

# TABLE OF DISRUPTIVE TECHNOLOGIES

A dashboard of 100 wonderful, weird (and possibly worrying) ways the world might change in the foreseeable future

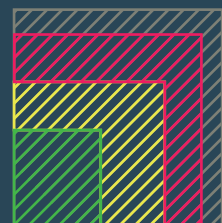
HIGH	De	Ps	Ht	Hc	Da	Sp	El	Vr	Co	Qt	
	Digital footprint eraser	Personal digital shields	Human head transplants	Human cloning & de-extinction	Distributed autonomous corporations	Space solar power	Space elevators	Fully immersive virtual reality (VR)	Artificial consciousness	We can't talk about this one	
	91 DE	92 DE	93 HA	94 HA	95 DE	96 SP	97 SP	98 DE	99 EA	100	
	Ci	Le	Sa	Br	Ad	Ab	Is	Ph	Th	Te	
	Conversational machine interfaces	Life-expectancy algorithms	Stratospheric aerosols	Battlefield robots	AI advisors & decision-making machines	AI board members & politicians	Invisibility shields	Factory photosynthesis	Transhuman technologies	Telepathy	
	81 MI	82 DE	83 SP	84 EA	85 DE	86 EA	87 SP	88 SP	89 HA	90 HA	
	Ss	Ip	He	Mp	Dn	Gv	Qs	Cp	Ud	Rd	
	Planetary-scale spectroscopy	Implantable phones	e-tagging of humans	Male pregnancy & artificial wombs	DNA data storage	Genomic vaccines	Quantum safe cryptography	Cognitive prosthetics	Data uploading to the brain	Reactionless drive	
	71 SP	72 MI	73 DE	74 HA	75 DE	76 SP	77 DE	78 HA	79 HA	80 SP	
	Gh	Ak	Rs	Em	Xx	Bh	Me	Tc	Dr	Wh	
Predictive gene-based healthcare	Automated knowledge discovery	Autonomous robotic surgery	Emotionally aware machines	Humanoid sex robots	Human bio-hacking	Internet of DNA	Thought control machine interfaces	Dream reading & recording	Whole Earth virtualisation		
61 DE	62 EA	63 EA	64 MI	65 MI	66 HA	67 DE	68 MI	69 HA	70 DE		
Md	Sw	Mm	Pb	Et	La	Sd	Lc	Pc	Sh		
Mega-scale desalination	Self-writing software	Public mood monitoring	Programmable bacteria	Peer-to-peer energy trading & transmission	Lifelong personal avatar assistants	Smart dust	Low-cost space travel	Planet colonization	Shape-shifting matter		
51 SP	52 EA	53 DE	54 SP	55 DE	56 MI	57 DE	58 HA	59 HA	60 SP		
Mc	Sf	Dt	Se	Bf	Op	Bs	Nm	Fu	Mr		
Medical tricorders	Smart flooring & carpets	Diagnostic toilets	Smart energy grids	Algal bio-fuels	Human-organ printing	Artificial human blood substitute	New materials	Fusion power	Self-reconfiguring modular robots		
41 DE	42 DE	43 DE	44 SP	45 SP	46 SP	47 SP	48 SP	49 SP	50 SP		
Dl	Pa	Av	Id	Df	Ap	Fp	Sr	Fd	Ze		
Distributed ledgers	Precision agriculture	Autonomous vehicles	Intention decoding algorithms	Drone freight delivery	Autonomous passenger aircraft	3D-printing of food & pharmaceuticals	Swarm robotics	4-dimensional materials	Zero-point energy		
31 DE	32 SP	33 EA	34 MI	35 EA	36 EA	37 SP	38 EA	39 SP	40 SP		
Rc	Sc	Cm	Ro	As	Rg	Wa	Eb	Bp	Be		
Robotic care companions	Smart controls and appliances	Cultured meat	Delivery robots & passenger drones	Autonomous ships & submarines	Resource gamification	Water harvesting from air	Broadcasting of electricity	Bio-plastics	Beam-powered propulsion		
21 MI	22 DE	23 SP	24 EA	25 EA	26 SP	27 SP	28 SP	29 SP	30 SP		
Cr	So	Pp	Eh	Wt	Ac	Mh	Sg	Pe	Ff		
Cryptocurrencies	Concentrated solar power	Predictive policing	Micro-scale ambient energy harvesting	Airborne wind turbines	Avatar companions	Metallic hydrogen energy storage	Smart glasses & contact lenses	Pollution eating buildings	Force fields		
11 DE	12 SP	13 DE	14 SP	15 SP	16 MI	17 SP	18 HA	19 SP	20 SP		
Sn	Dw	Va	We	Bi	Px	Cc	Vt	Sj	Am		
Smart nappies	Deep ocean wind farms	Vertical agriculture	Wireless energy transfer	Balloon-powered internet	Powered exoskeletons	Computerized shoes & clothing	Vacuum-tube transport	Scram jets	Asteroid mining		
1 DE	2 SP	3 SP	4 SP	5 SP	6 HA	7 DE	8 SP	9 SP	10 SP		
SOONER	← TIME* →										LATER
LOW											HIGH

