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LONDON

WHAT WILL THE SMART HOME OF THE FUTURE LOOK LIKE IN 2030?

NOVEMBER 2017

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FOREWORD

Back in 2007, the technology landscape looked very different. The first iPhones were rolling off the shelves, HD-DVD and Bluray were fighting it out for supremacy and Facebook had only just become more popular than MySpace.

A decade on, the progress of consumer technology has been rapid. Artificial intelligence (AI), voice recognition and virtual reality (VR) – areas that once only interested academics, sci-fi writers and tech geeks – have become household terms. Technology continues to usher in huge changes to our lives, transforming the way we interact with everything around us.

Forward-looking predictions about where we are headed next pose a significant challenge, as there are simply too many unknown variables that could disrupt our current outlook. Yet many technological innovations today are still in their infancy, allowing us to predict with some confidence some of the seismic shifts that we can expect in our domestic lives over the coming decades.

OVERVIEW:
WHAT SORT OF WORLD WILL WE LIVE IN BY 2030?

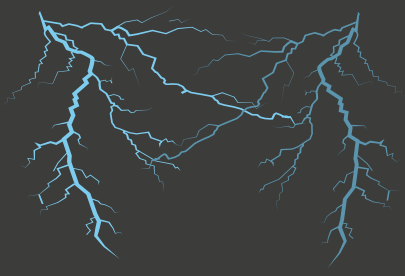
If we fail to tackle climate change in a meaningful way, then serious environmental shifts will already be obvious by 2030. Extreme weather events and less arable land could lead to crop yields reducing by up to 5% globally[1]. At the same time, the world's population is expected to rise to 8.5 billion[2].

Urban spaces need to be planned more intelligently to accommodate an anticipated population boom. Information from an incredible amount of smart IoT devices[3] would give cities the tools they need to provide effective management of transportation and critical infrastructure as well as enabling efficient energy distribution. Many more people will work from home at least some of the time[4], while electric car technology will be making serious inroads into the automotive market[5].

As our population increases, the average age will soar. People aged 65 and over currently form the fastest-growing age group in the UK, and this will grow by almost 60% in the next 20 years[6]. This will impact health and social care provision and force us to develop more innovative approaches to the way that we care for others. Technology will be expected to play a large role in enabling people to live healthier, happier lives into advanced age.

It's assumed that most of the housing that will exist in 2050 has already been built[7]. This means that, outwardly, our urban landscapes will look broadly similar to the way they do today. The big changes, however, will occur inside our properties, with new technology making our homes more energy efficient, more secure and more relaxing places to spend time in.

URBAN SPACES NEED TO BE PLANNED MORE INTELLIGENTLY TO ACCOMMODATE AN ANTICIPATED POPULATION BOOM.

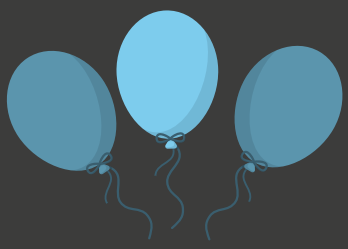


EXTREME WEATHER COULD REDUCE CROP YIELDS BY UP TO 5–10% BY THE 2030S.

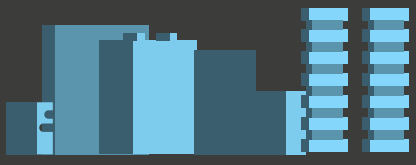
THE GLOBAL POPULATION IS EXPECTED TO REACH 8.5 BILLION BY 2030.

BETWEEN 20–30 BILLION CONNECTED DEVICES ARE FORECAST TO EXIST BY 2020.

HALF OF THE GLOBAL WORKFORCE IS LIKELY TO BE WORKING FROM HOME SOME OF THE TIME.



PEOPLE AGED 65 & OVER WILL BECOME THE FASTEST GROWING AGE GROUP.



MOST OF THE HOUSING STOCK FOR 2050 HAS ALREADY BEEN BUILT.

ARTIFICIAL INTELLIGENCE IN THE HOME

It is hard to imagine a scenario in which artificial intelligence won't play a significant role in our daily lives[8]. As the ability to collect and process data based on sensors, natural language and audio-video sources improves, so the pool of knowledge that informs artificially intelligent systems decisions will increase.

