

Extreme weather primer - weathering the perfect storm

Extreme weather: welcome to the new normal

Climate anomalies are on the rise globally with 2013 marking the 28th consecutive year with a global temperature above the 20th century average (Source: NOAA). Extreme weather is becoming the new normal, with extremes now covering 10% of the globe vs. 0.1% to 0.2% from 1951-1980 (Source: NASA). While no single incident can be definitively attributed to climate change, there is overwhelming scientific evidence that we should expect more damaging extreme weather events, with up to 40% of global land area at risk from extreme heat by 2040E (Source: Coumou et. al.).

Losses are skyrocketing: we're not sufficiently prepared

Global climate-related losses have risen to as much as US\$200bn in 2005 as a result of Hurricane Katrina. 2011 and 2012 were the two worst years on record for extreme weather events, which caused a total of more than \$170 billion in damages, much of that to businesses (Source: NOAA). 90% of the S&P Global 100 across industry sectors identify extreme weather and climate change as current or future business risks (Source: C2ES). But worryingly, less than 50% of companies have integrated climate change adaptation into their business strategies (Source: CDP).

It's getting warmer: on track for a 4°C (7.2°F) warmer world

Without further action to reduce greenhouse gas emissions (GHGs), scientists are now nearly unanimously predicting a 4°C rise in temperatures by 2100 and it could happen as early as the 2060s. This would mean unprecedented heat waves, severe drought, and major floods in many regions with serious impacts on human systems and ecosystems and new risks that would threaten our future adaptation needs (Source: World Bank).

A perfect storm is brewing: food-water-energy security

By 2030E, global food demand is set to increase by up to 50%, water demand by up to 40% and energy demand by up to 50%. Given how closely food, water and energy security are connected, this will mean increasing trade-offs and resource rationing. It also threatens to create a "perfect storm" of global events, which poses key questions for governments, stakeholders, corporates and investors as to how to meet these demands while adapting to and mitigating climate change.

Weathering the storm: 7 entry points for long-term solutions

In our view, a number of stocks are placed to benefit from their role as long-term solution providers for the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. We have identified c200 stocks covered by BofAML Global Research across seven entry points: 1) Water; 2) Fertilizers; 3) Crop Science; 4) Farming and Agricultural Equipment; 5) Second Generation Biofuels; 6) Energy Efficiency; and 7) Renewables and Cleantech.

>> Employed by a non-US affiliate of MLPF&S and is not registered/qualified as a research analyst under the FINRA rules.

Refer to "Other Important Disclosures" for information on certain BofA Merrill Lynch entities that take responsibility for this report in particular jurisdictions.

BofA Merrill Lynch does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision.

Refer to important disclosures on page 75 to 76. Link to Definitions on page 74.

Bank of America
Merrill Lynch

Sarbjit Nahal >>

+44 20 7996 8031

Equity Strategist

MLI (UK)

sarbjit.nahal@baml.com

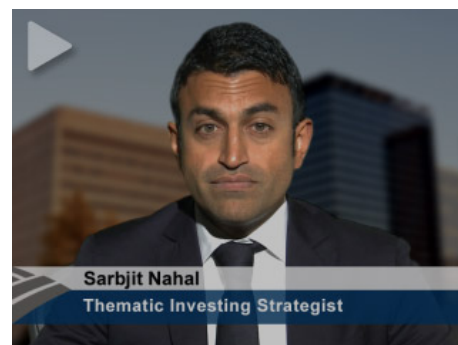
Valery Lucas-Leclin >>

+44 20 7996 8058

Equity Strategist

Merrill Lynch (France)

valery.lucas-leclin@baml.com

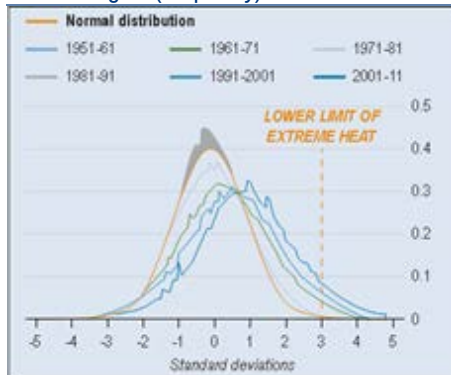


Click the image above to watch the video.

Contents

Weathering the perfect storm	3
Extreme weather & climate change, welcome to the new normal	9
A perfect storm is brewing: food vs. water vs. energy security	26
Weathering the perfect storm: 7 entry points for long-term solutions	49

Chart 1: Global temperature deviations from June to August (frequency)



Source: Goddard Institute for Space Studies, BofA Merrill Lynch Global Research
Temperature deviation from the 1951-1980 reference period in 250km wide cells around the Earth's surface.

Weathering the perfect storm

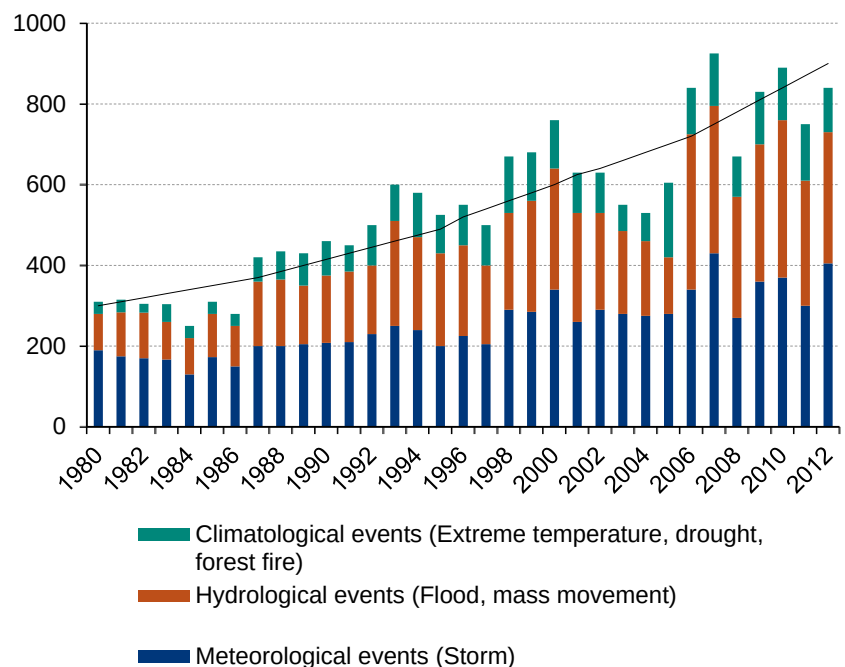
Extreme weather: welcome to the new normal

Climate anomalies are on the rise globally with 2013 marking the 28th consecutive year with a global temperature above the 20th century average (Source: NOAA). Extreme weather is becoming the new normal, with extremes now covering 10% of the globe vs. 0.1% to 0.2% from 1951-1980 (Source: NASA). While no single incident can be definitely attributed to climate change, the overwhelming scientific evidence is that we should expect more damaging extreme weather events, with up to 40% of global land area at risk from extreme heat by 2040 (Source: Coumou et. al.).

Losses are skyrocketing: we're not sufficiently prepared

Since 1980, global extreme weather- and climate-related losses have risen to as much as US\$200bn in 2005 (2010 \$) as a result of Hurricane Katrina. 2011 and 2012 were the two most extreme years on record for destructive weather events, which caused a total of more than \$170 billion in damages, much of that to businesses (Source: NOAA). 90% of the S&P Global 100 across industry sectors identify extreme weather and climate change as current or future business risks (Source: C2ES). But worryingly, less than 50% of companies have integrated climate change adaptation into their business strategies (Source: CDP).

Chart 2: Weather catastrophes worldwide 1980-2012

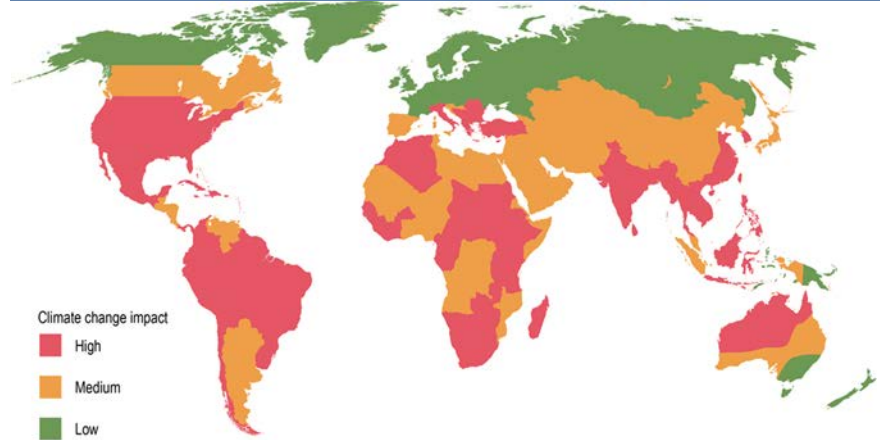


Source: Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As at January 2013

It's getting warmer: on track for a 4°C (7.2°F) warmer world

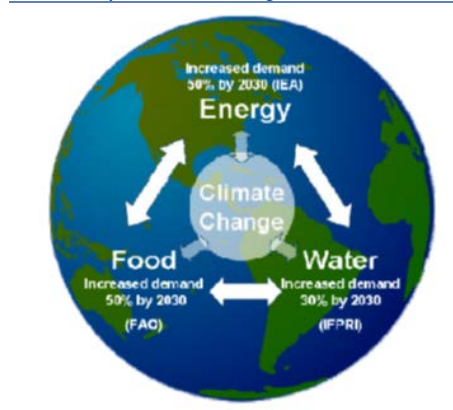
Without further action to reduce GHGs, scientists are now nearly unanimously predicting a 4°C rise in temperatures by 2100 and it could happen as early as the 2060s. This would mean unprecedented heat waves, severe drought, and major floods in many regions with serious impacts on human systems and ecosystems and new risks that would threaten our future adaptation needs (Source: World Bank).

Chart 3: World climate change impact stress map



Source: Syngenta, UNEP, Cline, BofA Merrill Lynch Global Research

Chart 4: A perfect storm of global events?



Source: HM Treasury, FAO, IEA, IFPRI, BofA Merrill Lynch Global Research

A perfect storm is brewing: food-water-energy security

By 2030, global food demand is set to increase by up to 50%, water demand by up to 40% and energy demand by up to 50%. Given how closely food, water and energy security are connected, this will mean increasing trade-offs and resource rationing. It also threatens to create a "perfect storm" of global events, which poses key questions for governments, stakeholders, corporates and investors as to how to meet these demands while adapting to and mitigating climate change.

Weathering the storm: 7 entry points for long-term solutions

In our view, a number of stocks are placed to benefit from their role as long-term solution providers for the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. We have identified c200 stocks covered by BofAML Global Research across seven entry points: 1) Water; 2) Fertilizers; 3) Crop Science; 4) Farming and Agricultural Equipment; 5) Energy Efficiency; 6) Second Generation Biofuels; and 7) Renewables and Cleantech.

Table 1: Extreme weather - Weathering the perfect storm exposure (WPS)

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
CZZ US	Cosan Ltd	Brazil	CZZ	ADVANCED BIOFUELS	Low
CSAN3 BZ	Cosan SA Ind Com	Brazil	CSIDF	ADVANCED BIOFUELS	Low
NES1V FH	Neste Oil	Finland	NTOIF	ADVANCED BIOFUELS	High
RDSB LN	Royal Dutch Shell	United Kingdom	RYDBF	ADVANCED BIOFUELS	Low
DD US	DuPont	United States	DD	ADVANCED BIOFUELS	Low
DE US	Deere & Co	United States	DE	AGRICULTURAL EQUIPMENT	High
AGCO US	AGCO Corp	United States	AGCO	AGRICULTURAL EQUIPMENT	High
CNH US	CNH Global	Netherlands	CNH	AGRICULTURAL EQUIPMENT	High
FI IM	Fiat Industrial	Italy	FNSDF	AGRICULTURAL EQUIPMENT	High

12 September 2013

Table 1: Extreme weather - Weathering the perfect storm exposure (WPS)

