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# The Third Industrial Revolution: Investment opportunities via stock markets

### Dr David Brown, PhD, FRSChem, FRSMed

Alchemy Biomedical Consulting alchemybiomedicalconsulting.vpweb.co.uk email: davidbrown1000@btinternet.com +44 (0) 7766 686 345

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- 1. What factors drive an Industrial Revolution?
- 2. Where are we today in the Third Industrial Revolution?
- 3. Investing:
  - two phases of investment opportunity.
  - what is performing now?
    - internet
    - biotechnology
    - advanced manufacturing
    - robotics
    - solar power
  - where to look for future opportunities, 2-5 years away
    - new finance
    - Internet of Things
  - and what's coming later
    - many, many things!

### Jacques Bughins, McKinsey Global Institute, 2013

#### **Growth take-off**



SOURCE: Angus Maddison's "World Population, GDP and Per Capita GDP, 1-2003 AD"; Projection based on Global Insight economic data; WIPO IP Statistics

# 1. What drives an Industrial Revolution?

Three breakthroughs...

- 1. A new communication system
- 2. A new energy source
- 3. A new financial system

# Breakthroughs that drove the 1st and 2nd Industrial Revolutions

1st Industrial Revolution 1770-1830, UK

1. Energy: coal, steam power

which drove...

2. Communication: canals, railways, mass printing/education

all funded by...

3. Financial: London stock market

2nd Industrial Revolution 1870-1914, UK/ Germany/ USA

1. Energy: oil, electricity

which drove...

2. Communication: cars, highways, telegraph, telephone, aircraft

all funded by ...

3. Financial: Limited liability corporation

# GDP per capita lift-off



# Lifespan has increased linearly since the 1st Industrial Revolution



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  - what is performing now?
  - where to look for future opportunities?

# Third Industrial Revolution What are the 3 breakthroughs?

- 1. Communication: Computing + Internet / Web
- 2. Energy:

Solar power. (And new nuclear?)

## 3: Financial:

Crowd funding. The internet giants become credit banks. And more to come?

# Third Industrial Revolution What are the 3 breakthroughs?

- 1. Communication: Computing + Internet / This first component of the TIR is well-ahead of the other two.
- 2. Energy:

Solar power + New nuclear.

## 3: Financial:

Crowd funding.

The internet giants become credit banks.

And more to come.

# Interaction / synergy between the major drivers of the 1st Industrial Revolution

New energy source (Coal / steam power)

Mass printing. Mass schooling. Mass literacy. Publishing industry: newspapers, books, magazines.

Steam-powered industrial plant. Metal and chemical extraction and usage.Tractors increased farm efficiency. Move of workers from land to factories. Growth of cities. Gas lighting.

New communication system (Steam powered printing and transport)

Steam-powered canal boats, then railways.

New financial system

(London Stock Market).

Growth of finance industry.

# Interaction / synergy between the major drivers of the 2nd Industrial Revolution



Oil-fueled transport industries: cars, lorries, aircraft, shipping. Invention of cheap steel, leading to building of longdistance railways and road networks, and skyscrapers. Modern power stations.

New financial system (Limited Liability Corporation)

New communication system (electricity-based telegraph then telephone)

> Increase in available investment capital. Expansion of investment industry. Democratization of investment.

# Interaction / synergy between the major drivers of the 3rd Industrial Revolution



# Interaction / synergy between the major drivers of the 3rd Industrial Revolution



# 1. Computing and Internet

## My computing history!!!



Two more key factors:

1968-74

**IBM 360** 

at university.

Fortran.

Punch cards!

www. Thankyou Tim Berners-Lee.

Mosaic/Netscape 1993/94. Thankyou Marc Andreessen.



# \$5 million vs. \$400

Price of the fastest supercomputer in 1975<sup>1</sup> and an iPhone 4 with equal performance

> 12,500x cheaper in 40 years. 300x improvement per year.



# The result: Global Internet Population x10 in 15 years, x100 in 20 years



# **Communication:**

# Compute costs declined 33% annually over past quarter century (Moore's Law)

Compute Costs Declining = 33% Annually, 1990-2013...

Decreasing cost / performance curve enables computational power @ core of digital infrastructure...



**Global Compute Cost Trends** 

# Storage costs falling at a similar rate

Decreasing cost / performance of digital storage enables creation of more / richer digital information...



### Best sources of revenue may surprise Not just replicating old sources. It's not only about advertising.

Mobile App Revenue = Still Trumps Mobile Ad Revenue @ 68% of Mobile Monetization



Global Mobile App + Advertising Revenue, 2008 – 2013

Source: Global Mobile App revenue per Strategy Analytics; comprises virtual goods, in-app advertising, subscription, & download revenue. Global Mobile Advertising revenue per PWC; comprises browser, search & classified advertising revenue.

# Apps even beat Hollywood!



### Education on-line via smartphones and phablets. Massive implications: the 1860s all over again, but now global



# People today can access <u>free</u> on smartphones capabilities that recently cost \$thousands

### **Dematerialization and Demonetization**

'Abundance: The future is better than you think'. Diamandis and Kotler 2012

76 Dematerialization

ear of Launch

"Positive deflation".

	Application	\$ (2011)	Original Device Name	Year*	MSRP	2011's S
1	Video conferencing	free	Compression Labs VC	1982	\$250,000	\$586,904
2	GPS	free	TI NAVSTAR	1982	\$119,900	\$279,366
3	Digital voice recorder	free	SONY PCM	1978	\$2,500	\$8,687
4	Digital watch	free	Seiko 35SQ Astron	1969	\$1,250	\$7,716
5	5 Mpixel camera	free	Canon RC-701	1986	\$3,000	\$6,201
6	Medical library	free	e.g. CONSULTANT	1987	Up to \$2,000	\$3,988
7	Video player	free	Toshiba V-8000	1981	\$1,245	\$3,103
8	Video camera	free	RCA CC010	1981	\$1,050	\$2,617
9	Music player	free	Sony CDP-101 CD player	1982	\$900	\$2,113
10	Encyclopedia	free	Compton's CD Encyclopedia	1989	\$750	\$1,370
11	Videogame console	free	Atari 2600	1977	\$199	\$744
	Total	free			Second States	\$902,065