With an increasing amount of useful data, predictive algorithms, inference engines and deep learning networks will help smart home technology to contextualise its surroundings. Facial and voice recognition could immediately recognise various members of the household and provide informed responses to open-ended questions, as well as alter settings and trigger systems to create an ideal living environment without the need for any human interaction.

While limited artificial intelligence is already present in our homes – thanks to smart speakers from Amazon, Google, Apple and more – the social, legal and ethical questions that a fully AI-enabled home raises have yet to be meaningfully tackled. As such systems would be capable of making independent decisions on the behalf of a homeowner, scientific, technological and government bodies will need to create frameworks so this field develops in a responsible way that keeps systems secure and occupiers safe.

While suggesting that 'Domesday scenarios [for AI] are overstated and highly unlikely', Harvard Professor Barbara Grosz, chair of the AI100 Standing Committee, believes that the future development of artificial intelligence will see such systems being designed to work collaboratively with human partners[9]:

"Much of the science-fiction narrative […] are stories that are meant to replicate human intelligence. You might ask why would we want to do that? We know how to replicate human intelligence; we also know there are many limitations to human intelligence. So I think it's much more productive to think about AI and the systems it develops as complementing human intelligence."

THE SOCIAL, LEGAL AND ETHICAL QUESTIONS THAT A FULLY AI-ENABLED HOME RAISES HAVE YET TO BE MEANINGFULLY TACKLED.

ENERGY EFFICIENCY

The UK targets an 80% reduction in CO2 emissions by 2050[10] and the Europe-wide goal for is a 20% share of renewable energy sources by 2020[11]. We need to make major changes to our infrastructure and energy distribution networks if we are to meet these ambitions. What's more, the first concrete steps towards this will need to be taken sooner rather than later.

The obvious solution is for our homes to become integrated into the fabric of the city as part of a 'smart grid'[12]. Features such as smart appliances, smart meters and localised storage could be used to keep our energy waste to a minimum.

More sophisticated smart home platforms will make managing a property more intuitive. Natural interfaces such as voice and gesture control will come to the fore[13], at the expense of touchscreens, switches and mobile apps.

Sophisticated whole-house integration is already possible, although it largely remains a premium service for an affluent clientele. This will change; by 2030, smart home technology will have become a standard feature in houses, becoming as critical as plumbing, lighting, windows and doors. Technology-focused new builds will create homes that are both extremely environmentally friendly and more resistant to environmental threats such as floods and fires.

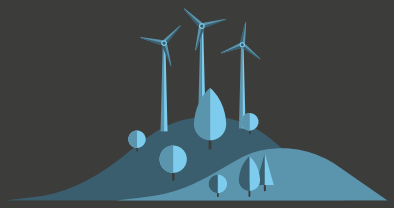
The shift towards mass adoption of smart home and smart city infrastructure will be uneven, skewed towards larger cities in certain parts of the world. Predictions suggest that of the 88 smart cities around the world by 2025[14], the majority will be located in Europe and Asia.

"While there is currently a significant divide between the capabilities of a mass-market DIY smart home system and whole-house integration, this will blur over time as the technology becomes more affordable for a wider segment of society. The smart home will go from being a prestigious addition to a home to becoming a must-have on a par with a television or an internet connection."

– Krystian Zajac, Chairman at Andrew Lucas

BY 2030, SMART HOME TECHNOLOGY WILL HAVE BECOME A STANDARD FEATURE IN HOUSES

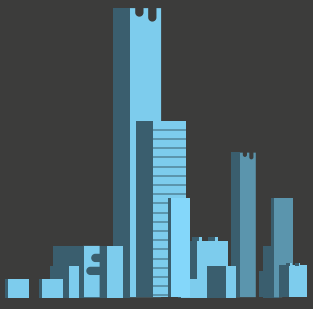
THE UNITED KINGDOM AIMS
TO CUT ITS CO2 EMISSIONS
BY 80% BY 2050.



THE EUROPEAN UNION'S
AMBITION IS TO HAVE
20% OF ALL ENERGY
TO BE RENEWABLE IN 2020.

BY 2030,
SMART HOME TECHNOLOGY
WILL BECOME WIDESPREAD.

NATURAL USER INTERFACES
LIKE VOICE CONTROL
WILL BECOME INCREASINGLY
PREVALENT.



THERE WILL BE
88 SMART CITIES
IN EXISTENCE BY 2025.

MOST NEW SMART CITIES WILL
BE LOCATED IN
EUROPE AND ASIA.