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
RBA US	Ritchie Bros	Canada	RBA	AGRICULTURAL EQUIPMENT	High
6326 JP	Kubota	Japan	KUBTF	AGRICULTURAL EQUIPMENT	High
YGE US	Yingli Green Energy	China	YGE	CLEANTECH	High
ENPH US	ENPH	United States	ENPH	CLEANTECH	High
TSL US	Trina Solar	China	TSL	CLEANTECH	High
FSLR US	First Solar	United States	FSLR	CLEANTECH	High
3800 HK	GCL-Poly	Hong Kong	GCPEF	CLEANTECH	High
JASO US	JA Solar	China	JASO	CLEANTECH	High
PWER US	PWER	United States	PWER	CLEANTECH	High
SOL US	ReneSola	China	SOL	CLEANTECH	High
SQM US	SQM	Chile	SQM	CLEANTECH	High
SPWR US	SunPower Corp.	United States	SPWR	CLEANTECH	High
STP US	Suntech Power	China	STP	CLEANTECH	High
TSLA US	Tesla	United States	TSLA	CLEANTECH	High
EGPW IM	Enel Green Power	Italy	XENLF	CLEANTECH	High
EDPR PL	EDP Renovaveis	Spain	EDRVF	CLEANTECH	High
ANA SM	Acciona	Spain	ACXIF	CLEANTECH	High
VWS DC	Vestas	Denmark	VWSYF	CLEANTECH	High
SCTY US	SCTY	United States	SCTY	CLEANTECH	High
NEE US	NextEra Energy	United States	NEE	CLEANTECH	High
TSL US	Trina Solar	China	TSL	CLEANTECH	High
YGE US	Yingli Green Energy	China	YGE	CLEANTECH	High
CREE US	CREE	United States	CREE	CLEANTECH	High
FSLR US	First Solar	United States	FSLR	CLEANTECH	High
SPWR US	SunPower Corp.	United States	SPWR	CLEANTECH	High
ITRI US	Itron	United States	ITRI	CLEANTECH	High
2208 HK	Goldwind	China	XJNGF	CLEANTECH	High
916 HK	China Longyuan	China	CLPXF	CLEANTECH	High
1798 HK	Datang Renewable	China	XGDRF	CLEANTECH	High
SUEL IN	Suzlon Energy	India	XZULF	CLEANTECH	High
CPFE3 BZ	CPFL Energia S.A	Brazil	XPFGF	CLEANTECH	High
CPL US	CPFL Energia	Brazil	CPL	CLEANTECH	High
BAYN GR	Bayer	Germany	BAYZF	CROP SCIENCE	Low
BAS GR	BASF	Germany	BFFAF	CROP SCIENCE	Medium
DOW US	Dow Chemical	United States	DOW	CROP SCIENCE	Low
NUF AU	Nufarm Limited	Australia	NUFMF	CROP SCIENCE	High
MON US	Monsanto	United States	MON	CROP SCIENCE	High
SYNN VX	Syngenta	Switzerland	SYENF	CROP SCIENCE	High
DD US	DuPont	United States	DD	CROP SCIENCE	Medium
AGRO US	Adecoagro	Luxembourg	AGRO	FARMING	High
FR SP	First Resources	Singapore	XUOEF	FARMING	High
GGR SP	Golden Agri	Singapore	GARPF	FARMING	High
SIMP IJ	Salim Ivomas Pratama	Indonesia	XLMTF	FARMING	High
AKRN LI	Acron	Russian Federation	XACJF	FERTILISERS	High
PHOR LI	Phosagro	Russian Federation	XTAZF	FERTILISERS	High
VALE US	Vale ON	Brazil	VALE	FERTILISERS	Low
CF US	CF Industries	United States	CF	FERTILISERS	High
AGU US	Agrium Inc.	Canada	AGU	FERTILISERS	High
URKA LI	Uralkali	Russian Federation	URALL	FERTILISERS	High
SABIC AB	SABIC	Saudi Arabia	XAUBF	FERTILISERS	Low
ICL IT	ICL	Israel	ISCHF	FERTILISERS	High
3983 HK	China BlueChem	China	CBLUF	FERTILISERS	High
BG US	Bunge	United States	BG	FERTILISERS	Low
FFBL PA	Fauji Bin Qasim	Pakistan	FJDF	FERTILISERS	High
FFC PA	Fauji Fertilizer	Pakistan	FAUJF	FERTILISERS	High
FHER3 BZ	Heringer	Brazil	XFTLF	FERTILISERS	High
IPL AU	Incitec	Australia	ICPVF	FERTILISERS	High
SDF GR	K+S Group	Germany	KPLUF	FERTILISERS	High
PCHEM MK	PCG	Malaysia	XOPNF	FERTILISERS	Low
OCIC EY	OCI	Egypt	ORSCF	FERTILISERS	Medium
POT US	Potash Corp	Canada	POT	FERTILISERS	High
SAFCO AB	SAFCO	Saudi Arabia	XDUAF	FERTILISERS	High

12 September 2013

Table 1: Extreme weather - Weathering the perfect storm exposure (WPS)

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
SQM US	SQM	Chile	SQM	FERTILISERS	High
297 HK	Sinofert HLDG	Hong Kong	SNFRF	FERTILISERS	High
MOS US	Mosaic	United States	MOS	FERTILISERS	High
IVRC IN	IVRCL Infrastruc	India	IIFRF	WATER INFRA. & SUPPLY	High
NJCC IN	Nagarjuna Const	India	NGRJF	WATER INFRA. & SUPPLY	Low
SBSP3 BZ	SABESP	Brazil	CSBJF	WATER INFRA. & SUPPLY	High
SBS US	Sabesp-ADR	Brazil	SBS	WATER INFRA. & SUPPLY	High
AGUAS/A CI	Aguas Andinas	Chile	XXSGF	WATER INFRA. & SUPPLY	High
AEG SJ	Aveng Ltd	South Africa	AVEPF	WATER INFRA. & SUPPLY	Low
CSMG3 BZ	COPASA	Brazil	CSAOF	WATER INFRA. & SUPPLY	High
IAM CI	Aguas Metropolit	Chile	XVNF	WATER INFRA. & SUPPLY	High
KEP SP	KEP	Singapore	KPELF	WATER INFRA. & SUPPLY	Low
KEP SP	KEP	Singapore	KPELF	WATER INFRA. & SUPPLY	Low
OHL SM	OHL	Spain	OBSJF	WATER INFRA. & SUPPLY	Low
PNN LN	Pennon	United Kingdom	PEGRF	WATER INFRA. & SUPPLY	High
ROR LN	Rotork	United Kingdom	RTOXF	WATER INFRA. & SUPPLY	Low
SVT LN	Severn Trent	United Kingdom	SVTRF	WATER INFRA. & SUPPLY	High
SEV FP	Suez Environnement	France	SZEVF	WATER INFRA. & SUPPLY	Medium
UU/ LN	United Utilities	United Kingdom	UUGWF	WATER INFRA. & SUPPLY	High
URS US	URS Corp.	United States	URS	WATER INFRA. & SUPPLY	Low
VIE FP	Veolia	France	VEOEF	WATER INFRA. & SUPPLY	Medium
KSB3 GR	KSB AG	Germany	KSVRF	WATER INFRA. & SUPPLY	Low
363 HK	Shanghai Indus	Hong Kong	SGHIF	WATER INFRA. & SUPPLY	Low
ACM US	AECOM Technology	United States	ACM	WATER INFRA. & SUPPLY	Low
3 HK	HK&China Gas	Hong Kong	HOKCF	WATER INFRA. & SUPPLY	Low
270 HK	Guangdong Invest	Hong Kong	GGDVF	WATER INFRA. & SUPPLY	High
392 HK	Beijing Enterprises	Hong Kong	BJINF	WATER INFRA. & SUPPLY	Low
IDXX US	IDEXX	United States	IDXX	WATER MANAGEMENT	Low
DE US	Deere & Co	United States	DE	WATER MANAGEMENT	Low
ITRI US	Itron	United States	ITRI	WATER MANAGEMENT	Medium
SYNN VX	Syngenta	Switzerland	SYENF	WATER MANAGEMENT	Low
MRO LN	Melrose plc	United Kingdom	MLSPF	WATER MANAGEMENT	High
ALFA SS	Alfa Laval	Sweden	ALFVF	WATER TREATMENT	Low
BN FP	Danone	France	GPDNF	WATER TREATMENT	Low
DOW US	Dow Chemical	United States	DOW	WATER TREATMENT	Low
6370 JP	Kurita Water	Japan	KTWIF	WATER TREATMENT	High
LXS GR	Lanxess	Germany	LNXSF	WATER TREATMENT	Low
7011 JP	Mitsubishi Heavy	Japan	MHVYF	WATER TREATMENT	Low
PLL US	Pall Corp	United States	PLL	WATER TREATMENT	Low
SCI SP	SCI	Singapore	SCRPF	WATER TREATMENT	Low
6506 JP	Yaskawa Electric	Japan	YASKF	WATER TREATMENT	Low
VATW IN	Va Tech Wabag	India	XVWBF	WATER TREATMENT	High
034020 KS	Doosan Heavy	Korea, Republic Of	DOHIF	WATER TREATMENT	Low
ICL IT	ICL	Israel	ISCHF	WATER TREATMENT	Low
NESN VX	Nestle (Reg)	Switzerland	NSRGF	WATER TREATMENT	Low
GE US	General Electric	United States	GE	WATER TREATMENT	Low
ECL US	Ecolab Inc	United States	ECL	WATER TREATMENT	Medium
SRCL US	Stericycle	United States	SRCL	WATER TREATMENT	Low
KRA1V FH	Kemira	Finland	KMRAF	WATER TREATMENT	Low
HEXAB SS	Hexagon AB	Sweden	HXGBF	WATER TREATMENT	Low
DD US	DuPont	United States	DD	WATER TREATMENT	Low
3402 JP	Toray	Japan	TRYIF	WATER TREATMENT	Low
3405 JP	Kuraray	Japan	KURRF	WATER TREATMENT	Low
SOLB BB	Solvay	Belgium	SVYSF	EFFICIENCY – AUTO	Low
MGA US	Magna Intl	Canada	MGA	EFFICIENCY – AUTO	Medium
AQP LN	Aquarius Platinum	United Kingdom	AQPB	EFFICIENCY – AUTO	Low
CON GR	Continental AG	Germany	CTTAF	EFFICIENCY – AUTO	Medium
JCI US	Johnson Controls	United States	JCI	EFFICIENCY – AUTO	Medium
JMAT LN	Johnson Matthey	United Kingdom	JMPLF	EFFICIENCY – AUTO	Low
LXS GR	Lanxess	Germany	LNXS	EFFICIENCY – AUTO	Low
LKQ US	LKQ Corp.	United States	LKQ	EFFICIENCY – AUTO	Low
TSLA US	Tesla	United States	TSLA	EFFICIENCY – AUTO	High

12 September 2013

Table 1: Extreme weather - Weathering the perfect storm exposure (WPS)