>\$900,000 worth of applications in a smart phone today



#### Top 10 Internet Properties by Global Monthly Unique Visitors, 3/14

#### Global Internet Public Market Leaders = Apple / Google / Facebook / Amazon / Tencent...

Rank	Company	Region	2014 Market Value (\$B)	2013 Revenue (\$MM)
1	Apple	USA	\$529	\$173,992
2	Google	USA	377	59,825
3	Facebook	USA	157	7,872
4	Amazon	USA	144	74,452
5	Tencent	China	132	9,983
6	eBay	USA	66	16,047
7	Priceline	USA	63	6,793
8	Baidu	China	59	5,276
9	Yahoo!	USA	35	4,680
10	Salesforce.com	USA	33	4,071
11	JD.com	China	29	11,454
12	Yahoo! Japan	Japan	25	3,641
13	Netflix	USA	24	4,375
14	Naver	Korea	23	2,190
15	LinkedIn	USA	19	1,529
16	Twitter	USA	18	665
17	Rakuten	Japan	16	4,932
18	Liberty Interactive	USA	14	11,252
19	TripAdvisor	USA	13	945
20	Qihoo 360	China	11	671
Total			\$1,787	\$404,644



Source: CapIQ. 2014 market value data as of 5/23/2014. Note: Colors denote current market value relative to Y/Y market value. Green = higher. Red = lower. Purple = newly public.

Multi-billion companies built in just a few years; but these will be surpassed...

# The next step: Internet of Things

It *will* be huge...but the timing?



Figure 9. Growth Forecast for Annual Revenues from Embedded Telematics by Revenue-Type



# 2. New energy sources:

# Solar and New Nuclear

Solar is approaching take-off now; new nuclear for the 2030s.

## Exponential increase in solar installations - and reduction in price



# Plummeting cost of solar compared to established energy sources





#### Solar PV Total Global Capacity, 2004–2013

### Germany a current leader: accounts for ~25% global PV capacity.



#### Solar PV Capacity and Additions, Top 10 Countries, 2013

### USA will become a leader in solar power:

Exponential increase in Photovoltaic (PV) capacity in USA



Source: Deutsche Bank

## Solar cost targets could be met before 2020

USA: Barclays analysis of solar

"The cost of solar plus storage for residential consumers of electricity is already competitive with the price of utility grid power in Hawaii".

California could reach the same point by 2017, with New York and Arizona following in 2018 "and many other states soon after".

**China: Wuxi Suntech Power** 

Electricity cost from solar = coal by 2016 -17

CEO Eric Luo, June 2014

## UK: solar power is now growing rapidly

2014: UK solar power almost doubled in generating capacity in 1 year

- 2.8GW at the end of 2013

- 5GW of capacity at the end of 2014

- enough power to supply the equivalent of 1.5 million homes.

The UK now has more than 650,000 solar installations – across homes, offices,

schools, churches, warehouses, farms, police stations, train stations

Figures published by the Department of Energy and Climate Change

2020: Solar in UK could be cost-competitive with gas
## Does cheap oil change prospects for solar power?

Solar competes with coal, natural gas, hydro, and nuclear power.

(Oil is mostly used for transport and chemicals).

Solar...makes up less than 1 percent of the electricity market today but

will be the world's biggest single source by 2050

(International Energy Agency).

Demand is so strong that the biggest limit to installations this year may be the availability of panels.

Bloomberg 2015

## Solar is the most scalable energy source

Earth has 10,000 times more sunlight than global energy demand

Energy source	Maximum power	Percent of Solar
Solar	85,000 TW	100.000
Ocean thermal	100 TW	0.120
Wind	72 TW	0.080
Geothermal	32 TW	0.380
River hydroelectric	7 TW	0.008
Biomass	6 TW	0.008
Tidal	3 TW	0.003
Coastal wave	3 TW	0.003

Maximum Power Contained in Renewable Sources

No other renewable scales like solar. It has nearly 850 times the potential of ocean thermal, its nearest competitor.

Source: Derek Abbott, Fellow, IEEE, "Keeping the Energy Debate Clean: How Do We Supply the World's Energy Needs?" *Proceedings of the IEEE* 98, no. 1 (January 2010).

Note this chart does not include new nuclear

# Land area required to fuel the world by solar is small!



World Economic Forum, Davos, January 2015

## Solar power: increasing efficiency

N.B. Perovskites and Graphene are not yet on this chart



A McKinsey study said the average cost of installed solar power in the US across all sectors has dropped to \$2.59 from more than \$6 a watt in 2010. It expects this fall to \$2.30 by next year and \$1.60 by 2020. This will put solar within "striking distance" of coal and gas, it said.

# Excellent progess in solar power - even before graphene comes on the scene!



- Graphene is just carbon single monolayer of atoms
- Breakthrough in artificial production 2003 by Andre Geim and Konstantin Novoselov at the University of Manchester, UK.....Nobel Prize in Physics in 2010 (for the the 'Scotch tape' technique !)
- Superconductor, 100 times stronger than steel by weight, conducts heat and electricity with great efficiency; is nearly transparent
- IBM produced first graphene-based integrated circuit in 2011
- potential solar capture efficiency 50-100%
- current PV materials (silicon, gallium arsenide) generate electricity from limited wavelength bands of light, graphene works on all wavelengths.
- supercapacitor: it may solve the battery/storage problem

Transformative: coat buildings, clothes, curtains etc in graphene to collect/ make their own power?

At the same time, power use efficiency is improving massively.

LED lighting: Huge reduction in cost and increase in efficiency



# New nuclear (2030's onwards)

Incremental improvement in Pressurised Water Reactors is the past.

Revolutionary advances appearing, prototypes under construction.

-Thorium reactors:

- **Molten salt reactors**: atmospheric pressure; burn-off 30 times more of the nuclear fuel, waste cut by 95%, giving 70x the power; molten salt is inert, if leaks it cools and solidifies. Fission stops automatically in an accident, no chain-reaction. Costs could be massively lower, competitive with coal and gas.

Remember the S-curve. This is the early Induction phase. It's not even on the Gartner Hype curve yet

Shares of nuclear facility builders remain in the doldrums.