ADAPTABLE HOMES

Many high end smart homes already incorporate a lot of hidden technology; this is likely to be an ordinary feature in homes come 2030. Increased automation and more intuitive human interaction will mean most smart home technology can operate unseen in the background. As Jonny Voon, Innovation Lead for IoT and Distributed Ledger at Innovate UK, believes:

"Truly successful IoT becomes invisible to end users. It just becomes part of the normal way of living, working, traveling and socialising."

More and more, the technology we use in our homes will become wireless. Static technology such as lighting fixtures, keypads and televisions could become more flexible in their configuration as a result, allowing them to be moved around when redesigning a room as simply as hanging a painting.

More people living around you means less private space. Consequently, the next generation of homes need creative configurations to allow us to perform many tasks in a single area. Micro-flats and micro-homes are increasingly common in large cities, while the average size of new homes in the UK is already the smallest in Europe at 76 sq m[15] – something that is likely to decrease further over time.

Motorised panels, hidden technology, in-wall audio-visual equipment and biodynamic lighting could all help transform single-purpose rooms into areas useful for multiple activities[16]. Retractable roofs, windows and walls could go one step further, bridging indoor and outdoor areas in order to maximise the amount of space available to occupants.

Getting rid of screens in favour of interactive touch interfaces on windows and turning walls and tables into interactive touchscreens have long been science-fiction dreams. There is no sign yet that this will become a reality by 2030, although Sony has experimented with portable projectors that can display touchscreens onto walls, floors or tables[17].

Smart adaptive glass, which adjusts window tint to manage glare, heat intake and sunlight, would help to make our dwellings more comfortable and energy efficient. This technology has already been adopted by San Francisco airport[18] and could potentially be adapted for residential buildings by 2030.

THE NEXT GENERATION OF HOMES NEED CREATIVE CONFIGURATIONS TO ALLOW US TO PERFORM MANY TASKS IN A SINGLE AREA.

THE PRIVACY TRADE-OFF

The trade-off between personal data and access to services has become a prominent moral discussion over the last few years. Our personal data is a powerful currency that is crucial for AI systems to work effectively. As this becomes more widespread, using certain technology systems is a choice that erodes our right to privacy.

That said, there are ways that a more open approach to personal data could benefit us. Merging personal calendar data with traffic reporting can let you know when to leave for work in the morning. Sharing data on your weekly shop and the food in your kitchen would allow an AI system to recommend recipes based on the ingredients available. In terms of home insurance, there are already businesses that install smart home technology for free in return for useful data that can keep houses safer and more secure, thereby reducing the number of claims being made[19].

Many data experts believe that 'a public life is the new default' and that modern technology will make it hard to maintain privacy[20]. Some might choose to opt out of this or find a privacy balance that works for them. However, for many the convenience gained will outweigh any doubts they might have about sharing their private data. As Alf Rehn, Chair of Management and Organisation at Abo Akademi University in Finland, believes:

"Privacy will be a luxury, not a right – something that the well-to-do can afford, but which most have learnt to live without."

OUR PERSONAL DATA IS A POWERFUL CURRENCY THAT IS CRUCIAL FOR AI SYSTEMS TO WORK EFFECTIVELY.

SECURITY AND THE SMART HOME

Internet of Things (IoT) infrastructure is projected to hit 25-30 billion devices by the early 2020s[21], with a significant number of these devices located in our homes. This exponential growth creates a huge opportunity for malicious parties to hack into our homes and gain sensitive information.

Worryingly, we're anticipating a global shortfall of cybersecurity specialists of up to 1.8 million by 2022. Our current cybersecurity sector, where only 12% of workers are under 35 and few female recruits are being hired[22], has created a perfect storm that threatens to compromise our workplaces, infrastructure and homes.

Ralph Langner, the cybersecurity expert whose team reverse-engineered the first known 'digital weapon' Stuxnet, believes that a hyper-connected world could be incredibly difficult to secure from malicious digital attacks[23]:

"The world looks much less cyber-safe in 2030 than today […] it's going to be extremely difficult, and in some cases maybe even impossible, to reverse course and go back to less complex architectures that we actually understand and manage to secure."

Cybersecurity is already a huge priority for businesses. Two thirds of companies have experienced some form of attack and annual losses as a result of cyber attacks top $9.5 million per annum[24]. This will become a primary concern for homeowners as well, as securing homes from digital intrusion becomes more critical to ensure our comfort and safety.