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
VCT LN	Victrix	United Kingdom	VTXPF	EFFICIENCY – AUTO	Low
BWA US	BorgWarner	United States	BWA	EFFICIENCY – AUTO	High
3402 JP	Toray	Japan	TRYIF	EFFICIENCY – AUTO	Low
CSR AU	CSR Ltd	Australia	CSRLF	EFFICIENCY – BUILDINGS	Medium
IR US	Ingersoll-Rand	United States	IR	EFFICIENCY – BUILDINGS	High
JCI US	Johnson Controls	United States	JCI	EFFICIENCY – BUILDINGS	Medium
KNEBV FH	Kone OYJ	Finland	KNYJF	EFFICIENCY – BUILDINGS	High
5202 JP	Nippon Sheet Glass	Japan	NPSGF	EFFICIENCY – BUILDINGS	Medium
UTX US	United Tech	United States	UTX	EFFICIENCY – BUILDINGS	Low
PHIA NA	Philips	Netherlands	PHGFF	EFFICIENCY - INDS. & INTEG.	Medium
SIE GR	Siemens	Germany	SMAWF	EFFICIENCY - INDS. & INTEG.	Medium
PRY IM	Prysmian	Italy	PRYMF	EFFICIENCY - INDS. & INTEG.	Low
RXL FP	Rexel	France	RXLSF	EFFICIENCY - INDS. & INTEG.	Low
ABBN VX	ABB Ltd.	Switzerland	ABLZF	EFFICIENCY - INDS. & INTEG.	Medium
MEO1V FH	Metso	Finland	MXTOF	EFFICIENCY - INDS. & INTEG.	Low
NEX FP	Nexans	France	NXPRF	EFFICIENCY - INDS. & INTEG.	Medium
SU FP	Schneider	France	SBGSF	EFFICIENCY - INDS. & INTEG.	Medium
SIEM IN	Siemens Ltd	India	SMNBF	EFFICIENCY - INDS. & INTEG.	Low
SPX LN	Spirax-Sarco	United Kingdom	SPXSF	EFFICIENCY - INDS. & INTEG.	High
VK FP	Vallourec	France	VLOUF	EFFICIENCY - INDS. & INTEG.	Low
6273 JP	SMC	Japan	SMECF	EFFICIENCY - INDS. & INTEG.	High
ALO FP	Alstom	France	AOMFF	EFFICIENCY - INDS. & INTEG.	Medium
ALFA SS	Alfa Laval	Sweden	ALFVF	EFFICIENCY - INDS. & INTEG.	Medium
ATCOA SS	Atlas Copco	Sweden	ATLKF	EFFICIENCY - INDS. & INTEG.	Low
CRG IN	Crompton Greaves	India	CPGZF	EFFICIENCY - INDS. & INTEG.	Low
2308 TT	Delta Elect	Taiwan	DLTEF	EFFICIENCY - INDS. & INTEG.	High
ELUXB SS	Electrolux	Sweden	ELUXF	EFFICIENCY - INDS. & INTEG.	Medium
HXL US	Hexcel Corp	United States	HXL	EFFICIENCY - INDS. & INTEG.	High
GE US	General Electric	United States	GE	EFFICIENCY - INDS. & INTEG.	Medium
G1A GR	GEA	Germany	GEAGF	EFFICIENCY - INDS. & INTEG.	High
HEXAB SS	Hexagon AB	Sweden	HXGBF	EFFICIENCY - INDS. & INTEG.	Low
ETN US	Eaton Corp PLC	United States	ETN	EFFICIENCY - INDS. & INTEG.	Low
ISYS LN	Invensys	United Kingdom	IVNSF	EFFICIENCY - INDS. & INTEG.	Low
VMW US	VMware Inc	United States	VMW	EFFICIENCY - IT	High
EMC US	EMC Corp	United States	EMC	EFFICIENCY - IT	High
INTC US	Intel	United States	INTC	EFFICIENCY - IT	High
AMZN US	Amazon.com	United States	AMZN	EFFICIENCY - IT	Low
ARM LN	ARM Holdings	United Kingdom	ARMHF	EFFICIENCY – IT	High
CRM US	Salesforce.com	United States	CRM	EFFICIENCY – IT	High
EQIX US	Equinix	United States	EQIX	EFFICIENCY – IT	High
CSCO US	Cisco Systems	United States	CSCO	EFFICIENCY – IT	Medium
GOOG US	Google	United States	GOOG	EFFICIENCY – IT	Low
AMD US	Advanced Micro	United States	AMD	EFFICIENCY – IT	High
HPQ US	Hewlett-Packard	United States	HPQ	EFFICIENCY – IT	Low
IBM US	IBM	United States	IBM	EFFICIENCY – IT	Low
ASML NA	ASML NA	Netherlands	ASMLF	EFFICIENCY – IT	High
INXN US	InterXion	Netherlands	INXN	EFFICIENCY – IT	High
TCY LN	Telecity	United Kingdom	TLCTF	EFFICIENCY – IT	High
PHIA NA	Philips	Netherlands	PHGFF	EFFICIENCY – LED & LIGHT.	Medium
SIE GR	Siemens	Germany	SMAWF	EFFICIENCY – LED & LIGHT.	Medium
046890 KS	Seoul Semiconductor	Korea, Republic Of	SLSOF	EFFICIENCY – LED & LIGHT.	High
CREE US	CREE	United States	CREE	EFFICIENCY – LED & LIGHT.	High
2448 TT	Epistar	Taiwan	EPIPF	EFFICIENCY – LED & LIGHT.	High
2393 TT	Everlight	Taiwan	EVLEF	EFFICIENCY – LED & LIGHT.	High
ITRI US	Itron	United States	ITRI	EFFICIENCY – SMART GRID	High
MRO LN	Melrose plc	United Kingdom	MLSPF	EFFICIENCY – SMART GRID	High
SQM US	SQM	Chile	SQM	EFFICIENCY – SMART GRID	Low
ALO FP	Alstom	France	AOMFF	EFFICIENCY - TRANSPORT	Medium
3898 HK	Zhuzhou CSR	China	ZHUZF	EFFICIENCY - TRANSPORT	High
NEX LN	National Express	United Kingdom	NXPGE	EFFICIENCY – TRANSPORT	High
BBD/B CN	Bombardier Inc.	Canada	YBBD B	EFFICIENCY – TRANSPORT	High
CNI US	Canadian Natl	Canada	CNI	EFFICIENCY – TRANSPORT	High

Table 1: Extreme weather - Weathering the perfect storm exposure (WPS)

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
1186 HK	CRCC	China	CWYCF	EFFICIENCY – TRANSPORT	Medium
390 HK	CRG	China	CRWOF	EFFICIENCY – TRANSPORT	High
1766 HK	CSR	China	CSRGF	EFFICIENCY – TRANSPORT	High
FGP LN	FirstGroup Plc	United Kingdom	FGROF	EFFICIENCY – TRANSPORT	High
GOG LN	Go-Ahead Group	United Kingdom	GHGUF	EFFICIENCY – TRANSPORT	High
525 HK	Guangshen Railway	China	GNGYF	EFFICIENCY – TRANSPORT	High
SGC LN	Stagecoach Group	United Kingdom	SAGKF	EFFICIENCY – TRANSPORT	High
VOS GR	Vossloh	Germany	VOSSF	EFFICIENCY – TRANSPORT	High
YZJSGD SP	Yangzijiang	Singapore	YSHLF	EFFICIENCY – TRANSPORT	Low

Source: BofA Merrill Lynch Global Research

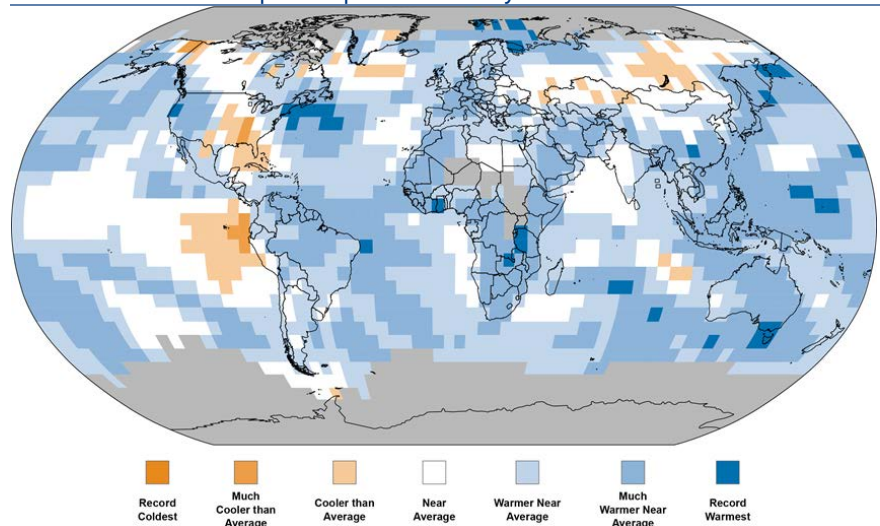
Extreme weather & climate change, welcome to the new normal

It's getting warmer & less predictable

2013 marks the 28th consecutive year with a global temperature above the 20th century average
(Source: NOAA)

2012 was the 10th warmest year globally since record keeping began in 1880. The globally-averaged annual combined land and ocean surface temperature was 0.57°C (1.03°F) above the 20th century average of 13.9°C (57.0°F). This has continued in 2013 with July 2013 the sixth highest July since record keeping began in 1880. It also marked the 341st consecutive month – over 28 straight years – with a globally averaged temperature above the 20th century average. The last below-average July temperature was July 1976 and the last below-average temperature for any month was February 1985. Including 2012, all 12 years to date in the 21st century (2001–2012) rank among the 14 warmest in the 133-year period of record (Source: NOAA National Climatic Data Center).

Chart 5: Land & ocean temperature percentiles at July 2013



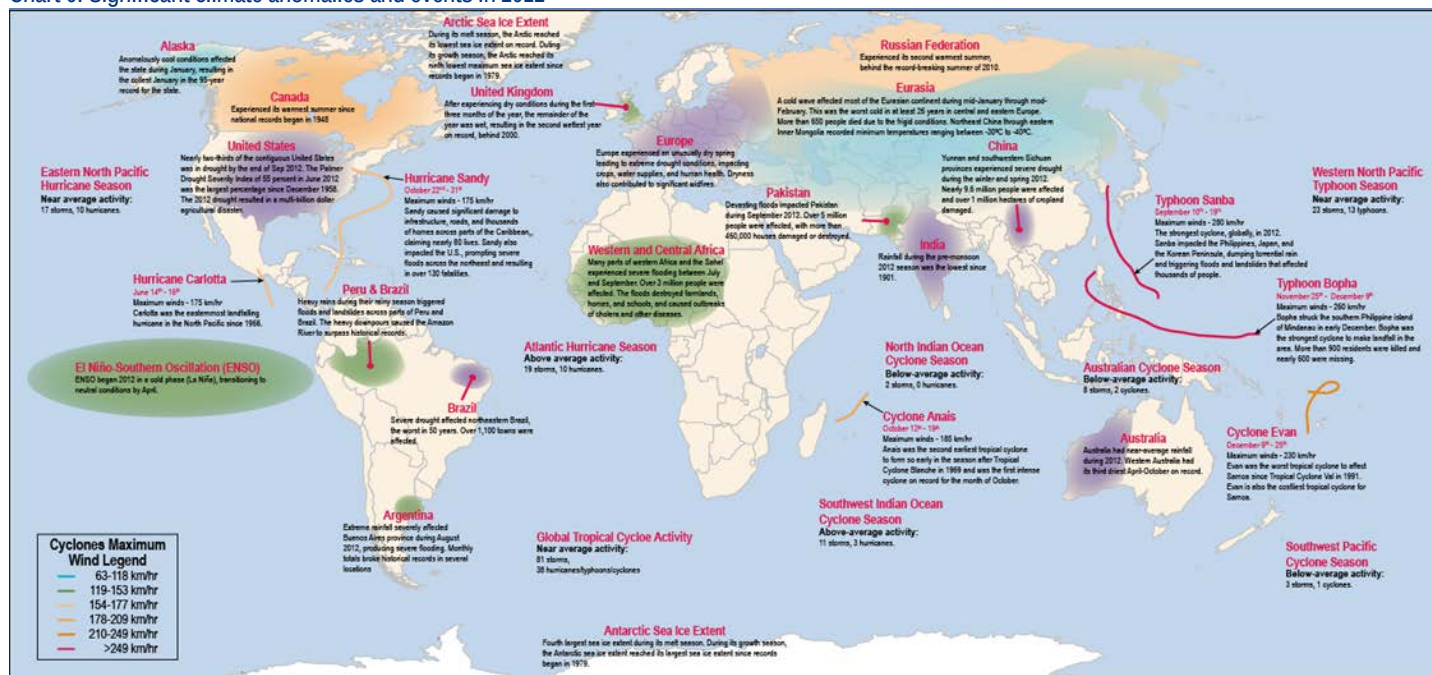
Source: NOAA, BofA Merrill Lynch Global Research

Climate anomalies on the rise globally

In 2012, most areas of the world experienced higher-than-average annual temperatures, including most of North and South America, most of Europe and Africa, and western, southern, and far northeastern Asia. Meanwhile, most of Alaska, far western Canada, central Asia, parts of the eastern and equatorial Pacific, southern Atlantic, and parts of the Southern Ocean were notably cooler than average. Additionally, the Arctic experienced a record-breaking ice melt season while the Antarctic ice extent was above average (Source: NOAA National Climatic Data Center).

12 September 2013

Chart 6: Significant climate anomalies and events in 2012



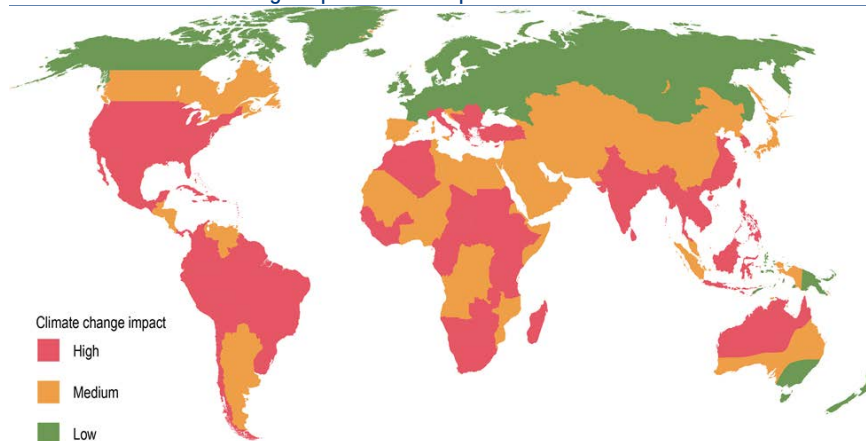
Source: NOAA

Growing focus on the extreme weather - climate change link

A world in which warming reaches 4°C above preindustrial levels, would be one of unprecedented heat waves, severe drought, and major floods in many regions, with serious impacts on human systems, ecosystems, and associated services (Source: World Bank)

The overwhelming majority of scientific opinion on climate change is that the Earth's climate system is unequivocally warming, and that it is highly likely that humans are causing it through activities that increase concentrations of greenhouse gases (GHGs) in the atmosphere. While it is not possible to attribute individual weather events to climate change – and natural variability inevitably plays a role - scientists are beginning to link certain extreme weather events including decreasing cold days, increasing very high temperatures, and altered rainfall patterns with climate change.