Current manufacturers may not be the future leaders, as happened in computing and healthcare.

# 3. New financial system

# **Cryptocurrencies?**

(Internet enabled)

#### Fact that ~5MM Bitcoin Wallets (+8x Y/Y) Exist Proves Extraordinary Interest in Cryptocurrencies



#### Peer to peer lending (P2P)



"LendingClub And Billion-Dollar Valuations Are Just The Beginning For Online Lending

"Last week marked the first ever-initial public offering for an online lending platform when LendingClub raised nearly \$870 million in its IPO. LendingClub was priced at \$15 per share but opened the day on the NYSE well above that at \$24.75 per share before closing the day at \$23.43 thus implying a company valuation of \$8.9 Billion." December 2014



- What is it: individuals act as Angels/VCs
- Origins: Kickstarter USA 2009, take-off 2012 in USA, 2013 in UK
- Types: several models (donation, early product access, equity, fund)
- Amounts raised: typically thousands to hundreds of thousands
- Potential:
  - If only HNWs input 2% of investable wealth in would dwarf VC by an order of magnitude per annum.
  - If the general public adds to this, the potential is vast.
- Legislation UK 2014, USA JOBS Act etc
- "Globally, crowdfunding appears to be doubling every 60 days." (Luke Johnson, Financial Times October 21, 2014).

- "As an alternative to the traditional forms of finance for cash-strapped ventures, it represents a real breakthrough. It is a powerful boost to the
  - environment for entrepreneurs and creators generally.
  - I believe in the years to come, crowdfunding will yield great economic benefits for its leading proponents, including the UK and the US."

Luke Johnson Financial Times October 21, 2014



- Over £16 million funded last year
- Each round led by an experienced / professional investor
- Economic parity for lead and crowd investors



# How big can Crowdfunding get? By 2020? By 2030? By 2050?





# Internet and/ or social media companies redraw finance landscape?

- Google The New Bank Rollover BitCoin
  - GoogleWallet (pay in store, send/receive money, has banking license in Europe already)
  - Google Android platform global already
- Apple Security improved e.g. iPhone fingerprint sensor (more secure than credit/debit cards). Apple has \$150bn cash - will it start lending (the definition of a bank).
- Facebook has applied for banking license in Ireland
- Sounger generation already atuned. Vast customer base already established
- Next they start lending!
- Germany: >25% Internet purchases now paid for through Ebay's subsidiary PayPal (>150 billion euros). Now offering credit. Can link credit card to account and charge automatically.
- Traditional banks downsize massively (people, facilities, % of financial system)
  - cf Amazon vs traditional bookstores

## New financial system: One component is 'eWallet'

Change has been slow:

Cash: still dominates globally.

**Plastic**: credit/debit cards have just overtaken cash in UK and USA - after 60 years! Globally cash still dominates.

**Online** payments: PayPal only 10% of online payments - after 15 years. Total online payments is still only 2-3% of consumer transcations worldwide.

**Newcomers** to online payment: PayM and Barclays' Pingit in the UK, Swish in Sweden, or Apple Pay ( - Google Wallet). Allow payment (like cards) AND to send and receive money.

**Barriers**: Too many incompatible systems - typical of the Induction Phase. Confusing to consumers, expensive for retailers. Security concerns + inconvenience of PINs.

Payback phase: when will it begin?

- When it makes consumers' lives simpler + adds value to the businesses that use it.

#### The winners?

Apple (customer-friendly h/w & s/w versus Google and Facebook (>1bn online customers)?Apple, Google and Facebook may emerge as banks w/o bricks and mortar.Costs↓Efficiency and convenience ↑Positive deflation!

#### It's more than just convenience and cost saving. Africa is a decade ahead - with unexpected benefits.

Access to M-PESA generates significant welfare effects through enabling informal financial relationships



Source: 1) Suri and Jack (2011) Risk sharing and transaction costs, Working Paper 2) Using regression techniques, the researchers perform several tests to rule out alternative explanations (like higher income) which are correlated with M-PESA usage

2009 Bill & Melinda Gates Foundation

#### Who is winning the Third Industrial Revolution?

Remember:

UK was home to the 1st Industrial Revolution 1770 onwards

- then became the dominant global economic and military power

USA and Germany led the 2nd Industrial Revolution from 1870 onwards

- then became the dominant global and European powers

## USA leads the internet

The internet was invented in the USA.

The WWW was developed by a UK national living in the USA

<u>1/13</u> – 9 of Top 10 Global Internet Properties 'Made in USA'... 79% of Their Users Outside America



Top 10 Internet Properties by Global Monthly Unique Visitors, 1/13

## Who leads the New Finance?

USA?

- Will the globally-dominant internet companies become the new banks?

UK?

- Will UK finance industry adapt and lead the New finance?
- The UK is already a global leader in crowdfunding.

## FinTech City (aka London) (FinTech is technology applied to financial services)

Panel from Google, Microsoft, American Express, Santander, SiliconValley Bank and a selection of venture capital firms selected **24 London Fintechs in global top 50**.

More than half of all European venture capital investments in FinTech made last year went to London firms, amounting to a record \$539m (£342.6m) of funding.

The sector employs more people (44,000) than New York or Silicon Valley.

"Silicon Valley Bank, the US-based firm which funds startups and VCs, believes any one of these London firms could become hugely valuable down the line." (City A.M. 3 February 2015.)

#### London's FinTech50 ones to watch

Algomi, Blockchain, Byhiras, Calastone, Commuter Club, Credit Benchmark, Currency Cloud, Darwinex, Duedil, Earthport, Ebury, Fund Apps, Funding Circle, GoCardless, Insly, Ixaris, LendInvest, Merit Software, Nutmeg, OpenGamma, Osper, Squirrel, Sybenetix, TransferWise

#### The UK is a uniquely well-suited location for FinTech.

Deal volumes in UK growing at 74 percent a year since 2008, compared with 27 percent globally and 13 percent in Silicon Valley.

Value of UK Fintech investment increased nearly eightfold in five years 2008-13, to US\$265 million a rate of 51% a year, (global average 26%,Silicon Valley 23%). Data from UKTI, 2014.