Many so-called smart homes are currently ill-equipped to deal with digital threats. The 2016 Dyn cyber attack, described as 'the largest in history', infected printers, routers, IP cameras and even baby monitors in US homes with Mirai malware, and then used them as a springboard to launch a distributed denial of service (DDoS) attack on several major consumer sites, including PayPal, Twitter, Netflix, Amazon and Spotify[25].

IT IS EXPECTED THAT A SHORTFALL IN CYBERSECURITY SPECIALISTS WILL HIT 1.8 MILLION BY 2022.

TOO FEW YOUNG AND FEMALE EMPLOYEES ARE BEING HIRED TO MAKE UP FOR THE CYBERSECURITY SHORTFALL.

$9.5 MILLION EVERY YEAR IS BEING LOST BY COMPANIES AS A RESULT OF CYBERCRIME.

"Right now, security cameras and alarm systems are the most popular systems being installed by smart home specialists. We expect to add digital security services to this list as customers become more aware of the dangers that a malicious hack can wreak upon their homes. Cyberprotection will become a service that is very much in demand."

– Wojtek Zajac, Technology Director at Andrew Lucas

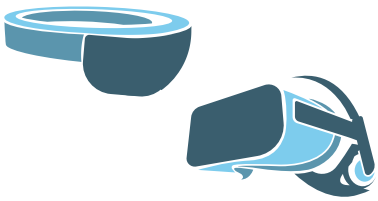
While cybersecurity remains an unresolved worry, physical security systems are likely to become much more secure in the coming years. Facial recognition could rapidly identify whether someone should be in a property, and inform the homeowner about it. Meanwhile, biometric-based virtual credentials are expected to replace standard documentation by 2030[26]. This will create a single digital identity that could be used to make payments, confirm an identity and even permit access to properties.

Other technology will join the sensors, cameras and sirens of a present-day smart security system. Drones could patrol a property's boundaries and feed back real-time information[27]. Inside, smart products whose primary function is not security-based – such as a robot vacuum cleaner – could be sent to investigate a triggered alarm.

MANY SO-CALLED SMART HOMES RIGHT NOW ARE ILL-EQUIPPED TO DEAL WITH DIGITAL THREATS.

VIRTUAL REALITIES

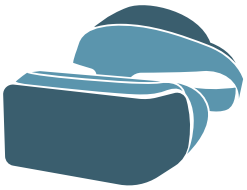
Virtual and augmented reality are still in their infancy and, although subject to an incredible amount of hype, there is significant development still to come in both fields. However, should the anticipated product development and market uptake actually happen, then the combined VR and AR sector could become a trillion-dollar industry by 2030[28]. This would require millions of people using this technology everyday, with headsets becoming as commonplace as televisions.



VR AND AR COULD BECOME A TRILLION DOLLAR INDUSTRY BY 2030.

The enclosed nature of virtual reality lends itself to experiences that involve immersive environments, such as gaming, 360° movies and virtual design, proofing and presentation for commercial and consumer applications[29]. While VR is already beginning to be used in the workplace for design, proofing and presentation purposes, this could go further with the advent of remote meetings taking place in VR and even a virtual workspace that replaces or augments your current PC and desk, allowing you to work from anywhere.

Augmented reality, meanwhile, has the potential to create an 'open world' environment where daily activities are complemented by a digital overlay. An augmented reality headset could be used as a 'second screen' much like a mobile phone, making it one of the primary interfaces through which we engage with others. Potential uses for this are almost endless, from interacting with a personal assistant to translating street signs and even controlling your home.



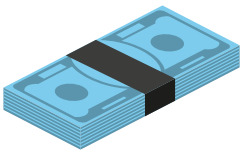
A TOTAL OF 6.3 BILLION VR HEADSETS WERE SHIPPED IN 2016 ACROSS THE ENTIRE GLOBAL MARKET

"There will be a time when everyone will be wearing spectacles – not because of bad eye sight, but due to augmented reality. During your usual commute, AR will let you talk with friends on video or listen to music, give you directions, warn you if you're about to walk into a tree.

"It'll also make your journey more seamless – automatic payment will mean the barriers at the underground station will open as you approach them, while a quick notification will overlay the latest line statuses before your eyes and help you plan your optimum route."

– Hamza Abbas, Sales Director at Andrew Lucas Studios

For all this to happen, a certain amount of patience will be required from investors and consumers until VR and AR fulfil their potential. When the market-changing iPhone came out, it was heralded by critics as a revolutionary device, yet only shipped 6.1 million units. There are now 700 million iPhones in use worldwide[30], and that is just Apple's share in a congested mobile phone market.