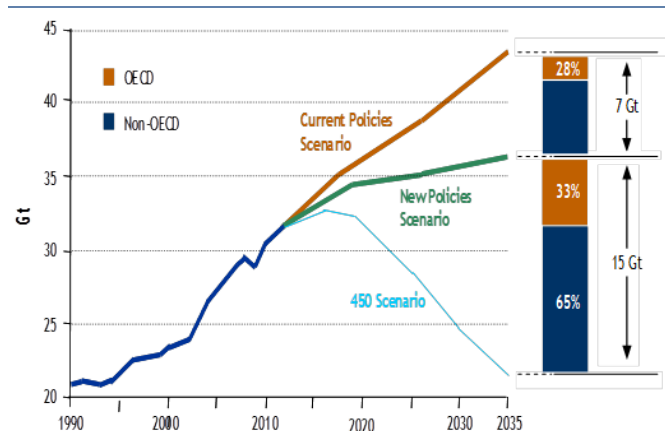
Chart 7: World climate change impact stress map



Source: Syngenta, UNEP, Cline, BoFA Merrill Lynch Global Research

At the current pace, cumulative CO₂ emissions over the next 25 years will amount to three-quarters of the total from the past 110 years – and China's per-capita emissions will match the average of OECD countries (Source: IEA)

Chart 8: IEA CO₂ emissions scenarios to 2025



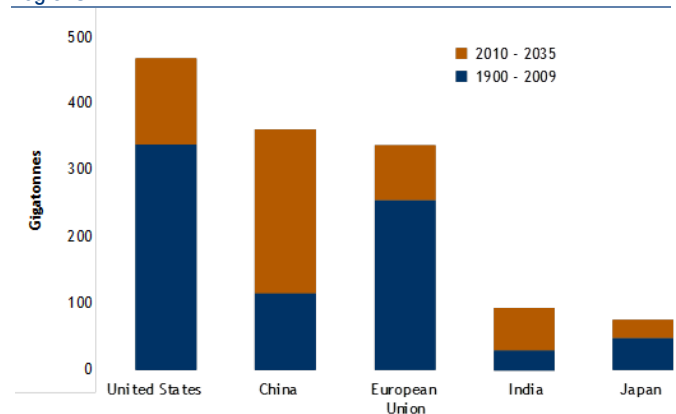
Source: IEA, BofA Merrill Lynch Global Research

Short-term, lower rates of economic growth would only have minimal impact on these energy and climate trends.

On track for a 4°C warmer world

Without further commitments and actions to reduce GHGs, the world is set to get warmer by more than 3°C than the pre-industrial era climate (Source: World Bank). Even with full implementation of mitigation commitments and pledges, there is a 20% chance of exceeding 4°C by 2100. If such commitments are not met, scientists are now nearly unanimously predicting a 4°C increase by 2100, and it could happen as early as the 2060s (Source: World Bank).

Chart 9: Cumulative energy-related CO₂ emissions in selected regions



Source: IEA, BofA Merrill Lynch Global Research

Devastating consequences on the horizon

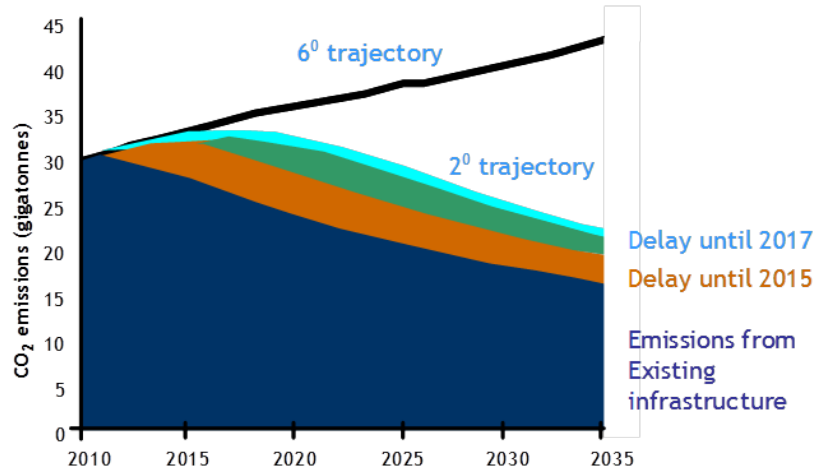
According to the World Bank's 2012 "Turn Down the Heat – Why a 4°C Warmer world Must be Avoided" report:

"The 4°C scenarios are devastating: the inundation of coastal cities; increasing risks for food production potentially leading to higher malnutrition rates; many dry regions becoming dryer, wet regions wetter; unprecedented heat waves in many regions, especially in the tropics; substantially exacerbated water scarcity in many regions; increased frequency of high-intensity tropical cyclones; and irreversible loss of biodiversity, including coral reef systems. And most importantly, a 4°C world is so different from the current one that it comes with high uncertainty and new risks that threaten our ability to anticipate and plan for future adaptation needs."

6° would be even more dangerous

Were new policies not implemented, we could be on an even more dangerous path, to an increase of 6°C – which would be significantly higher than the globally agreed goal of an increase of 2°C (which would require the long-term atmospheric concentration of GHGs in the atmosphere to be limited to 450 parts per million (ppm) of CO₂-eq (source: IEA).

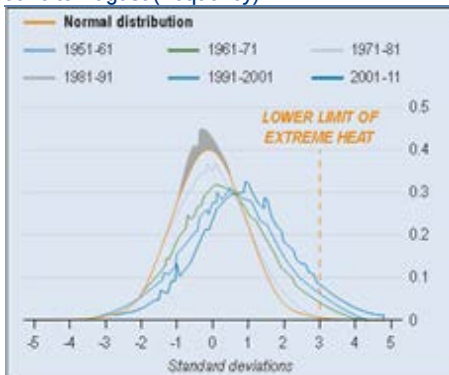
Chart 10: CO₂ emissions temperature trajectories to 2035



Source: IEA WEO 2011, BoFA Merrill Lynch Global Research

"We know from past changes that ecosystems have responded to a few degrees of global temperature change over thousands of years, But the unprecedented trajectory that we're on now is forcing that change to occur over decades. That's orders of magnitude faster, and we're already seeing that some species are challenged by that rate of change." – Prof. Noel Diffenbaugh, Stanford Woods Institute for the Environment

Chart 11: Global temperature deviation from June to August (frequency)



Source: Goddard Institute for Space Studies, BoFA Merrill Lynch Global Research
Temperature deviation from the 1951-1980 reference period in 250km wide cells around the Earth's surface

Speed of change - up to 10x faster than last 65mn years

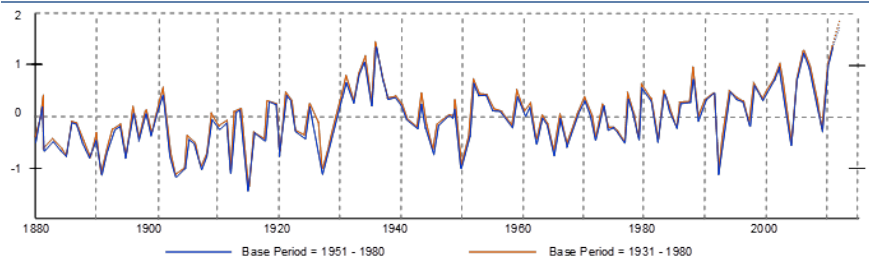
Recent research by Stanford scientists suggests that climate change is on pace to occur at a rate 10x faster than any climate shift recorded in the past 65mn years and that without intervention, this could lead to a 5-6°C spike in annual temperatures by the end of the century (i.e. comparable to the hike we saw 20,000 years ago as the earth emerged from the last ice age but over a much shorter period) (Source: Diffenbaugh et. al., Science 2013)

Extreme weather is becoming the new normal

Peer reviewed climate modelling – and more importantly, actual statistical observations of past extreme weather events and temperatures – increasingly show a direct link to climate change. There is a growing belief that such events will become more frequent and more severe in the coming years. Sceptics remain – but this work reinforces evidence that climate change is occurring and that it is increasingly harmful:

- **Extremes are much more frequent and more intense worldwide.** Extremely hot temperatures covered about 0.1% to 0.2% of the globe from 1951 to 1980. But in the last three decades, while the average temperature has slowly risen, the extremes have soared and now cover about 10% of the globe.

Chart 12: U.S. Jun-Jul-Aug surface temperature anomaly (°C)



Source: NASA Goddard Institute for Space Studies, BofA Merrill Lynch Global Research

"The odds that natural variability created these extremes are minuscule, vanishingly small. To count on those odds would be like quitting your job and playing the lottery every morning to pay the bills."

– James E. Hansen, Director of NASA Goddard Institute for Space Studies (Washington Post, 2012)

- **Recent extreme weather events may be attributed to climate change.** Catastrophic droughts in Texas and Oklahoma (2011), the Russian heat wave of (2010), and the European heat wave (2003) according to scientists can be wholly or partly attributed to climate change (Source Hansen et. al, National Academy of Sciences 2012; National Oceanic and Atmospheric Administration 2012). There is growing belief that the current US drought falls within this category.
- **Natural variability is being altered by climate change.** While none deny its impact on extremes, the variability of day to day weather – as well as recurring climate patterns such as El Niño and La Niña – are potentially being altered by climate change with greater odds that the “climate dice” roll warmer (Source Hansen et. al, Proceedings of the National Academy of Sciences 2012).
- **The largest warming will occur over land and will range from 4°C to 10°C.** Increases of 6°C would be expected in the Mediterranean, North Africa, Middle East, and the contiguous U.S. Recent extreme heat waves are likely to become the new normal, tropical areas are likely to experience heat waves of unprecedented magnitude and duration, the coolest months would be substantially warmer, and the warmest July in the Mediterranean would be 9°C warmer than today’s warmest July (Source World Bank).

Unprecedented extreme weather here to stay long-term

While it is all too easy to link any and all incidents of extreme weather events with climate change, scientific evidence increasingly points to the worsening of: warming in high latitudes (including unprecedented high-temperature extremes in the tropics), sea-level rises and flooding (with the tropics higher than the global mean), increases in tropical cyclone intensity (especially in low-latitude regions), and increasing aridity and drought (especially in tropical and subtropical areas (Source: World Bank).

40% of land area could be facing extreme heat by 2040e

Based on climate modelling, extreme heat waves could by 2020 affect about 10% of total land area - double today's figure. By 2040, it could quadruple. Over the same period, the researchers believe that more extreme “five-sigma events” or unprecedented heat waves – could emerge and cover 3% of the global land surface by 2040. (Source: Coumou et al, Environmental Research Letters, 2013).

Today's CO2 decisions can still influence what will happen in 20-30Y

The same study found that under a low CO2 emission scenario, the number of extremes would stabilise by 2040, whereas under a high emission scenario, the

Extreme “five-sigma events” or unprecedented heat waves – could emerge and cover 3% of the global land surface by 2040

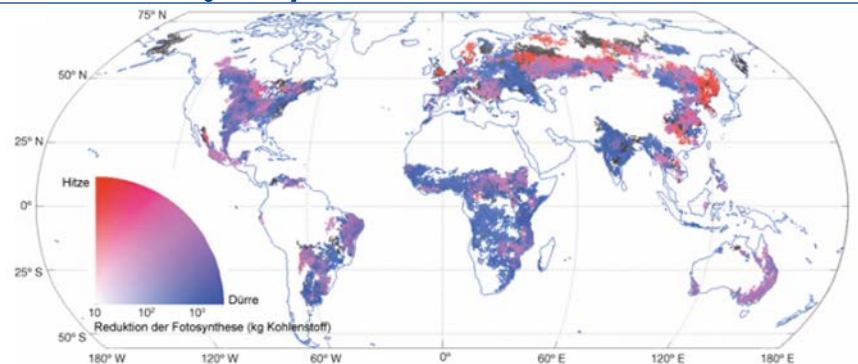
"As extreme climate events reduce the amount of carbon that the terrestrial ecosystems absorb and the carbon dioxide in the atmosphere therefore continues to increase, more extreme weather could result. It would be a self-reinforcing effect." - Markus Reichstein, Max Planck Institute for Biogeochemistry

land area affected by extremes will increase 1% p.a. until three-sigma heat waves affect 85% of the global land area by 2100 and five-sigma events about 60 %.

Extremes having significant impact on the carbon balance

Extreme weather is having a much more pronounced impact on the carbon balance than had previously been assumed. In the past 50 years, plants and the soil have absorbed up to 30% of human-induced CO₂ emissions. However, research by scientists involved with the Max Planck Institute for Biogeochemistry and CARBO-Extreme Project shows that terrestrial ecosystems such as forests, meadows and agricultural land absorb approximately 11bn tons less CO₂ every year as the result of the extreme climate events than they could if the events did not occur. That is equivalent to approximately a third of global CO₂ emissions per year being emitted into the atmosphere.

Chart 13: Regions where drought (blue), heat (red), both (purple) and other (grey) extreme events prevent plant uptake of CO₂ and to what extent [lighter colours = weaker effect, darker colours = stronger effect]



Source: Reichstein et. al.

"Earth's changing climate and the global spread of infectious diseases are threatening human health, agriculture and wildlife." - Sam Scheiner, National Science Foundation (NSF) Program Director

Globally, temperature increases of 2-3°C would increase the number of people who, in climatic terms, are at risk of malaria by around 3-5%, i.e. several hundred million (Source: WHO)

Climactic conditions affect disease & human health

It is well established that climactic conditions affect diseases – and the WHO says that “changes in infectious disease transmission patterns are a likely major consequence of climate change.” Disease ecologists are also seeing an increase in disease and parasitism, which together with warmer temperatures - could place growing numbers of species at risk of extinction. This could also have important human health impacts as pathogens like cholera, dengue, and malaria are linked to warmer temperatures. Indirect risks also exist in threats to agricultural systems and game species that are crucial for subsistence and cultural activities. That said, the climate signal can be hard to distinguish from factors like GDP/wealth, health infrastructure, and access to medicines – meaning a further need for monitoring and surveillance of local impacts (Source: Altizer et. al., Science 2013).