#### Why?

- the presence of a large and technologically sophisticated customer base
- London's position as a world-leading centre for financial services (251 foreign banks, and 588 foreign financial services companies.)
- good availability of business capital
- a supportive regulatory approach
- excellent financial services infrastructure,
- London's position as a global trading hub.
- ability to attract talent from around the world
- increasingly innovative culture

Potential for UK leadership in 1 of the 3 main drivers of an Industrial Revolution

# Everyone wins! Economic growth has a huge impact on disease, poverty <u>and</u> global warming.

- 3x increase in world per capita income in past 50 years (in real terms)
- If continues, by 2100 world per capita income will be 9x that of year 2000
- Will it happen?
  OECD predicts increased per capita income between 3x and 20x by 2100 Worst case ... average globally the same as UK today
   Best case ... average globally is x7 wealthier than UK today
   "Medium" scenario (SSP2) is x13 i.e. x4 wealthier global average than UK today
- Will Global Warming stop this happening?

IPCC projections for greenhouse gas emission show they <u>reduce</u> as wealth increases – Lowest emissions modeled came out at x16 today's wealth - close to OECD prediction of x13 - and IPCC says that will avert climate change

– Highest emissions come from lowest economic growth

Conclusion: the solution to diseases, poverty, climate change is rapid economic development...

...which is underway now as the Third Industrial Revolution accelerates.

#### And maybe it's even better than that!

#### The future is exponential



SOURCE: Angus Maddison's "World Population, GDP and Per Capita GDP, 1-2003 AD"; Projection based on Global Insight economic data; WIPO IP Statistics

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"The Technology, Healthcare and Energy sectors have the capacity to change how we live our lives.

Innovation in any one of these has the potential to fuel a major bull market but right now we are presented with accelerating innovation in all three."

Eoin Treacy, 20 January 2015

# My approach

1. I invest in TIR as <u>part of my portfolio</u>, not all my portfolio. I have several investment funds, with totally different strategies and risks profiles:

- Angel investments (early-stage TIR start-ups: very high risk).

E T

Ν

- Third Industrial Revolution via Funds & individual shares.
- Trend following (equities, forex, commodities etc)
- Property (buy-to-let direct ownership + real estate funds)
- I S K - Permanent Portfolio (modified)
  - Inflation-proofed cash

Third Industrial Revolution is just one part of a balanced portfolio.

2. I avoid newly-floated companies. They tend to do badly over the early years of their life. N.B. Angel investors and VCs exit at IPO for a reason!

3. I use low-cost collective vehicles (Funds, ETFs) as much as possible to reduce volatility.

There is currently no investment fund based on Third Industrial Revolution theme

- 4. Timing: I use these to assess readiness for investment
  - S-curve of technology development
  - Gartner hype curve
  - FullerTreacy Money charts breakouts, strong trends.

## S-curve of technology development



cost/time

An example: Additive Manufacturing (aka '3D printing') 15-20 years before first 'high-end' applications. 25-30 before cost reduction and widespread use.



Source: Defoitte analysis; Wohlers Associates, "Additive manufacturing and 3D printing state of the industry", 2012; The University of Texas at Austin, "Selective laser sintering, birth of an industry," December 7, 2012, http://www.me.utexas.edu/news/2012/0712\_sls\_history.php, accessed January 25, 2014.

Graphic: Deloitte University Press | DUPress.com



D Brown, Drug Discovery Today, 2007, 12, 1007-1012

Payback

Induction time

cost/time

# Gartner Hype Cycle



#### Induction phase is Gartner Hype and disillusion phase



Guidance in this presentation is to investors in public stockmarkets in the 'payback' phase.

## Gartner hype cycle predictions July 2014



The slides above apply to all industries. Now let's look at investing in specific sectors.

Computing and Internet, including microprocessors,software and security.

This is the most mature TIR area.

Charts: that many are <u>much</u> above their 2008 high.

#### x2 peak of 2008 (S&P500 is only 25% above 2008 peak). (FTSE 100 has yet to reach 2008 peak!)



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#### Not just USA FTSE 350 Computer and Software services: >2x peak of 2008



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#### Internet Retail: x4 peak of 2008

#### S&P500 Internet Retail (S5INRE INDEX) 1970.373 58.99



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#### Amazon: x7 in 10 years

#### Amazon.com Inc (AMZN US EQUITY) 378.995 5.62



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## Apple: more than ten-fold in 10 years



Apple (AAPL US EQUITY) 128.45 -0.27

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## Google: x10 in 10 years

Google Inc. A Class (GOOGL US Equity) 546.45 3.8



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## Tencent: ~100x in 10 years!

Tencent Holdings Ltd (700 HK EQUITY) 129.90 -0.9



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### ARM (Cambridge, UK): x10 in 10 years



## The biggest gains of all? Anyone heard of it?



Headquarters in Toronto, Canada, and offices in North America, Europe and Australia. Over 4,500 employees generating consolidated revenues exceeding US\$800 million.

## Investing in funds is less risky than single companies.

## Powershares NASDAQ Internet ETF



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Company	Weighting
Apple Inc. (AAPL)	15.3%
Microsoft Corp. (MSFT)	8.4%
Google Inc. (GOOG)	7.0%
Intel Corp. (INTC)	4.2%
Oracle Corp. (ORCL)	3.7%

#### Vanguard Information Technology VIPERs (VGT US EQUITY) 108.72 0.43

2015-02-19



Company	Symbol	% Assets
Amazon.com, Inc.	AMZN	8.40
Facebook, Inc.	<u>FB</u>	8.27
eBay Inc.	EBAY	5.32
Google Inc.	GOOGL	5.07
Google Inc.	GOOG	5.04
The Priceline Group Inc.	PCLN	4.88
Netflix, Inc.	NFLX	4.51
Salesforce.com Inc Common Stock	CRM	4.27
Yahoo! Inc.	YHOO	4.24
LinkedIn Corporation Class A Co	LNKD	3.75

#### Top 10 Holdings (53.75% of Total Assets)

#### First Trust Dow Jones Internet Index Fund (FDN US EQUITY) 65.68 1.02



## UK IT Fund: More than double its 2008 peak.



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## UK IT Fund: More than double its 2008 peak.

