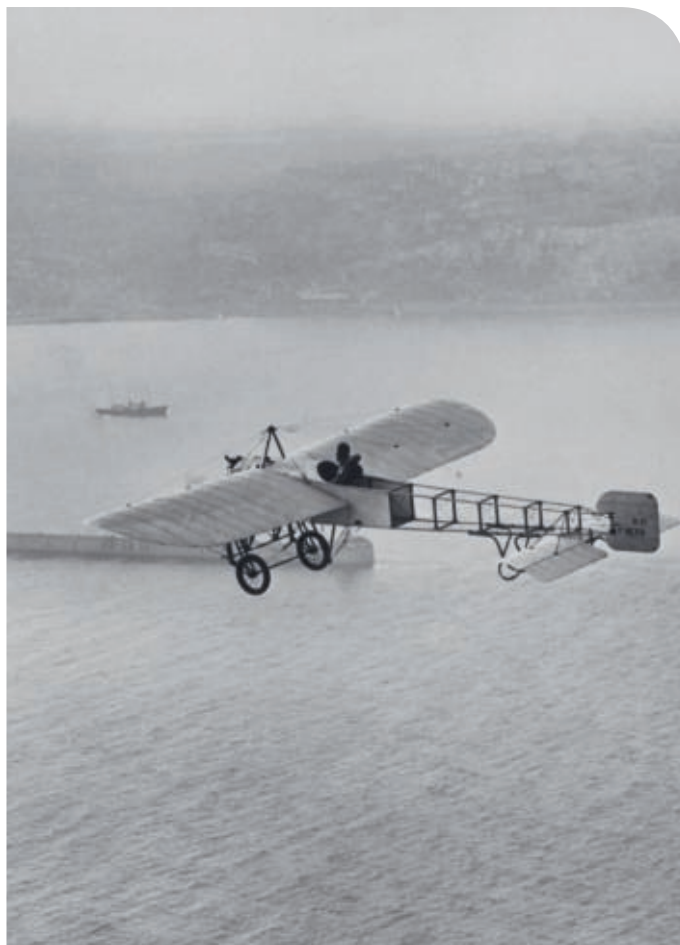


“Machinery production was the basis of three developments that were the immediate explanations of the continuation of economic growth until the First World War”

in exchange for their investing capital in laying track all over the country.”

The importance of the railways cannot be overstated. Writing in *Railroaded*, published in 2011, Richard White observed that: “If a Western Rip Van Winkle had fallen asleep in 1869 and awakened in 1896, he would not have recognised the lands that the railroads had touched. Bison had yielded to cattle; mountains had been blasted and bored. Great swaths of land that had once whispered grass now screamed corn and wheat. Nation-states had conquered Indian peoples. Population had increased across much of this vast region, and there were growing cities along its edges. A land that had once run largely north-south now ran east-west. Each change could have been traced back to the railroads.”

Great industrialists emerged. Men like Henry Ford, who championed the assembly line, and inventors such as Orville and Wilbur Wright, who made the first successful powered flight. The expansion of the telegraph



and the invention of the telephone enabled quicker and more efficient communication, while electricity brought power and light to ever increasing corners of the globe. All of which impacted society at large.

“There were rags-to-riches stories in this era,” says Lockhart. “Some believed that it was a wondrous era of innovation and that you could pull yourself up by your bootstraps if only you made good decisions and worked hard enough. Others, like those who still follow Karl Marx, faulted a rigged system that forced those who were doing better before – craftsmen, for example – into an impoverished working class and a socioeconomic dead end.”

“Reformers emerged in Germany, Britain and the US (they called themselves Progressives in America) who succeeded in passing legislation that mitigated industrialisation’s worst effects, such as child labour, workplace injuries, and corrupt municipal government.

“Society at large has been in a state of constant and rapidly increasing change since then, and it’s still not over yet. The Cold War, for example, partly occurred because of these changes and disagreements over

Above: French aviator Louis Bleriot was the first person to fly across the English Channel.

Above left: The laying of telegraph lines across the Atlantic made international communication possible.



Above: The completion of the transcontinental railway decreased the travel time between the US East and West coasts from six months to a week.

how to deal with them. Some would say things are getting better, some would say they're getting worse, and others, like me, might say we don't have sufficient perspective to really say."

What is clear, however, is that those nations who lived the Second Industrial Revolution profited greatly, despite the effects on society and the sometimes ruthless nature of capitalism.

During a speech at the Commonwealth Club of San Francisco in September 1932, Franklin D Roosevelt (soon to be president of the US) recognised this fact. "It was in the middle of the 19th century that a new force was released and a new dream created," he said. "The force was what is called the industrial revolution, the advance of steam and machinery and the rise of the forerunners of the modern industrial plant.

"The dream was the dream of an economic machine, able to raise the standard of living for everyone; to bring luxury within the reach of the humblest; to annihilate distance by steam power and later by electricity, and to release everyone from the drudgery of the heaviest manual toil. It was to be expected that this would necessarily affect government. Heretofore, government had merely been called upon to produce conditions within which people could live happily, labour peacefully, and rest secure. Now it was called upon to aid in the consummation of this new dream. There was, however, a shadow over the dream. To be made real,

it required use of the talents of men of tremendous will and tremendous ambition, since by no other force could the problems of financing and engineering and new developments be brought to a consummation.