Table 2: Infectious diseases are affected by climate change

Disease	Vector	Population at risk (mn)	No. people currently infected or new cases per year	Present distribution	Likelihood of altered distribution
Malaria	Mosquito	2,400	300-500 million	Tropics and Subtropics	Highly likely
Schistosomiasis	Water snail	600	200 million	Tropics and Subtropics	Very likely
Lymphatic Filariasis	Mosquito	1094	117 million	Tropics and Subtropics	Likely
African Trypanosomiasis (sleeping sickness)	Tsetse fly	55	250,000 to 300,000 cases per year	Tropical Africa	Likely
Dracunculiasis (Guinea worm)	Crustacean (Copepod)	100	100,000 cases per year	South Asia, Arabian Peninsula, Central-West Africa	Unknown
Leishmaniasis	Phlebotomine sand fly	350	12 million infected, 500,000 new cases per year	Asia, Southern Europe	Likely
Onchocerciasis (river blindness)	Black fly	123	17.5 million	Africa, Latin America	Very likely
American Trypanosomiasis (Chagas disease)	Triatomine bug	100	18 million	Central and South America	Likely
Dangue	Mosquito	1800	10-30 million cases per year	All Tropical countries	Very likely
Yellow Fever	Mosquito	450	>5,000 cases per year	Tropical South America, Africa	Likely

Source: WHO

The climate does not have to deviate much to upset that peace and wellbeing – a 1 standard-deviation shift is roughly equal to warming an African country by 0.35°C (0.63°F), for an entire year, or warming a county in the U.S. by 2.9°C (5.2°F), for a given month (Source: Hsiang et. al.)

Greater human conflict, will hotter heads prevail...

Researchers from Princeton University and the University of California-Berkeley suggest that more human conflict is a likely outcome of climate change. The researchers found that 1 standard-deviation shift — the amount of change from the local norm — in temperature and precipitation greatly increase the risk of personal violence (+4%) and intergroup conflict (+14%). The researchers report that climate-change models predict an average of 2 to 4 standard-deviation shifts in global climate conditions by 2050.

12,000 years of worrying evidence

The researchers based their analysis on 60 studies exploring the extreme weather-conflict link from 10,000 BCE to present day from a number of disciplines. Examples include spikes or increases in: civil conflicts (tropics); ethnic violence (Europe, South Asia); land invasions (Brazil); domestic violence (India, Australia); assaults and murders (U.S., Tanzania); police use of force (Holland); and the collapse of empires (Mayan, Chinese). That said, the researchers said that exactly why climate affects conflict and violence is the most pressing question for future research in the space.

2012 was a game changer

Climate events in 2012 – notably in the U.S. – helped to put extreme weather and even climate change on top of governmental and stakeholder agendas.

Hottest year on record in U.S.

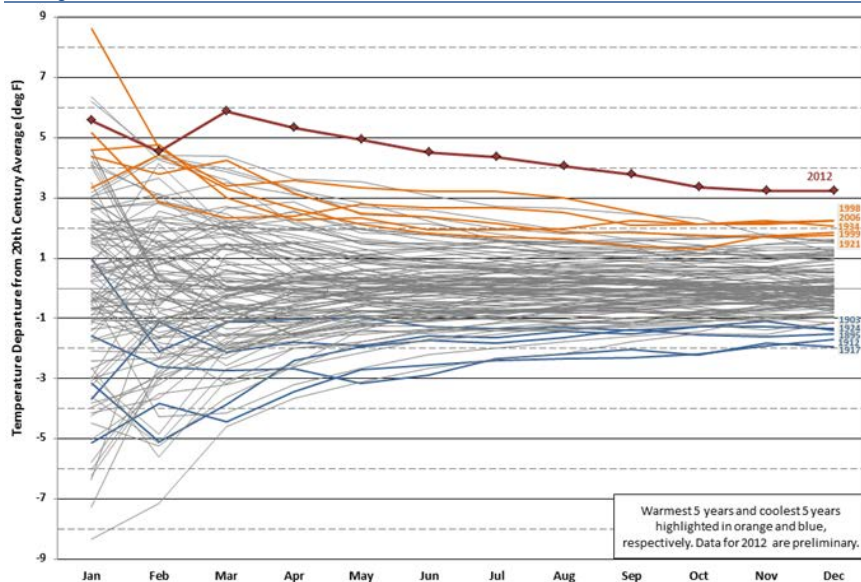
In 2012, the contiguous U.S. (lower 48 states) had its warmest year since national records began in 1895, surpassing the previous record set in 1998 by 0.6°C (1.0°F) (Source: NOAA).

Table 3: 1Y evolution of moderate, severe, extreme & exceptional drought for lower 48 states

Date	% of lower 48 states
Current (at Aug. 8 2013)	50.04
3 months ago	45.61
Start of calendar year	61.09
Start of water year	65.45
1Y ago	63.2

Source: National Drought Mitigation Center

Chart 14: 2012 was the warmest year for the contiguous U.S. since 1895: 3.3°F above average

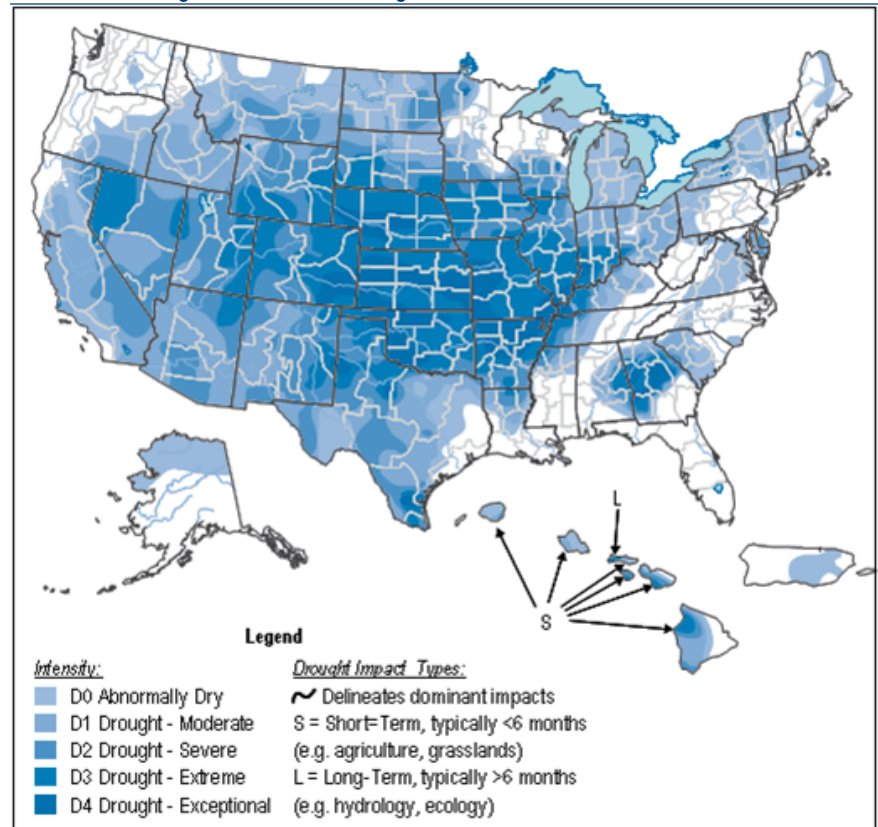


Source: NOAA's National Climatic Data Center., BofA Merrill Lynch Global Research

Worst drought since the 1950s

In August and September of 2012, c65% of the lower 48 states suffered from moderate to exceptional drought – a record in the United States Drought Monitor history.

Chart 15: US drought conditions at 28 August 2012

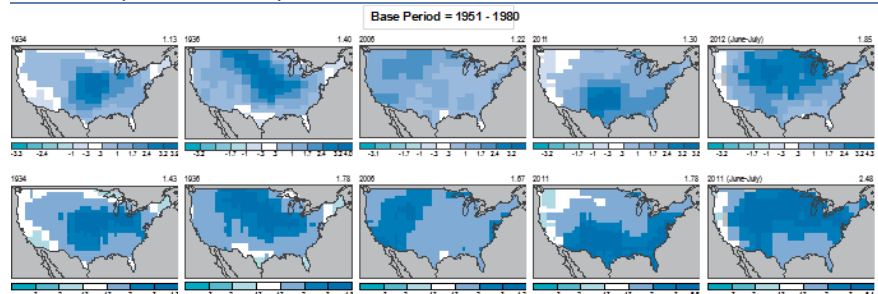


Source: The Drought Monitor, National Drought Mitigation Center.

It wasn't the Dust Bowl, but...

The 2012 US drought was not as severe as the multi-year mega-drought of the Dust Bowl in the 1930s when 2.5 million people moved out of the regions affected, 100 million acres of land was affected, and 75% of topsoil was lost by the end of the decade. But 2012 actually covered more territory than the Dust Bowl did in 1934.

Chart 16: US Jun-Jul-Aug surface temperature anomaly (°C) – Dust Bowl (1934, 1936) vs. current era (2006, 2011, 2012)

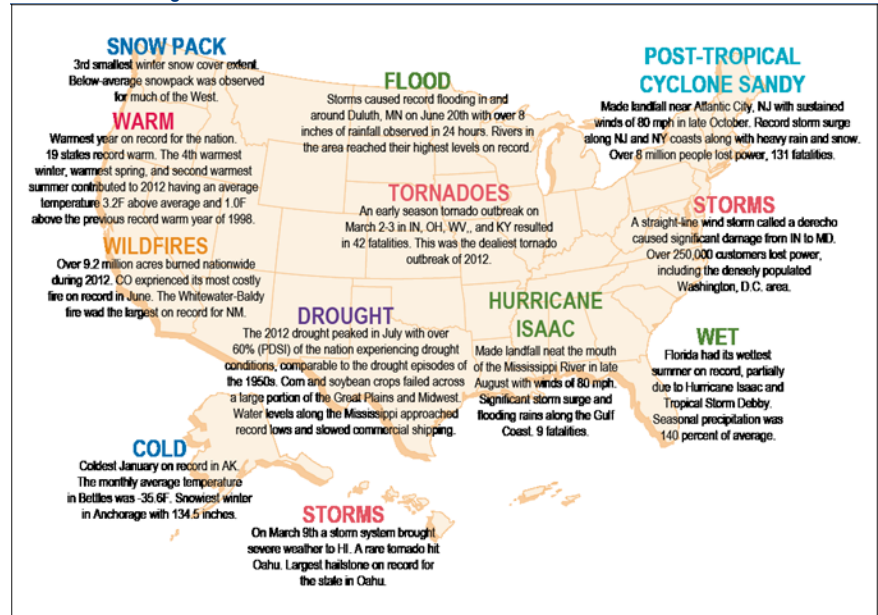


Source: Source: NASA Goddard Institute for Space Studies, BofA Merrill Lynch Global Research. The top row shows the temperature anomalies in °C and the bottom row shows the temperature anomalies in the 1951-1980 standard deviation

“Superstorm” Sandy and climate extremes

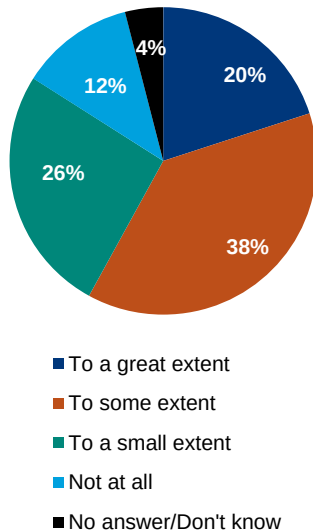
2012 also saw the U.S. get hit by Hurricane Sandy – the second-costliest hurricane in American history after Katrina - with 222 direct and indirect deaths, 650,000 homes damages or destroyed, and 8.5mn customers left without power (Source: NOAA). Estimates as of June 2013 assessed damage to have been over US\$68 billion. Its severe and widespread damage, together with its unusual merge with a frontal system, resulted in the nicknaming of the hurricane as “Superstorm Sandy”.