$2.3 BILLION WAS INVESTED IN VR AND AR TECHNOLOGIES IN 2016

Conversely, in 2016 all the major companies combined (Oculus, HTC, Samsung, Google and Sony) shipped a combined total of 6.3 million VR headsets[31], with $2.3 billion being invested in VR and AR technologies during the same period[32]. While having similar levels of initial adoption to the original iPhone is no guarantee of success, there is clear potential for VR and AR to build an audience of the magnitude the smartphone market now enjoys by 2030 – yet to win over customers plenty of progress is needed in the interim.

Speaking at the Oculus Connect 3 Conference in October 2016, Oculus chief scientist Michael Abrash highlighted several developments that he feels would markedly change the face of virtual and augmented reality in the coming years[33]. These include 'virtually perfect' eye-tracking to allow foveated graphics rendering and reduce the amount of pixel rendering needed[34], as well as enhancing the field of view, achieving 4K x 4K resolution and creating variable depth of focus.

He also believes that the next decade will see a coming together of augmented and virtual reality to create a hybrid mixed reality solution capable of handling both, which he labels 'augmented VR':

"My prediction is that […] augmented VR will be used for longer and for many more things. While there are many unsolved problems, and a lot of research and engineering still needs to be done, augmented VR is so important that I'm confident the obstacles will be overcome and the boundary between virtual reality and real reality will progressively blur over the next five years."

Key to this happening will be the development of tether-free headsets, allowing users to move freely around a real-world environment, yet able to wirelessly access the processing power of a PC.

Although the stage is set for exponential growth in virtual and augmented reality, there isn't yet enough evidence to suggest that we'll be using it all day, every day like we do our laptops and phones. Instead, it is likely that in 2030 VR and AR will be enabling technologies that we use frequently to aid us in certain tasks and activities, rather than something that completely dominates our lives.

THE NEXT DECADE WILL SEE A COMING TOGETHER OF AUGMENTED AND VIRTUAL REALITY TO CREATE A HYBRID CAPABLE OF HANDLING BOTH.

CONCLUSION

The world that we inhabit in 2030 won't be the perfect utopia of glistening chrome and steel that our imaginations might wish it to be. While there will be significantly more technology around us, our lives won't feel much more technologically-influenced than now, as most of the heavy lifting will take place behind the scenes.

By 2030, there will be new technologies that we currently do not foresee, and the rate of progress between various areas of smart home technology will vary hugely due to funding, consumer uptake and installation costs. While smart home technology will become a more mass market proposition, there will continue to be a market for luxury smart homes, where those who can afford it will take advantage of the latest that technology has to offer.

Overall, the smart home has the potential to revolutionise our lives, leaving us happier, healthier and more comfortable. While cybersecurity poses an increasing risk to both our online and offline safety, the potential benefits of a more connect lifestyle vastly outweigh the risks. While some people will choose to live as 'technology hermits', it's anticipated that the vast majority of the population will prefer to live with the modern conveniences that a smart home will bring.

All that remains to be seen is what unforeseen technology areas will emerge in the coming decade, either complementing, augmenting or even wholly replacing the technological shifts that are already taking place in our society.

THE SMART HOME HAS THE POTENTIAL TO REVOLUTIONISE OUR LIVES, LEAVING US HAPPIER, HEALTHIER AND MORE COMFORTABLE.

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ABOUT ANDREW LUCAS LONDON

Andrew Lucas London believes in enhancing lives through technology. Long-term stalwarts in the custom install industry, the business specialises in highly intelligent smart homes that enhance our clients' lifestyles. All of our projects are based upon five key principles: that the smart homes we create must be green, secure, effortless, beautiful and genuinely intelligent.

Andrew Lucas London also runs a virtual reality design consultancy, **Andrew Lucas Studios**, which creates photorealistic animated VR and AR experiences for creative, commercial and residential projects

This publication has been written in general terms and thus should not be relied on to cover specific situations; the application of the principles set out will depend upon the specific circumstances involved. As such, it is recommended that professional advice is sought before acting (or not acting) on the contents of this publication.

Andrew Lucas London would happily offer advice to readers on how to apply the principles set out in this publication to their specific circumstances. Andrew Lucas London accepts no duty of care or liability for any loss occasioned to any person acting or refraining from action as a result of any material in this publication.