"So manifest were the advantages of the machine age, however, that the United States fearlessly, cheerfully, and, I think, rightly, accepted the bitter with the sweet. It was thought that no price was too high to pay for the advantages, which we could draw from a finished industrial system. This history of the last half century is accordingly in large measure a history of a group of financial Titans, whose methods were not scrutinised with too much care, and who were honoured in proportion as they produced the results, irrespective of the means they used. The financiers who pushed the railroads to the Pacific were always ruthless, often wasteful, and frequently corrupt; but they did build railroads, and we have them today. It has been estimated that the American investor paid for the American railway system more than three times over in the process; but despite this fact the net advantage was to the United States."

Lockhart agrees. "The countries that experienced this revolution – in Western Europe, the US and Japan – became not only economically powerful, but the great powers of world affairs in the 20th century and beyond," he says. "They remain among the most advanced nations today. Most others are trying to catch up." †



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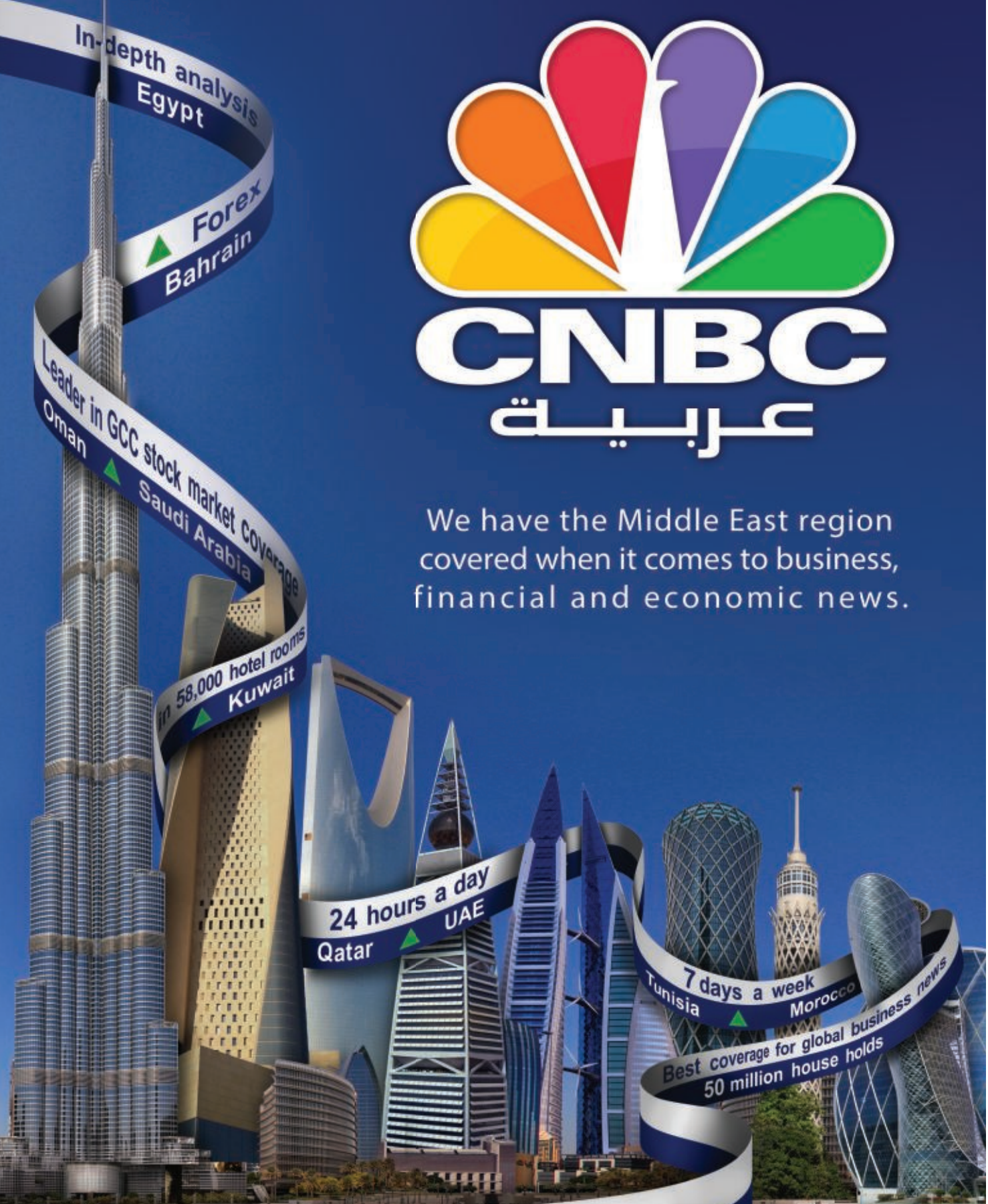
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