Security	Weight
Apple	16.35%
Microsoft Corp.	8.72%
Intel Corp.	4.42%
Facebook Class A	4.16%
International Business Machines Corp.	4.03%
Oracle Corp.	3.88%
Google Class A	3.80%
Google Class C	3.75%
<u>Cisco Systems</u>	3.61%
Qualcomm	3.12%

Legal & General Global Technology Fund (UK) (LEGGTII LN EQUITY) 23.52 0.03





# Software ETF: Less overlap in holdings with previous funds.



Top 10 Holdings (56.02% of Total	Assets)	
Company	Symbol	% Assets
Oracle Corporation Common Stock	ORCL	8.76
Adobe Systems Incorporated	ADBE	8.31
Salesforce.com Inc Common Stock	CRM	8.28
Microsoft Corporation	<u>MSFT</u>	7.30
Intuit Inc.	INTU	6.19
Symantec Corporation	SYMC	4.27
Electronic Arts Inc.	<u>EA</u>	4. 26
Autodesk, Inc.	ADSK	3.07
Red Hat, Inc. Common Stock	RHT	2.99
Activision Blizzard, Inc	ATVI	2.59

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# **Cloud Computing Fund**



Top 10 Holdings (36.99% of Total	Assets)	
Company	Symbol	% Assets
Netflix, Inc.	<u>NFLX</u>	4.41
Amazon. com, Inc.	<u>AMZN</u>	3.85
Brightcove Inc.	BCOV	3.82
Informatica Corporation	INFA	3.72
Red Hat, Inc. Common Stock	<u>RHT</u>	3.68
Juniper Networks, Inc. Common S	JNPR	3.59
Teradata Corporation Common Sto	TDC	3. 58
Oracle Corporation Common Stock	ORCL	3. 50
Salesforce.com Inc Common Stock	CRM	3.42
Zynga Inc.	ZNGA	3.42

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## **Opportunities in internet security**

There are two types of companies: those who have been hacked, and those who don't yet know they have been hacked.

John Chambers Chief Executive Officer of Cisco

#### Palo Alto Networks Inc (PANW US Equity) 137.91 1.03





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#### CalAmp Corp (CAMP US EQUITY) 18.86 0.17

2015-02-19

www.fullertreacymoney.com



FIREEYE INC (FEYE US Equity) 44.27 0.61

2015-02-19

www.fullertreacymoney.com

#### The first cyber-security ETF launched November 2014:

#### PureFunds ISE Cyber Security ETF

Garrier Sand	Purefuents IBE Cyter Security ETF (MACK)			
Tamana Street	Basic Chart 20 ter Sues Ibertit nor			
Summer of Street	Paral ands HE Optor Security ET (1738Acce)			
Barry Larth Averages	Range to by to be Type Br ( Geo) Grade Buse Line ( Log Ster # ) L			
MENTE & INFO	Congress HACK In Control Control (Congress)			
Balatifular ETT	Prenfrends BE Cyber Selendly ET			
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	Frees			
	Stilleton Street 1 111 101 101 - 1			

Top 10 Holdings (44.98% of Total Assets) Infoblox Inc. AHNLAB Inc Cisco Systems, Inc. Fortinet, Inc. The KEYW Holding Corporation Barracuda Networks Palo Alto Networks, Inc. FireEye, Inc. Juniper Networks, Inc. IntraLinks Holdings, Inc. Investing in Biotechnology

This is the second most mature TIR area

# Out with the old. In with the new?

Stage 1: Genome reshuffles the healthcare industry

Many major pharma companies invested too early in the wrong technologies, or too late in the right technologies.

New players are emerging - the winners in the drug development technology war.

- But there is more to come, much much more. The centralised model is defunct, patient-centric healthcare is emerging.
- Democratization of healthcare, via the internet (just as with Information, Finance etc).

# Why 'Big Pharma' sank in the 2000s



David Brown, Drug Discovery Today, 2007, 12, 1007-1012

cost/time

# Human Genome according to S-curve / Gartner Hype cycle



# Healthcare:

# Personal genome sequencing now below \$1k

Better diagnosis of disease susceptability More rapid treatment? Better match of drug to patient Greater efficacy, lower side effects. Cost savings? Rapid progress with vaccines, protein therapeutics, antibodies, diagnostics. Note S-curve 'induction' phase of 15-20 years before 'payback' phase.



# Healthcare:

#### Personal genome sequencing now below \$1k Better diagnosis of disease susceptability

More rapid treatment?

Better match of drug to patient

Greater efficacy, lower side effects. Cost savings?

Rapid progress with vaccines, protein therapeutics, antibodies, diagnostics.

Note S-curve 'induction' phase of 15-20 years before 'payback' phase.

\$1,000,000 -	\$2.7 billion, 13 years	
\$100,000 -	Cost and duration of the Human Genome Project, completed in 2003	
\$10,000 - \$1.000 -	Current cost \$1000 per genome. 2,700,00 cost reduction in 12 years. 225,000x improvement per year.	
\$100 - 580 <sup>0</sup>	• (ast p • (ast p • (ast p • (ast p) • (ast and time to sequence a human genome in the next decade <sup>2</sup>	

# Solexa (Cambridge, UK) was bought by Illumina (USA) in 2006



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# It's payback time: Biotechnology has taken off:

NASDAQ Biotech Index (NBI INDEX) 3471.319 26.88 2015-02-19 Daily MA 200 NW www.fullertreacymoney.com This website is © 2008-2015 Fuller Treacy Money plc. All rights reserved. NB: Notice relative strength in 2008: annual loss was only  $\sim$  -12%;

#### 20 year chart: AMEX Biotechnology Index. 3x peak of year 2000. 4x peak of 2008.



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## The real winners for investors are the upstarts: Some examples... Gilead: 200x in 20 years.



Note chart pattern 2008-9 and 2010-12

# Celgene: 350x in 20 years

Celgene Corp (CELG US EQUITY) 120.21 1.8 2015-02-19 Daily MA 200 -50 month Jul W. 

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# Spot the S-curve / Gartner hype cycle!