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REFERENCES AND FURTHER READING

1 *Managing the Impacts of Climate Change on Poverty,* Stephane Hallegatte et al. (World Bank Group)
openknowledge.worldbank.org/bitstream/handle/10986/22787/9781464806735.pdf

2 *World population to reach 8.5 billion by 2030, driven by growth in developing countries,* (United Nations)
un.org/sustainabledevelopment/blog/2015/07/un-projects-world-population-to-reach-8-5-billion-by-2030-driven-by-growth-in-developing-countries

3 *Popular Internet of Things Forecast of 50 Billion Devices by 2020 Is Outdated,* Amy Nordrum (IEEE Spectrum)
spectrum.ieee.org/tech-talk/telecom/internet/popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated

4 *Will half of people be working remotely by 2050?,* Laura Vanderkram (Fast Company/Global Leadership Summit)
fastcompany.com/3034286/will-half-of-people-be-working-remotely-by-2020

5 *Electric vehicles to be 35% of global new car sales by 2040,* Jennifer MacDonald (Bloomberg New Energy Finance)
about.bnef.com/blog/electric-vehicles-to-be-35-of-global-new-car-sales-by-2040

6 *How the population of England is projected to age,* (Office for National Statistics)
ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/compendium/subnationalpopulationprojectionssupplementaryanalysis/2014basedprojections/howthepopulationofenglandisprojectedtoage

7 *New green revolution needed to cut carbon emissions from existing buildings,* (Department for Communities and Local Government)
gov.uk/government/news/new-green-revolution-needed-to-cut-carbon-emissions-from-existing-buildings

8 *Will AI make our smart homes smarter?,* Ben McCabe (Connected Lifestyle/Andrew Lucas London)
andrew-lucas.com/connected-lifestyle/will-ai-make-smart-homes-smarter/

9 *What artificial intelligence will look like in 2030,* Leah Burrows (Harvard Gazette)
news.harvard.edu/gazette/story/2016/09/what-artificial-intelligence-will-look-like-in-2030/

10 *Scenarios for the Development of Smart Grids in the UK,* Dimitrios Xenias et al. (UK Energy Research Centre)
orca.cf.ac.uk/56375/2/Scenarios%20for%20the%20Development%20of%20Smart%20Grids%20in%20the%20UK%20Lit%20Review.pdf

11 *Ibid.*

12 *The Future of Smart Grid Technologies,* (University of California, Riverside)
orca.cf.ac.uk/56375/2/Scenarios%20for%20the%20Development%20of%20Smart%20Grids%20in%20the%20UK%20Lit%20Review.pdf

13 *Has voice recognition's time finally come?,* Ben McCabe (Connected Lifestyle/Andrew Lucas London)
andrew-lucas.com/connected-lifestyle/voice-recognitions-time-finally-come/

14 *Smart Cities to Rise Fourfold in Number from 2013 to 2025,* (IHS)
news.ihsmarkit.com/press-release/design-supply-chain-media/smart-cities-rise-fourfold-number-2013-2025

15 *Study finds premise behind bedroom tax is 'fundamentally flawed',* (University of Cambridge)
cam.ac.uk/research/news/study-finds-premise-behind-bedroom-tax-is-fundamentally-flawed

16 *Creating multi-purpose spaces with home automation,* Ben McCabe (Connected Lifestyle/Andrew Lucas London)
andrew-lucas.com/connected-lifestyle/home-automation-make-home-fit-for-multipurpose/

17 *Sony Xperia Touch,* (Sony)
sonymobile.com/gb/products/smart-products/xperia-touch/

18 *San Francisco International Airport Selects View Dynamic Glass for Terminal 1 Redevelopment,* (View Dynamic Glass)
viewglass.com/assets/pdfs/SFO-view-dynamic-glass.pdf

19 *What is connected home insurance?, Dee McKeown* (Neos Insurance)
neos.co.uk/about-connected-home-insurance/

20 *The Future of Privacy,* (Pew Internet)
pewinternet.org/2014/12/18/future-of-privacy/

21 *Popular Internet of Things Forecast of 50 Billion Devices by 2020 Is Outdated,* Amy Nordrum (IEEE Spectrum)
spectrum.ieee.org/tech-talk/telecom/internet/popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated

22 *IAAC Women's Report,* (Information Assurance Advisory Council)
iaac.org.uk/media/1408/womensreport.pdf