## Example of organizations active in each area

- 1 Monit (South Korea), Abena Nova (Denmark), Siempre Secos (Spain)
- 2 Statoil (Norway), Siemens (Germany), Voltturn (US), UMaine (US)
- 3 Green Skies Vertical Farms (US), Aero Farms (US), Neo Farms (Germany), Urban Crop Solutions (Belgium)
- 4 WiTricity (US), Powermat (Israel), Apple/Power By Proxi (US), Qualcomm (US), Mojo Mobility (US), Mopar (US), Fulton Innovation (US)
- 5 Google/Alphabet (US)
- 6 ReWalk (US), Rex Bionics (US), SuitX/US Bionics (US), Ekso Bionics (US), Lockheed Martin (US)
- 7 Google/Alphabet (US), Samsung (Korea), Hexoskin (Canada) Owllet (US), Komodo Tech (Canada), Shiftwear (US), Lechal (India), OM Signal (Canada)
- 8 The Boring Company/Elon Musk (US), China Aerospace Science and Industry Corporation (China)
- 9 Reaction Engines (UK), NASA (US), Boeing (US), Lockheed Martin (US), Airbus (France)
- 10 Deep Space Industries (US), Planetary Resources (US), Made in Space (US)
- 11 Bitcoin (Japan), Ripple (US), Litecoin (US)
- 12 Solarreserve (US), Abengoa (Spain), North China Power Engineering (China), Shanghai Electric (China), Zhejiang Supcon Solar (China), NWEPI (China)
- 13 PredPol (US), ECM Universe (US)
- 14 Pavegen (UK), ECEEN (China)
- 15 Google/Alphabet (US), Joby Energy (US), Altaeros (US), Kitegen (Italy), Enerkite (Germany)
- 16 Pullstring (US), Amazon (US), Alphabet/Google (US), Nintendo (Japan), Invisible Girlfriend/Boyfriend (US)
- 17 NASA (US)
- 18 Alphabet/Verily (US), Amazon (US), Vuzix (US), Eversight (Israel)
- 19 Elegant Embellishments (Germany), iNova (Spain), Studio Roosegaarde (Netherlands), Prosolve 370e (Germany)
- 20 Dstl (UK), Boeing (US)
- 21 Softbank (Japan), AIST (Japan), Blue Frog Robotics (France), Care-o-bot (Germany), Riken/Sumitomo Riko (Japan), Mayfield Robotics (US)
- 22 Amazon (US), Google/Alphabet (US), Philips (Netherlands), Samsung (South Korea), Dyson (UK), Miele (Germany), iRobot (US)
- 23 Impossible Foods (US), Memphis Meats (US), Super Meat (Israel), Finless Foods (US), New Harvest (US)
- 24 Wing/Alphabet (US), Starship Technologies (UK), Volocopter (Germany), eHang (China), Piaggio (Italy)
- 25 Leidos (US), Boeing (US), Rolls Royce (UK)
- 26 Joulebug (US), Waterpebble (UK)
- 27 Permalution (US), Sun to Water (US)
- 28 Powercast (US)
- 29 NatureWorks (US), Gruppo MAIP (Italy), Genomatica (US), Green Dot Bioplastics (US)
- 30 NASA (US)
- 31 Everledger (UK), Stampery (Spain), Brickblock (Germany), Slock.it (Germany)
- 32 Blue River Technology (US), Hortau (Canada)
- 33 Google/Waymo (US), Voyage (US), Nvidia Automotive (US), most major auto-makers
- 34 Amazon (US), Google/Alphabet (US), Philips (Netherlands), Samsung (South Korea), Dyson (UK), Miele (Germany), iRobot (US)
- 35 Google/Alphabet (US), Amazon (US), Flirtey (US)
- 36 Airbus (France), Boeing (US)
- 37 FabCafe (Japan), NASA (US)
- 38 SRI International (US)
- 39 Stratasy (US), Autodesk (US)
- 40 NASA (US)
- 41 Basil Leaf Technologies (US), Dynamical Biomarkers Group (US/Taiwan), Scanadu (US)
- 42 Starwood Hotels (US), MariCare (Finland), Scanalytics (US), Futureshape (Germany)
- 43 Flowsky (Japan), Scanadu (US)
- 44 Tesla (US), ABB (Switzerland), Siemens (Germany), IBM (US), Itron (US)
- 45 Synthetic Genomics/ExxonMobil (US), Global Algae Innovations (US), Algenol (US)
- 46 Organavo (US), Envision TEC (Germany), RegenHU (Switzerland), Cellink (Sweden), Seraph Robotics (US)