#### Vertex Pharmaceuticals Inc (VRTX US EQUITY) 111.97 -1.6



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# Regeneron: 16x in 5 years

#### Regeneron Pharmaceuticals Inc (REGN US EQUITY) 426.60 20.8



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# Valeant: 12x in 5 years

#### Valeant Pharmaceuticals International (VRX US EQUITY) 169.13 0.71



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#### Fashionable in 1990s (initial hype phase), then a decade of under-performance (the induction phase), then lift-off (payback phase).



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## Taro: 15x in 5 years

### Taro Pharmaceutical Industries Ltd (TARO US EQUITY) 154.87 -0.38 2015-02-19 Daily MA 200

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### Alexion: 36x in 10 years

#### Alexion Pharmaceuticals Inc (ALXN US EQUITY) 182.28 1.99



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Individual biotechnology companies are high risk:

Success or failure can depend on a single clinical trial result!

Investment via funds speads the risk.

### ETF: Major pharma companies - sales force strength

10.54

7.40

6.46

5.94

4.35

3.86

3.83

3.78

3.61

3.58



### Portfolio of larger established pharmaceutical companies

HCA Holdings	4.50%
Abbvie	4.34%
Regeneron	4.11%
Bristol Myers Squibb	4.08%
Merck	3.75%
Amgen	3.67%
Actavis PLC	3.17%
Biogen Idec Inc USD	3.13%
ONO Pharmaceutical	2.87%



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# Racier: Portfolio of rapidly growing mid-teir biotechnology companies

<u>Biogen Idec Inc USD</u>	10.93%
Celgene Corp NPV	9.29%
Amgen Inc Ordinary US \$ 0.01	9.19%
Gilead Sciences Inc Common Stock USD0.001	
Illumina Inc Com Stk Usd0.01	
Alexion Pharmaceuticals USD0.0001	
Medivation Inc Com Stk USD0.01	
Vertex Pharmaceuticals Inc Com Stk	
Regeneron Pharmaceuticals Inc Common Stock	4.52%
Pacira Pharmaceuticals Inc USD0.001	3.71%

#### Biotech Growth Fund (UK) (BIOG LN EQUITY) 729.50 1.5



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### **Overlapping holdings with BIOG**

Amgen Inc Ordinary US \$ 0.01	7.32%
Celgene Corp NPV	7.25%
<u>Biogen Idec Inc USD</u>	7.25%
Gilead Sciences Inc Common Stock USD0.001	7.12%
Aptiv Solutions	6. 43%
Regeneron	5.09%
Alexion Pharmaceuticals USD0.0001	4. 18%
Ophthotech	3. 38%
Incyte Corp Com Stk USD0.001	3. 3 <mark>5</mark> %
Onyx	3.34%

International Biotechnology (IBT LN EQUITY) 481.50 1.5



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### Schroder Medical Discovery Fund (UK) (SCHMEDA LN EQUITY) 127.00 0.4

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#### AXA Framlington Health Fund (UK) (FRAHEAI LN EQUITY) 1555.00 4.0

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### L&G Global Health and Pharmaceuticals Index Trust (UK) (LEGGHPA LN EQUITY) 51.09 0.25

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### streetTRACKS SPDR Biotech ETF (US) (XBI US EQUITY) 211.70 1.8

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### And there are opportunities around the world



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### Lee's Pharmaceuticals (950 HK Equity) 10.72 0.0

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#### Sino Biopharma (1177 HK Equity) 7.01 -0.02

2015-02-18

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### India Bombay Healthcare Index (BSETHC INDEX) 15808.64 12.31

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### Aurobindo Pharma Ltd (ARBP IN EQUITY) 1056.50 19.55



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### The largest Pharma company in Africa. The company supplies more than 650 branded medicines, specializing in generics and treatments for HIV/AIDS and tuberculosis.



### Investing via public markets in very early-stage UK biotechs may soon be possible.

"Neil Woodford focuses on fledgling companies with fund launch."

"Popular UK equity manager Neil Woodford is to launch an investment trust in April focusing on early-stage companies, including biotechnology and alternative finance firms.

"The Woodford Patient Capital trust will float on the London Stock Exchange in April, seeking to raise at least £200m in its initial public offering, and will be capped at £500m."

FT, Feb 6, 2015

### Jim Mellon raising £100m for early-stage biotech fund

Biotech is "the single biggest trend to affect mankind ... and there are fortunes to be made."

2012 book "Cracking The Code"--- 2012 book by Jim Mellon and Al Chalabi

My sector preferences today are Internet/ IT & Life Sciences. There are many good existing opportunities.

The mid-term: Life science sector will run and run. Why?

Genome + IoT: within a few years; characterising patients individually.

Genomics and data bases via NHS will come together, allowing correlations identification of patterns via machine learning.

Effect of treatment will improve enormously.

It's a multi-trillion dollar opportunity, the first ever.

Diagnosis alone will be trillions.

USA spends twice as much on healthcare than Europe for a worse outcome!

Over 65s globally are estimated to have \$65 trillion in savings. Their health is their top priority.

This is at Angel/VC stage, but will enter stock market stage in 5-7 years.

### Out with the old. In with the new:

Stage 2: Dematerialisation of Healthcare. The trillion dollar opportunity.

Internet, smartphones, e-Health, m-Health

Synergy between personal genome + I-o-T + machine learning

Smartphone-based diagnostics, real-time monitoring

Smartphone-based treatment

Patient self-education

Kitchen-sink molecular biology

Transformation of clinical trials

Much better treatment, better health, longer lives

Multi-trillion markets will develop

Excellent investment opportunies ahead

# The future will be driven by... The learning circle: Healthcare.

(Health may be first. But the same will happen everywhere).



Current healthcare leaders may be replaced by the next wave within a decade: 'Big Pharma' — Biotechnology — Integrated healthcare etc etc in waves over decades.

### Where are the components on the Gartner Hype Curve? (For healthcare, but applies to IoT in general.)



Bottom line: I-o-T is where the internet was in 2000.

### Investing in New Manufacturing

Less mature than Internet and Biotechnology.

Becoming mature for Industrial and Medical.

5-10 years from payback phase for consumer products.







## **3D** printing

3D printing began in the 1980s.