Chart 17: 2012 Significant U.S. Climate Events



Source: NOAA, BofA Merrill Lynch Global Research

Chart 18: To what extent does climate change & global warming affect the risk that your neighbourhood will be hit by a major natural catastrophe



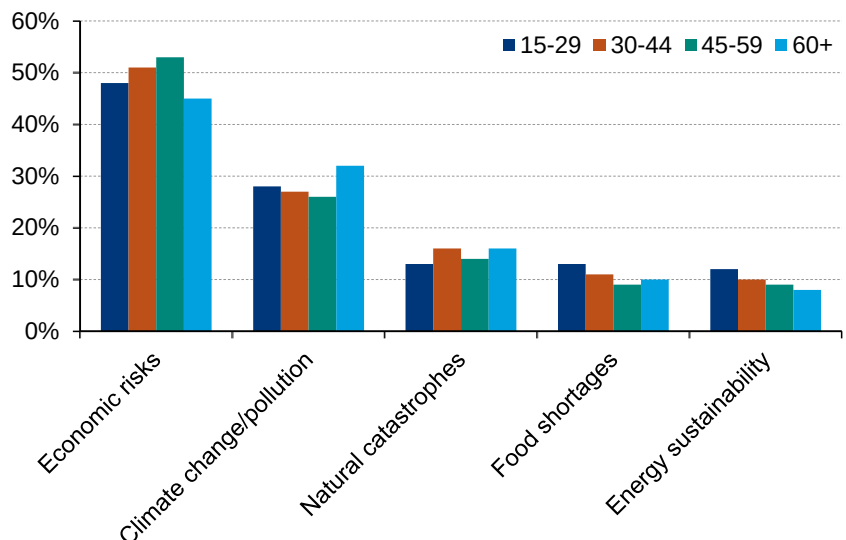
Source: Swiss Re, BofA Merrill Lynch Global Research

Stakeholders & investors getting concerned Men & women on the street are getting worried

Consumers are demonstrating an increasing awareness of climate change and extreme weather with an August 2013 poll of nearly 22,000 people in 19 countries on five continents commissioned by Swiss Re and conducted by Gallup showing that:

- **84% believe that climate change will be responsible for more extreme weather** in the future
- **Climate change & pollution rank as the 2nd most important risk facing countries** at the moment (after economic risks) at 26-32% (by age group). A further 13-16% listed natural catastrophes, 9-13% food shortages and 8-12% energy sustainability – all of which are closely linked with climate change.
- **China & Switzerland regard climate change as the most important risks** facing their countries at the moment at 44% and 43% respectively
- **Nearly 8 in 10 fear damage from extreme weather** (e.g. an earthquake, flood or other natural disaster within the next 20 years)
- **91% want governments to do more to promote energy efficiency** and 75% said they would use renewable energy if it were made available (Source: Swiss Re).

Chart 19: Generations most aligned on risk perception - world view

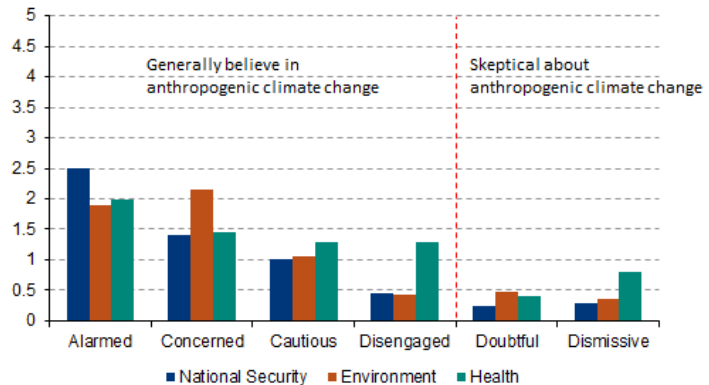


Source: Swiss Re, BofA Merrill Lynch Global Research

Public health impacts most concern stakeholders

The potential for human health impacts may make climate change more personally relevant and emotionally engaging to segments of the public who are currently disengaged or even dismissive of the issue – according to a survey of 11,000 U.S. residents. The survey showed that framing global warming as a public health issue rather than as an environmental or national security one produces the most emotionally compelling response among people, since it focuses on the immediate implications a warmer climate could have on people's lives (Source: Myers et. al., Climactic Change 2012)

Chart 20: # of Sentences that made the respondent hopeful



Source: Myers et. al., Climatic Change 2012, BofA Merrill Lynch Global Research

Investors targeting climate change & extreme weather risk

An August 2013 report prepared by Mercer for the Global Investor Survey on Climate Change – surveyed 84 asset owners and asset managers with US\$14tn in AUM and based in 10 countries and found that climate change is increasingly influencing investments.

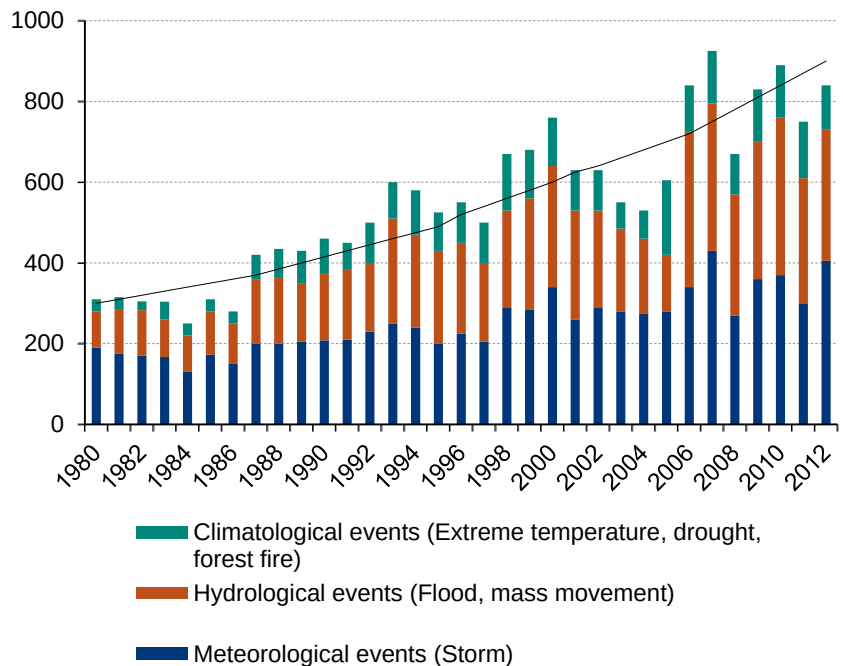
- **81% of responding Asset Owners and 68% of Asset Managers stated they view climate change as a material risk or opportunity across their entire investment portfolio.** The bulk of the remaining responses see climate change as a material risk across some asset classes only – primarily public and private equities, real estate, and infrastructure, with cash typically excluded and some debate over the potential impacts for corporate and sovereign debt.

Climate-related losses are skyrocketing

Since 1980, global weather- and climate-related disaster losses have ranged from a few billion to a high of US\$200bn in 2005 (in 2010 dollars) as a result of Hurricane Katrina. And these estimates do not include indirect and intangible losses. According to NOAA, 2011 and 2012 were the two most extreme years on record for destructive weather events, which caused a total of more than \$170 billion in damages, much of that to businesses.

Weather can cause up to a 1.7% rise or fall of GDP
(Source National Centre for Atmospheric Research
(based on an analysis of 70Y of weather data)

Chart 21: Weather catastrophes worldwide 1980-2012



Source: Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As at January 2013

The greatest annual loss to date in the U.S. was 2005 when Hurricanes Katrina, Rita, Wilma and Dennis struck Florida and the Gulf Coast states (costs exceeded US\$187bn, CPI-adjusted to 2012 dollars) (Source: NOAA)

Extreme weather events dominated the list in 2012

2012 stood out for weather- and climate-related disasters, accounting for 90% of global insured losses – with Aon Benfield's Annual Global Climate and Catastrophe Report – reporting 295 separate natural disaster events, above the ten year average of 257, with the U.S. coming second to Asia in experiencing the most catastrophes.

\$77bn in insured losses & \$186bn in economic losses

Natural catastrophes and man-made disasters caused economic losses of US\$186bn with 144,000 lives lost. U.S. extreme weather events pushed total insured claims for 2012 to US\$77bn, making it the third most expensive year in history (but lower than 2011 with earthquakes and flooding in Asia-Pacific) (Source: Swiss Re).

US hit hard - Sandy & drought

The U.S. also accounted for 67 per cent of insured losses globally in 2012 (Source: Aon Benfield) including nine of the ten most expensive insured events (Source: Swiss Re), such as:

- **Hurricane Sandy, \$70bn in economic losses & \$25-35bn in insured losses** – with \$20-25 billion covered by private insurance (Source: Munich re, Swiss Re).
- **2012 U.S. crop losses, US\$11-17bn** – including payouts from the federal Multi-Peril Crop Insurance program, making it the highest ever recorded loss in agricultural insurance (Source: Swiss Re, Munich Re)

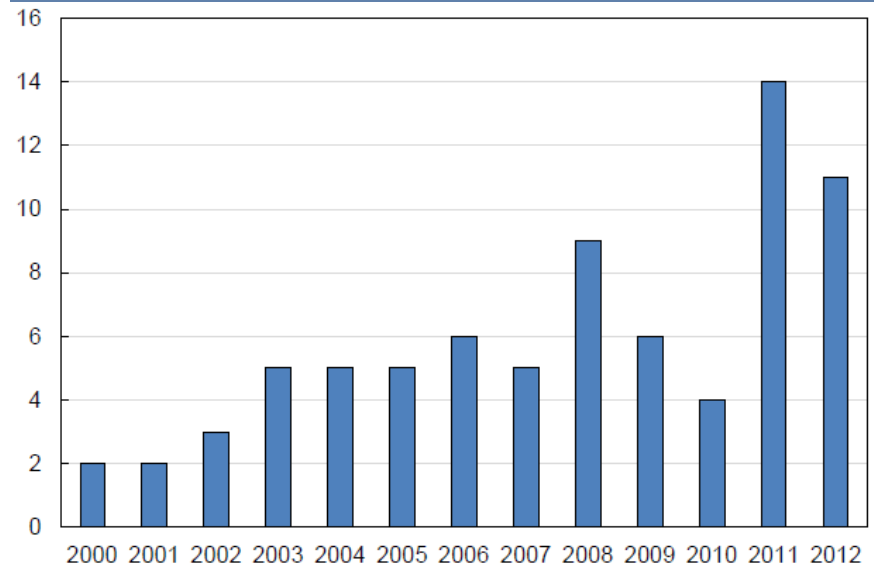
7 of the 10 costliest storms in US history happened between 2004 and 2012 (Source: US EIA)

"Sandy challenged the industry with its combination of record wind field and storm surge. The possibility that such events could increase in frequency and strike densely populated regions such as the northeast US means that extreme storm-surges need to be more thoroughly understood." (Source: Matthias Weber, Swiss Re's Group Chief Underwriting Officer)

Devastating U.S. economy & millions of lives

Since 1980, the United States has sustained 144 weather disasters whose damage cost reached or exceeded \$1 billion. The total cost of these 144 events exceeds US\$1tn (U.S. Department of Commerce 2013). Moreover, seven of the ten costliest storms in U.S. history occurred between 2004 and 2012 (U.S. DOC 2012).

Chart 22: US billion dollar weather / climate disasters



Source: National Oceanic and Atmospheric Administration

"[W]e cannot continue to ignore our nation's housing crisis, the environmental justice issues that continue to plague our communities, and the growing economic inequality that inhibits our country's growth. Resiliency in low-income communities is an investment we can and must make." (Source: CAP)

EMs & low-income individuals at greatest risk

Large parts of the emerging world are being hit hardest – given that many parts are prone to extreme weather and low insurance penetration levels. But even in developed markets, low-income communities are disproportionately affected by extreme weather. An August 2013 report by the Center for American Progress (CAP) states that neighbourhoods where a majority of residents live at or below the poverty line are ill-prepared to deal with fallout from storms and other weather-related disasters – and thus are harder hit when extreme weather arises. Superstorm Sandy and its disproportionate impact of the storm surge on low-income renters is one illustration. Potential adaptation measures proposed by the Cap include:

- Strengthening and increasing affordable housing
- Addressing environmental factors
- Enhancing economic stability

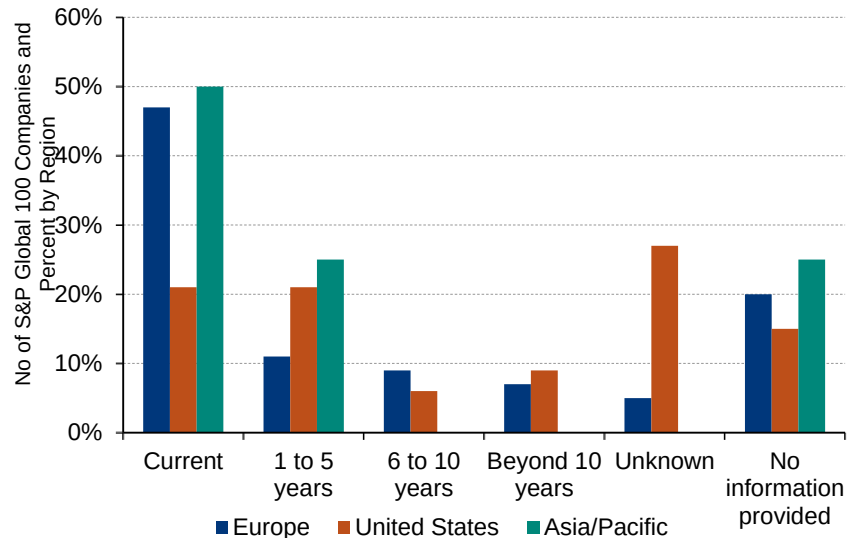
90% of S&P Global 100 are feeling the pain

90% of the S&P Global 100 Index companies identify extreme weather and climate change as current or future risks to their business, across all industry sectors (Source: Climate and Energy Solutions (C2ES)). While the vast majority of companies acknowledge these risks, they are also being challenged with adequately understanding the risks and their implications for the business.