- 47 Hb02 Therapeutics (South Africa), Biospace (US)
- 48 For example Vantablack by Surrey NanoSystems (UK)
- 49 ITER (EU/France), Tokamak Energy (UK), Alphabet/Google/Tri Alpha Energy (US), General Fusion (Canada), Helion Energy (US), Lockheed Martin (US)
- 50 Festo (Germany)
- 51 Israel Desalination Enterprises Technologies (Israel), Acciona (Spain), Fluence Corporation (US)
- 52 Microsoft (US), Google/Alphabet (US), Open AI (US)
- 53 Open Utility/Escent (UK/Netherlands), Knowelsys (China)
- 54 Ginkgo Bioworks (US), US Naval Research Laboratory (US), US Army Research Lab (US), Darpa (US)
- 55 Open Utility (UK/Netherlands), Power Ledger (Australia), LO3 energy (US), Energy Web Foundation (Switzerland)
- 56 Konami Corp (Japan), Mitsuku (UK)
- 57 MOOG (US), Darpa (US)
- 58 Space X/Elon Musk (US), Blue Origin (US), Virgin Galactic (UK), Rocket Lab (US), Axiom Space (US), SpaceIL (Israel), Firefly Aerospace (US)
- 59 Space X (US), UAE Mars Mission (UAE), NASA (US)
- 60 Intel (US)
- 61 Kite Pharma/Gilead Sciences (US), 23andMe (US), Phenogen Sciences (US), Regeneron (US), Veritas Genetics (US)
- 62 IBM (US)
- 63 Intuitive Surgical (US), Verb Surgical/Alphabet/Johnson & Johnson (US), Da Vinci Surgery (US)
- 64 IBM (US), Toyota (Japan), Mimosys (Japan), Persado (US), Joy AI (US)
- 65 Realbotix (US), True Companion (US)
- 66 BioTeq (UK), Grindhouse Wetwear (US), Dangerous Things (US), see also The Eyeborg Project and the Cyborg Foundation
- 67 Alphabet/Google Genomics (US), Amazon (US), Illumina (US), Oxford Nanopore Technologies/Metrichor (UK)
- 68 CTRL-Labs (US), Emotiv (US), Neuralink (US), maybe Facebook (US)
- 69 No example found
- 70 Improbable (UK)
- 71 European Organization for Astronomical Research in the Southern Hemisphere (European consortium of 16 countries)
- 72 No example found
- 73 Epicenter (Sweden) and Three Square Market 32M (US) are close
- 74 No example found
- 75 Twist Bioscience (US)
- 76 Vaccinogen (US), EpiVax (US), IBM (US), Juno Therapeutics (US)
- 77 Alphabet/Google (US), KETS (UK), IDQ (Switzerland), Isara (Canada)
- 78 Darpa (US)
- 79 Kernel (US), Neuralink/Elon Musk (US), 2045 Initiative (Russia), Darpa (US), General Electric/BrainGate (US), possibly Facebook (US)
- 80 NASA (US), Cannae (US)
- 81 Apple (US), Amazon (US), Alphabet/Google (US), Microsoft (US)
- 82 No example found
- 83 CIA (US)
- 84 Lockheed Martin (US), QinetiQ (UK), Boston Dynamics/Softbank (US/Japan)
- 85 Woebot (US), Pefin (US), LV (UK)
- 86 Deep Knowledge Ventures (Hong Kong), Tieto (Finland)
- 87 BAE Systems (UK), Toyota (Japan), NB. Big difference between optical camouflage and bending light to make things disappear
- 88 Breakthrough Energy (US), RIPE (US), Joint Centre for Artificial Photosynthesis (US)
- 89 SENS Research Foundation (US), Methuselah Foundation/Peter Thiel (US)
- 90 Facebook (US), Neuralink/Elon Musk (US)
- 91 Suicide Machine (Netherlands), Just Delete Me (US)
- 92 No example found
- 93 Turin Advanced Neuromodulation Group (Italy)
- 94 Sooam (South Korea), Revive and Restore (US)
- 95 No example found
- 96 Rebeam (US), Solaren Corp (US)
- 97 Thoth Technology (Canada)
- 98 Improbable (UK), HelloVR (US), Magic Leap (US), Microsoft (US). See also Mind Maze (US), Facebook (US) and possibly Apple (US)
- 99 Possibly Alphabet/Google (US)
- 100 As it says, we can't say