- Used by large companies / Autonomies e.g. car design
- Was expensive. That is changing rapidly the internet is

democratising manufacturing.

- ~ 40 manufacturers sell 3D printers to businesses - payback phase beginning in this sector, though not in consumer sector yet.
- ~ 200 startups worldwide are developing consumer-oriented 3D printers. Key change: simple user interfaces, driven off tablets and smartphones. But early days: cf Sinclair ZX computer 1985!

#### Figure 2. Additive manufacturing (AM) process flow



### Manufacturing is a \$10 trillion market - this will be HUGE.

### Airbus and Boeing are now exploring the possibility of building entire planes with giant 3D printers. (City A.M. 17 Feb 2015)

INDUSTRIES	CURRENT APPLICATIONS	POTENTIAL FUTURE APPLICATIONS
AEROSPACE	<ul> <li>Concept modeling and prototyping</li> <li>Printing structural and non-structural production parts</li> <li>Printing low-volume replacement parts</li> </ul>	<ul> <li>3D-printed electronics directly embedded on parts</li> <li>3D-printed aircraft engine components</li> <li>Printing aircraft wings</li> <li>Growing applications for more structural parts</li> </ul>
SPACE	<ul> <li>Printing specialized parts for space exploration</li> <li>Printing structures using lightweight, high-strength materials</li> <li>Printing parts with minimal waste</li> </ul>	<ul> <li>Printing on-demand parts/spares in space to enable self-repairs</li> <li>Printing large structures directly in space, circumventing launch vehicle size limitations</li> </ul>
AUTOMOTIVE	<ul> <li>Rapid prototyping and manufacturing of end-use auto parts</li> <li>Printing parts and assemblies of antique cars and racecars</li> <li>Quick printing of parts or an entire vehicle for the entertainment industry</li> </ul>	<ul> <li>Printing sophisticated auto components for superior performance</li> <li>Printing auto components designed through crowdsourcing</li> <li>3D printers co-existing with traditional machines on the shop floor</li> </ul>
HEALTH CARE	<ul> <li>Printing prostheses and implants</li> <li>Printing medical instruments and models</li> <li>Printing hearing aids and dental implants</li> </ul>	<ul> <li>Developing organs for transplants</li> <li>Large-scale pharmaceutical production</li> <li>Developing human tissues for regenerative therapies</li> </ul>
CONSUMER PRODUCTS/ RETAIL	<ul> <li>Rapid prototyping</li> <li>Creating and testing design iterations</li> <li>Printing customized jewelry and watches</li> <li>Limited product customization</li> </ul>	<ul> <li>Co-designing and creating with customers</li> <li>Customized living spaces</li> <li>Growing mass customization of consumer products</li> </ul>

Sources: Deloitte analysis; CSC, 3D printing and the future of manufacturing, 2012.

Graphic: Deloitte University Press | DUPress.com

### 3D printers. Market cap \$3.2bn

#### 3D Systems Corp (DDD US EQUITY) 30.65 0.24



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### 3D printers Market cap \$3.2bn

#### Stratasys Inc (SSYS US EQUITY) 62.59 1.1



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### Market cap \$200m



### German 3D printing company. Market cap \$157m.



### Renishaw is currently the UK's only maker of metal 3D-printing machines (among other hi-tech capabilities). Market cap £1.73bn. (x3 high of 2008).



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### Arcam AB (SS) (ARCM SS EQUITY) 179.00 1.5

### 3D printing of human organs and tissues for medical research and replacement therapy



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# Software / CAD to drive 3D printing

#### Autodesk Inc (ADSK US EQUITY) 61.46 0.35 2015-02-19 Daily MA 200 -35

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# Software / CAD Market cap \$16.7bn

#### DASSAULT SYS S A (DASTY US EQUITY) 68.44 1.45



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2015-02-19

### 3D measurement and imaging systems for manufacturing, industrial, building construction, and forensic applications.



#### FARO Technologies Inc (FARO US EQUITY) 59.45 1.13

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# **Robotics:**



# Industrial Robot Sales 2013 (from the Financial Times)



Robotics Business Review is a great source of information for top 50 robot companies.

# 1. Fanuc, Japan, the largest globally: 4x in 6 years



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### 2. Yaskawa, Japan



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### 3. ABB, Switzerland



### 4. Kuka, Germany: 7x in 6 years



#### KUKA (GR) (KU2 GY EQUITY) 67.81 0.58

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## The challengers:

## Marata, Japan: 3x in 2 years

2015-02-20 Murata Manufacturing (6981 JP EQUITY) 13650.00 165.0 Daily **魚4000** MA 200 

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### The challengers:

### Siasun Robot & Automation Co Ltd (China): 4x in 2.5 years



Siasun Robot & Automation (300024 CH Equity) 41.96 -0.37



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2015-02-17

# Keyence: develops and manufactures automation sensors, vision systems, barcode readers, laser markers, measuring instruments, and digital microscopes.



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# Hollysys: China's largest domestic provider of automation control systems to domestic nuclear, rail and industrial markets.



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# **ROBO ETF**



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# GO UCITS ROBOG is another recently launched robotics ETF

# Challengers to watch - currently private

Universal Robots, Denmark

Rethink Robotics, USA

Estun, China

Who is well placed for the Internet of Things?

### CDNS: Electronic Design Automation. Creates software and hardware that assists semiconductor companies in designing chips.



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# Synopsys Inc: (Electronic Design Automation).



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# Mentor graphic Corp: (Electronic Design Automation).



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# ARM and Cambridge UK has components essential to I-o-T, especially for healthcare (chips and sensors).



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# Investing in solar power

Investable now but vulnerable to supply issues - demand is rocketing

"The entry of shale oil and gas is a partial solution. The application of Moore's law to solar cell development has even more potential to displace fossil fuels and maintain a low energy price structure. The evolution of nuclear technology shows similar promise."

Eoin Treacy, 20 January 2015

#### MAC Global Solar Energy Index (SUNIDX INDEX) 190.19 -2.67





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Company	% Assets
HANERGY THIN FILM PO	10.90
SunEdison	7.73
SolarCity Corporation	6.71
First Solar, Inc.	6. 33
SunPower Corporation	5. 53
GCL-POLY ENERGY HLDG	5.21
SHUNFENG INTERNATIONAL	5. 15
Sino-American Silicon Products Inc	4. 36
Canadian Solar Inc	3.94
Trina Solar Limited	3.85



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### 2015-02-19 90 80 70 Daily MA 200 10 M M.M.