23 *How can we protect infrastructure from cyber attacks?,* Clint Witchalls (World Economic Forum)
weforum.org/agenda/2015/09/how-can-we-protect-infrastructure-from-cyber-attacks/

24 *Cyber Security Breaches Survey 2016,* (Department for Digital, Culture, Media & Sport)
gov.uk/government/publications/cyber-security-breaches-survey-2016

25 *An After-Action Analysis of the Mirai Botnet Attacks on Dyn,* Allison Nixon, John Costello, Zach Wikholm (Flashpoint Intel)
flashpoint-intel.com/blog/cybercrime/action-analysis-mirai-botnet-attacks-dyn/

26 *Digital IDs Make Passports and Other Physical Credentials Obsolete,* (Acuity Market Intelligence)
prnewswire.com/news-releases/by-2030-digital-ids-on-biometric-smartphones-and-other-smart-mobile-devices-make-passports-national-ids-drivers-licenses-payment-cards-and-other-physical-credentials-obsolete-300306804.html

27 *Surround your home with brighter security [video],* (Sunflower Labs)
sunflower-labs.com/

28 *Virtual and Augmented Reality – are you sure it isn't real?,* Kota Ewasa et al. (Citi)
citivelocity.com/citigps/ReportSeries.action?recordId=54&src=Home

29 *VR design shows Attol Architecture in best possible light ahead of new studio launch,* Ben McCabe (Connected Lifestyle/Andrew Lucas)
andrew-lucas.com/connected-lifestyle/vr-design-shows-attol-architecture-best-possible-light-ahead-new-studio-launch/

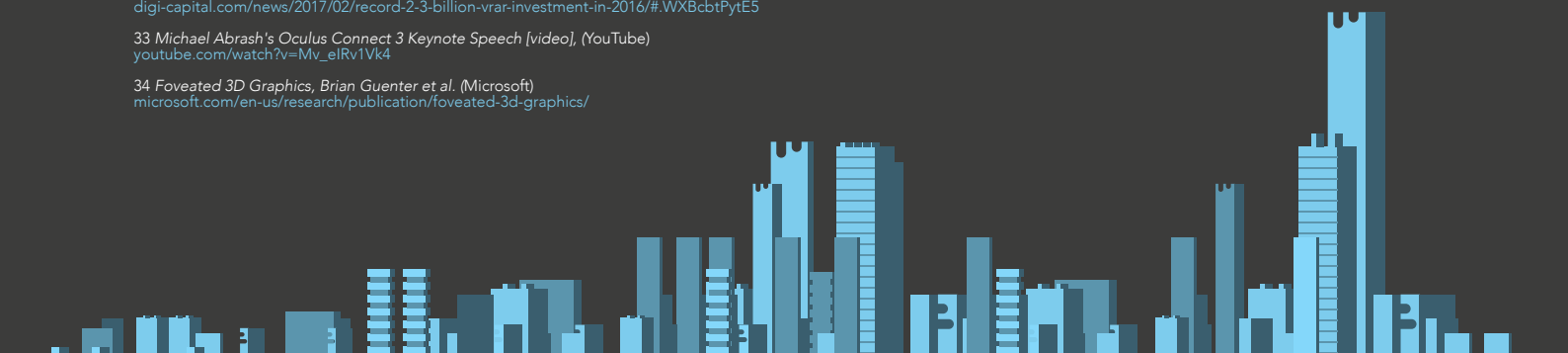
30 *Here's How Many iPhones Are Currently Being Used Worldwide,* Don Reisinger (Fortune)
fortune.com/2017/03/06/apple-iphone-use-worldwide/

31 *Super Data Report: 6.3 Million Virtual Reality Headsets Shipped in 2016,* Joe Durbin (Upload VR)
uploadvr.com/report-6-3-million-virtual-reality-headsets-shipped-2016/

32 *Record $2.3 billion VR/AR investment in 2016,* (Digi-Capital)
digi-capital.com/news/2017/02/record-2-3-billion-vrar-investment-in-2016/#.WXBcbtPytE5

33 *Michael Abrash's Oculus Connect 3 Keynote Speech [video],* (YouTube)
youtube.com/watch?v=Mv_elRv1Vk4

34 *Foveated 3D Graphics, Brian Guenter et al.* (Microsoft)
microsoft.com/en-us/research/publication/foveated-3d-graphics/



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