\* Time is defined as ubiquity or mainstream use not invention

## Legend



Ghost Technologies: Fringe science & technology. Defined as highly improbable, but not actually impossible. Worth watching.

**Horizon 3:** Distant future 20 years + (Explore).

**Horizon 2:** Near future 10-20 years hence (Experiment).

**Horizon 1:** Happening now (Execute).

## How to read entries

**Sn** — Abbreviation of technology

Smart nappies — Description of technology

1 DE — Theme (See next right)

Examples (See right hand panel)

## Themes

Each of the 100 technologies has been subjectively categorised according to five broad themes, which are:

- DE Data Ecosystems
- SP Smart Planet
- EA Extreme Automation
- HA Human Augmentation
- MI Human-Machine Interactions

## The Small Print

Conceived and created by Richard Watson and Anna Cupani at Imperial Tech Foresight. Thanks are due to Gaby Lee, Simon Tindemans, Thomas Heinis, Stephen Green, Peter Childs, Maria Jeansson, Nik Pishavadia, Roberto Trotta, Aifric Campbell, Christopher Haley, Tom Cleaver, Guido Cupani, Gerard Gorman, Finn Giuliani, Lawrence Whiteley and the Science Communication students at Imperial College for their invaluable assistance and enthusiasm.

The purpose of this publication is to make individuals and institutions future ready. Also, to make people think, at least periodically.

It is a mixture of prediction and provocation intended to stimulate debate, but be aware that other elements should always be considered when assessing potential impact, especially the wider psychological and regulatory landscape in which technologies exist. Most importantly, the technologies highlighted on this table appear without any discussion of moral or ethical factors. Generally speaking, no technology should be used unless it improves the human condition and with potentially disruptive technologies always remember that "with great power comes great responsibility". (There are various attributions for this quote ranging from Spiderman, Dr Spock, Yoda, Churchill, Roosevelt and possibly the French Revolution).

Examples are purely illustrative and do not constitute any form of recommendation, validation or investment advice. Also note that with smaller companies and start-ups in particular the landscape is continually changing so treat examples with caution. There will also undoubtedly be errors and misjudgements, so please use a bit of common sense. If you'd like to contact us to congratulate us, criticise us or buy us lunch our address is techforesight@imperial.ac.uk. You can also reach Richard via richard@nowandnext.com.

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