#### SunEdison, Inc (SUNE US EQUITY) 21.97 -0.05

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# A more diversified 'new energy' fund



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#### New Energy Fund (LX) (SARENER LX EQUITY) 5.70 0.07

2015-02-18



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#### UBS Global Innovators (New Energy LX) (UBSFUEN LX EQUITY) 70.66 0.55

2015-02-18

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# New Nuclear - not on Gartners chart!



# Nuclear Construction will lead: Shares to monitor. (Will uranium be the fuel?)

### **Companies:**

(Areva)

Atkins Babcock & Wilcox

Chicago Bridge & Iron

(General Electric)

Harbin Power Equipment

Idemitsu Kosan

JGC Corp

Korea Electric Power

Shanghai Electric Group

Toshiba Plant Systems

### **Collective funds:**

Market Vectors Uranium+Nuclear Energy ETF (NLR) - includes exposure to large utilities companies.

Global X Uranium ETF (URA) follows the 23 global uranium mining companies.

<u>These ETFs were all closed!</u> iShares Global Nuclear Energy ETF (NUCL) was closed 10/2014.

ETFS WNA Global Nuclear Energy (NUKP).

ETFS Global Nuclear Energy (NUKE).

PowerShares Global Nuclear Energy portfolio (PKN).

#### Market Vectors Nuclear Energy ETF (US) (NLR US EQUITY) 49.99 -0.61



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#### Global X Uranium ETF (US) (URA US EQUITY) 11.26 -0.06



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2015-02-19

# More general clean energy ETFs

# London ETF, no currency risk





2015-02-19



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Holdings	% of Portfolio
Vestas Wind Systems A/S VWS DC	10.05%
Cree Inc CREE	6.01%
First Solar Inc FSLR	5.78%
Iberdrola Renovables S.A. IBR SM	5.16%
Kurita Water Industries Ltd 6370 JP	4.89%
Gamesa Corp Tecnologica SA GAM SM	4.85%
Verbund - Oesterreichische Elektrizitaetswirtschafts	4.29%
Itron Inc ITRI	4.04%
MEMC Electronic Materials Inc WFR	3.81%
Covanta Holding Corp CVA	3.65%

Market Vectors Global Alternative Energy (US) (GEX US EQUITY) 57.1601 -0.56





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#### Top 10 Holdings (24.35% of Total Assets)

Company	Symbol	% Assets
Ballard Power Systems, Inc.	BLDP. TO	2.58
Trina Solar Limited Sponsored A	TSL	2.52
Yingli Green Energy Holding Com	YGE	2.51
China Ming Yang Wind Power Grou	<u>MY</u>	2.50
Canadian Solar Inc	CSIQ. TO	2.46
Sky Solar Holdings, Ltd.	SKYS	2.43
First Solar, Inc.	FSLR	2.37
JA Solar Holdings, Co., Ltd.	<u>JASO</u>	2.37
SunPower Corporation	SPWR	2.31
Ormat Technologies, Inc. Common	ORA	2.30

### PowerShares Progressive Energy (PUW US EQUITY) 26.60 -0.05



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2015-02-19

More general technology funds are an alternative to sector focus

Top 10 Holdings (141.92% of Total Assets)	
Company Symbol % Assets	
Dj U.S. Technology Index Swap Credit Suisse International	51.40
Dj U.S. Technology Index Swap Deutsche Bank Ag	23.03
Ishares U.S. Technology (Iyw) Swap Bank Of America, Na	22.52
Apple Inc.	14.15
Microsoft Corporation	8.37
Dj U.S. Technology Index Swap Citibank, N.A.	6.49
Dj U.S. Technology Index Swap Morgan Stanley & Co. International Plc	4.69
Dj U.S. Technology Index Swap Societe Generale	3.86
Intel Corporation	3.84
Facebook, Inc.	3.57

ProShares Ultra Technology (ROM US EQUITY) 162.79 1.13



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2015-02-19

Baidu Inc Ads Each Rep 1 Ord Cls 'A' Sh	8.87%
Illumina Inc Com Stk Usd0.01	8.03%
Amazon.com Inc Com Stk USD0.01	6.56%
Tencent Holdings Ltd	6.09%
Alibaba Group Holding Ltd ADS	4.90%
Industria De Diseno Textil SA EUR0.03	4.56%
Facebook Inc Com USD0.000006	2.92%
Fiat Chrysler Automobiles NV EUR0.01	2.81%
Atlas Copco AB Series 'A' NPV	2.49%
Prudential plc Ordinary 5p	2.49%

### Scottish Mortgage Investment Trust PLC (SMT LN EQUITY) 253.90 -0.7

2015-02-19



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### SPDR Morgan Stanley Technology (MTK US EQUITY) 104.5001 0.72

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### Allianz Technology Trust (ATT LN EQUITY) 560.00 6.75

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## Semiconductor, IT, media focus

<u>Apple</u>	9.59%
Vodafone Group	8.95%
ARM Holdings	6.64%
Facebook Class A	6.61%
<u>Splunk</u>	4.68%
<u>Tableau Software</u>	4.49%
ServiceNow	4.43%
Nimble Storage	4.42%
ASML Holding N.V.	4.11%
Orange	3.37%



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### Claymore China Technology ETF (US) (CQQQ US EQUITY) 35.83 -0.25

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Global X Nasdaq China Technology ETF (US) (QQQC US EQUITY) 21.8462 -0.13

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### Best guess at current phase of development of technologies Timelines are Gartner's, to 'Plateau of Productivity'.



The Markets Now: February 23, 2015 East India Club, 16 St. James Square, London, SW1Y 4LH

# The Third Industrial Revolution - and investment.

Dr David Brown, PhD, FRSChem, FRSMed

Alchemy Biomedical Consulting alchemybiomedicalconsulting.vpweb.co.uk email: davidbrown1000@btinternet.com +44 (0) 7766 686 345