- **Many companies are already experiencing climate change impacts or expect to in the near future.** Nearly all S&P Global 100 companies say that

they are experiencing a greater intensity and variability of extreme weather than they did in the past. 38 100 companies report that they have already experienced the adverse effects of extreme weather and climate change, and an additional 17 companies believe that such impacts will affect them in the next five years (Source: C2ES).

Chart 23: Earliest estimates for when extreme weather impacts will occur



Source: C2ES research based on Carbon Disclosure Project and other information sources (2012).

The UK's National Adaptation Programme Report (2013) shows that 64% of UK businesses have suffered supply chain disruption due to extreme weather and 70% of major businesses and their suppliers see significant risk from climate change. Yet only 40% of large businesses in the UK are taking action to ensure they are ready to deal with the impacts of climate change.

- **The top two areas of concern are direct impacts on production capacity** such as property damage or supply interruptions (57%) and impacts on operational costs such as higher commodity prices or maintenance costs (47%) (Source: C2ES).
- **40% of S&P Global 100 companies highlight current or potential future risks to their supply chains** from extreme weather and climate change. 25%, primarily in the consumer goods, healthcare, and information and ICT & services sectors, are concerned about interruptions across their global value chain, specifically, damage to suppliers of key inputs, transport difficulty for intermediate goods, or supply disruptions for getting final products to market. 18% are also particularly concerned about the availability and quality of water supply (Source: C2ES).

Insurance sector turning its attention to climate change

The impact of extreme weather is hitting the insurance and reinsurance industries via insured property losses and challenges to risk models and premiums. A June 2013 report by the Geneva Association – an international re/insurance think tank – questions the on-going commercial viability of the catastrophe risk business in some areas and calls for updated internal risk modelling that takes into account a reasonably wide range of "hypothetical but scientifically justifiable scenarios." It also calls on the industry to play a pro-active role including lobbying to raise awareness of the impacts of climate change

Regulation may be a further driver

A number of U.S. states including California, New York, and Washington mandate that major insurers disclose how they are managing climate change

"The U.S. business community is increasingly analyzing the risks, opportunities, and financial implications of climate change and integrating them into long term business plans. In recent years, the financial repercussions of weather variability and extremes have significantly impacted the U.S. economy by affecting both supply and demand for the products and services of almost every industry."
" Lea Reynolds, M.J. Bradley and Associates

Whilst 80% of responding FTSE100 companies identified substantive risks to their business due to climate change, less than 50% incorporated climate change adaptation into their businesses strategies (Source: CDP)

"In many ways, building resilience is doing what companies have always done—strategic planning, risk assessment, investing in infrastructure, diversifying the supply chain, safeguarding employees—using the best information available about potential risks." (Source: C2ES)

risks – and federally, there could be reforms to the National Flood Insurance Program.

The “little guys” are being hit hardest

Small businesses – the heart of most economic (employing nearly 50% of the U.S. workforce - are being hit hardest by extreme weather and climate change and must take steps to adapt, according to a new report from Small Business Majority (SBM) and the American Sustainable Business Council (ASBC):

- Lasting economic damage: of the 60,000 to 100,000 small businesses negatively affected by Hurricane Sandy, up to 30% are estimated to have failed as a direct result of the storm. 25% of small to mid-sized businesses do not reopen following a major disaster.
- 57% of small businesses have not closely analysed the potential economic losses from extreme weather events or other climate-related risks, in part due to a lack of resources to do so (Source: SBM, ASBC).

Companies are not doing enough

The number of businesses saying that they are taking action to adapt to climate change has increased significantly from around 24% in 2009 to 34% in 2012 – with large businesses the most pro-active (Source: Ipsos Mori).

- **77% of the S&P Global 100 companies are managing physical climate impacts as part of their conventional business continuity** or enterprise risk management systems. But while business continuity and risk management plans can be effective corporate planning tools for dealing with extreme weather events, most companies will need to adjust how they use these tools to reflect the changing profile, frequency and intensity of climate-related risks (Source: C2ES).
- **Only 28% have undertaken climate-related vulnerability assessments and 18% used climate-specific tools or models to comprehensively assess risks.** Companies undertaking such measures tend to be at higher risk (e.g. dependent on a certain resource or commodity, located in extreme weather geographies, direct financial interest) (Source: C2ES)
- **76% of businesses surveyed would act if it saved them money,** but there is sometimes confusion about what adaptation means (Source: Ipsos Mori) with a marked diversity between attitudes and approaches to risk and adaptation needs in different business sectors (Source: CDP).
- **Uncertainty about climate change impacts is a barrier to action.** 24% of S&P Global 100 companies cite the uncertainty associated with the nature, timing, location, and/or severity of climate change as posing a challenge for deciding how and when to invest in resilience beyond “business as usual.”

Emerging best practices

In terms of emerging best practice on climate change adaptation, generally, companies are tending to follow a four-step process: they collect information and build knowledge about the growing risks; assess and prioritize them using corporate risk management frameworks; develop plans and guidance that inform management decisions; and incorporate risk factors into an on-going, iterative review process (Source: C2ES).

Table 4: Four best practice steps for managing extreme weather risks

Step	Overview	Details
Build awareness	Building a clear understanding of the risks associated with extreme weather and climate change	This effort should reach out broadly across the company to include all people who must be part of an effective response, including senior managers at headquarters, facility managers in the field, enterprise risk managers, and supply chain planners. It should engage all employees and communities that play an important part of planning and response strategies. This outreach effort should address the common misperception that future conditions will be similar to those experienced in the past, and should make clear that climate change is increasing the risks of certain types of extreme weather events and these risks may have significant impacts on the company's bottom line
Assess vulnerabilities	Identify the impacts that future changes in the likelihood or magnitude of extreme weather events could have on their operations and facilities	A vulnerability assessment would benefit from including the following considerations: • A high-level initial screening of potential climate risks across the company, with more in-depth vulnerability assessments of high-risk facilities and operations; • Forward-looking assumptions about changes in the risk profile of extreme weather and climate change; and • Information about changes in related factors (e.g., land use, population growth, competition for scarce resources) that could also amplify or alter risks
Manage risks & pursue opportunities	Develop plans to prioritize actions to manage these risks and maximize opportunities	Specific risk mitigation actions could include: • Modifying planning and operations; • Fortifying or relocating infrastructure and facilities; • Addressing volatility or changes in the supply of key commodities such as water; • Managing risks within supply chains; and • Expanding or adjusting insurance coverage identified a range opportunities to offer new services or products better suited to a world experiencing more frequent or intense extreme weather
Assessment & review	Develop adaptive risk management planning	Periodically updating their understanding of risks and their responses as new information becomes available and they are fine tuning their resilience strategies and capacities over time

Source: Center for Climate and Energy Solutions

But also increasing recognition of market opportunities

Most companies are also looking to potential business opportunities off the back of extreme weather:

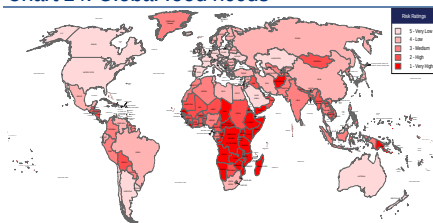
- **75% of the S&P Global 100 companies identified potential market opportunities resulting from a changing climate** (e.g. drought- and salinity-resistant crops, technologies that enhance water use efficiency, weather-related insurance products, enhanced land management techniques, and storm-resistant building materials.
- **37% identified expanding markets for existing products and services** as the most promising opportunities for business and revenue growth,
- **27% (mostly in the banking and financial services sector) identified opportunities for new products** and
- **16% described opportunities to reduce operational costs.**

Companies in the manufacturing & industrials and consumer goods sectors were the least likely to identify new opportunities (Source: C2ES).

A perfect storm is brewing: food vs. water vs. energy security

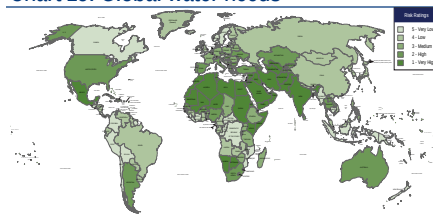
The world is facing long-term challenges to food, water and energy security. By 2030 global food demand is set to increase by 50%, water demand by 40% and energy demand by 50%. As the UK's former Chief Scientific Advisor Sir John Beddington stated, "This threatens to create a perfect storm of global events," which poses key questions for governments, stakeholders, corporates and investors. These include whether we: can feed 9 billion people equitably, healthily and sustainably; cope with the demands on water; provide enough energy to supply the growing population coming out of poverty; and can we do this while mitigating and adapting to climate change?

Chart 24: Global food needs



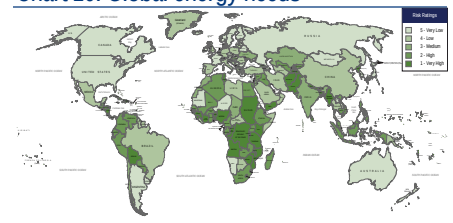
Source: BofA Merrill Lynch Global Research (WDWW (Who Does What Where) Geographical Risk Screening Model)

Chart 25: Global water needs



Source: BofA Merrill Lynch Global Research (WDWW (Who Does What Where) Geographical Risk Screening Model)

Chart 26: Global energy needs

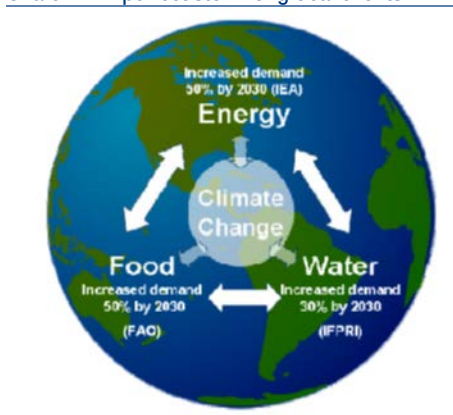


Source: BofA Merrill Lynch Global Research (WDWW (Who Does What Where) Geographical Risk Screening Model)

Food-water-energy nexus

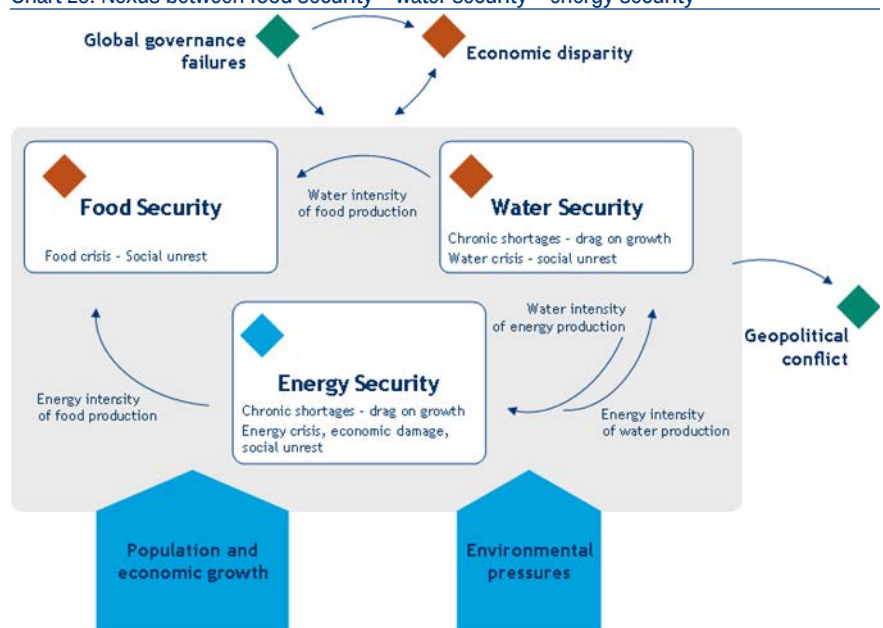
Food security, energy security and water security are also linked by a series of sometimes reciprocal inputs, and influenced by other factors such as population, economic growth and environmental pressures along with the two overarching factors of global governance failures and economic disparity. Trade-offs between the three resources, as well as between users in the form of resource rationing, will, in our view, become an increasingly important issue, as will managing these trade-offs.

Chart 27: A perfect storm of global events?



Source: HM Treasury, FAO, IEA, IFPRI, BofA Merrill Lynch Global Research

Chart 28: Nexus between food security – water security – energy security



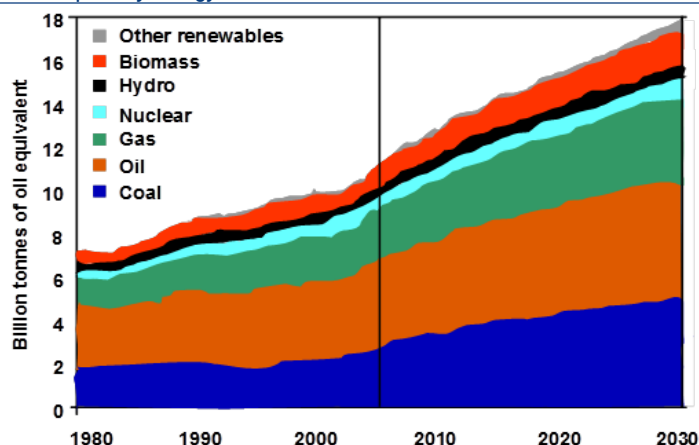
Source: WEF, BofA Merrill Lynch Global Research

[Thematic Investing: Global energy efficiency primer
- less is more 18 April 2013](#)

Global energy crisis, demand to increase by up to 50% by 2030

The world is facing a global energy crisis, with close to 9% of GDP being spent on energy. Primary energy demand is expected to increase by at least one third – and up to 50% by 2030 with demand to grow for all energy sources including coal, oil, natural gas, nuclear, hydro and renewables. Emerging markets will account for 90% of the projected growth in global energy demand. As a result, energy-related CO₂ emissions are likely to increase by 20%, following a trajectory consistent with a long-term rise in the average global temperature in excess of 3.5°C – and potentially resulting in irreversible climate change, according to the IEA.

Chart 29: World primary energy demand to 2030



Source: IEA, BofA Merrill Lynch Global Research

Short-term variations in economic growth have only marginal impacts on long-term energy and climate change trends

A world in which warming reaches 4°C above preindustrial levels would be one of unprecedented heat waves, severe drought, and major floods in many regions, with serious impacts on human systems, ecosystems, and associated services (source: World Bank)

See further our reports on “Extreme Weather” and our CO₂ Screening tool

[Extreme Weather, 28 September 2012](#)
[CO₂ Screener, 01 March 2013](#)

On the path to an unsustainable energy future

The overwhelming majority of climate change experts agree that the earth's climate system is unequivocally warming, and it is more than 90% certain that humans are causing this through activities that increase concentrations of greenhouse gases (GHGs) in the atmosphere. Without a bold change of policy, the world risks locking itself into an insecure, inefficient and high-carbon energy system.

Energy demand to increase by at least 35% to 2035E

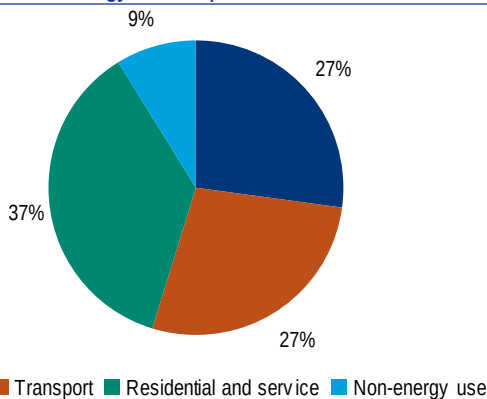
Assuming that actual implementation of intended global policies and measures is undertaken in a cautious manner – under the IEA's World Energy Outlook's central New Policies scenario – primary energy demand is expected to increase by 35% between 2010 and 2035. Growth is expected to slow from an average of 1.6% per year in the period 2010-20 to 1.0% per year in 2020-35, as measures introduced to meet energy security and climate objectives take effect and as economic and population growth rates drop in the key emerging economies (source: IEA).

Ensures that irreversible climate change is becoming a reality

As a result, without further commitments and actions to reduce GHGs, the world is set to get warmer by 3.6-4.0°C than the pre-industrial era climate (source: IEA, World Bank) vs. the 2.0°C critical threshold considered by scientists an adequate means of avoiding dangerous climate change. Even with full implementation of mitigation commitments and pledges, there is a 20% chance of exceeding 4°C by 2100. If such commitments are not met, scientists are now nearly unanimously

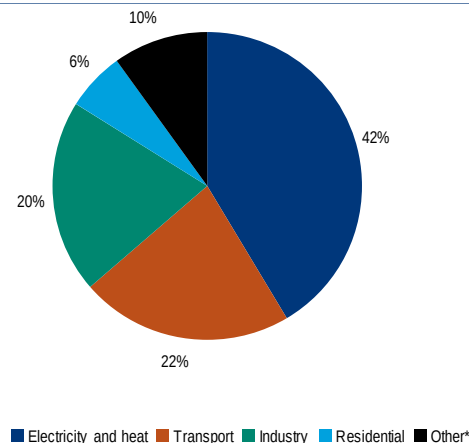
predicting a 4°C increase by 2100, or even as early as the 2060s (source: World Bank).

Chart 30: World total energy consumption - 2009



Source: IEA, BofA Merrill Lynch Global Research

Chart 31: World CO2 emissions - 2010



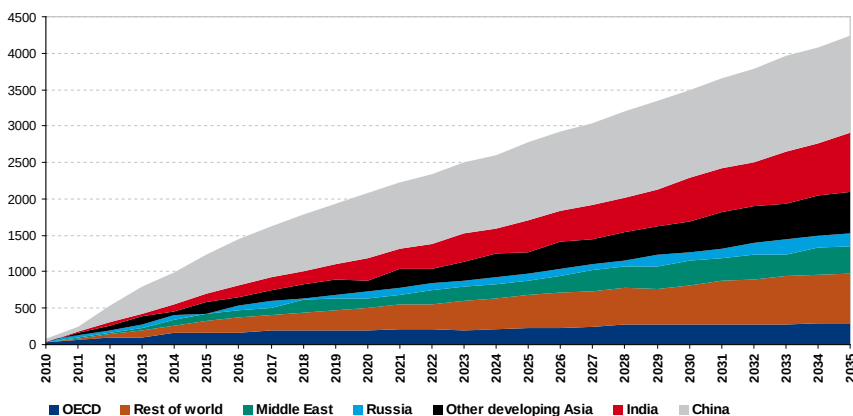
Source: IEA, BofA Merrill Lynch Global Research

Average energy consumption per capita in IEA member countries is 5 toe/year or 2x the global average and 8x India. But IEA countries have the lowest energy intensity due to higher GDP per capita and the impact of energy efficiency implementation (source: IEA).

90% of energy demand growth in non-OECD

90% of the projected growth in global energy demand will come from emerging markets. China, India and the Middle East will account for 60% of the increase in energy demand between 2010 and 2035. China alone is set to be the world's largest energy consumer by 2035, consuming 77% more than the US (even if it's per capita demand will still be 52% lower). Brazil, India, Indonesia and the Middle East will see energy demand grow even faster than China to 2035. EMs also dominate the expansion of supply of fossil fuels (source: IEA).

Chart 32: Global energy demand increases by one-third from 2010 to 2035 (Mtoe)

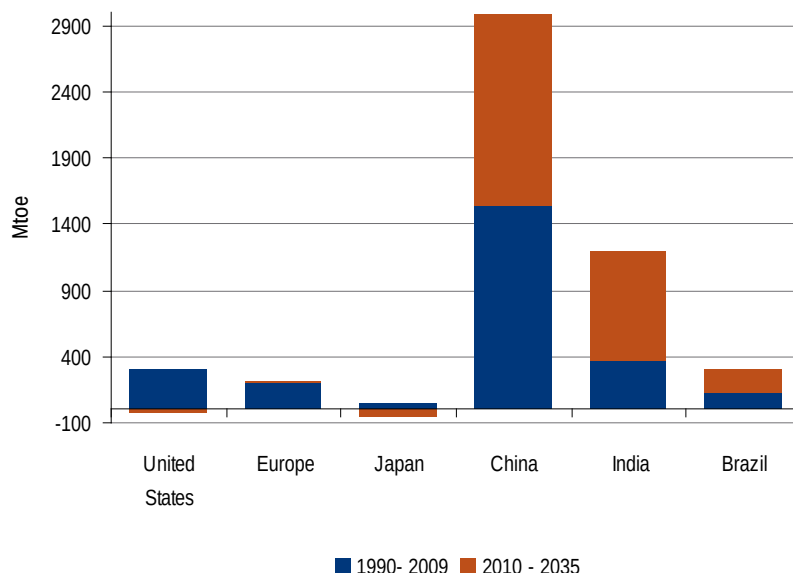


Source: EA WEO 2011, BofA Merrill Lynch Global Research

Demand is set to grow for all energy sources

Positively, from a climate change perspective, the share of fossil fuels in global primary energy consumption is set to fall from around 80% today to 70% in 2035. In 2035, the share of renewables (including traditional biomass) in world primary energy demand should reach 18%, from 13% in 2010. However, the IEA's central scenario assumes growth in world demand for all energy sources to 2035.

Chart 33: Additional primary energy demand to 2035 (Updated)



Source: EIA WEO 2012

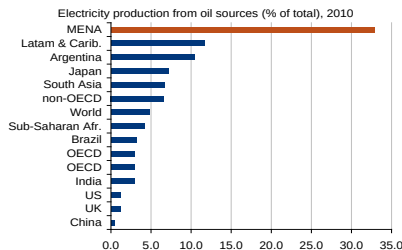
- **Coal use to rise by 21%** by 2035 vs. 2010, largely driven by emerging markets.
- **Oil demand increases by 13%** largely driven by transport.
- **Gas gains in importance:** Gas' share in the energy mix is expected to rise – with absolute growth similar to coal and oil combined - and its use is set to catch up with total global coal consumption.
- **Renewables increase from 13% to 18% of the mix in 2035** with the growth accounting for half of new installed capacity, but continuing to be underpinned by subsidies; while relative growth is faster than any other energy form; absolute renewables supply is still not close to the level of any single fossil fuel by 2035.
- **Nuclear generation grows by 58%** driven by China, India and South Korea (source: IEA).

Table 5: World primary energy demand by fuel in the New Policies Scenario (Mtoe)

	1990	2010	2015	2020	2030	2035	2010-35*
Coal	2,231	3,474	3,945	4,082	4,180	4,218	0.80%
Oil	3,230	4,113	4,352	4,457	4,578	4,656	0.50%
Gas	1,668	2,740	2,993	3,266	3,820	4,106	1.60%
Nuclear	526	719	751	898	1,073	1,138	1.90%
Hydro	184	295	340	388	458	488	2.00%
Bio energy	903	1,277	1,408	1,532	1,755	1,881	1.60%
Other renewables	36	112	200	299	554	710	7.70%
Total	8,779	12,730	13,989	14,922	16,417	17,197	1.20%

Source: IEA, BofA Merrill Lynch Global Research

Chart 34: MENA generates 30% of its power from oil, far greater than other EMs whose use of oil in electricity averages 7%



Source: WB, BofA Merrill Lynch Global Commodity Research

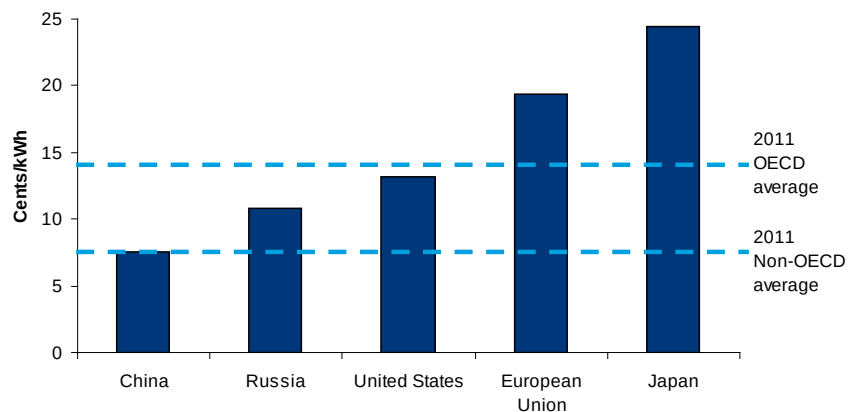
Energy for electricity remains fastest-growing sector

Global demand for electricity is set to continue to grow faster than demand for any other final form of energy until 2035. It is expected to grow at 2.2% pa to 2035, of which more than 80% is attributable to non-OECD countries. Total electricity consumption is forecast to be 72% higher in 2035 than in 2010. Electricity continues to gain share in final energy use, meeting one-third of non-transport energy demand in 2030 (vs. 28% in 2011) (source: BP). Power generation capacity additions are projected to total 3,900GW by 2035, with the largest additions in China (source: IEA). Energy used to generate electricity is expected to account for 57% of the projected growth in primary energy consumption to 2030 (vs. 54% for 1990-2010) (source BP).

High electricity prices are here to stay

Electricity prices are set to increase to 2035 with the highest prices persisting in the EU & Japan, well above those in China, Russia & the U.S. (source: IEA).

Chart 35: Average household electricity prices, 2035



Source: IEA WEO 2012

Relatively high oil prices are here to stay long-term

While, longer dated oil prices have fallen in 2013 off the back of a combination of factors, it is important to stress that relatively high oil prices are probably here to stay (vs. the inflation-adjusted price of under US\$25/barrel we saw from the mid-1980s to 2003).

Our BofAML Global Commodities Research team's views are as follows:

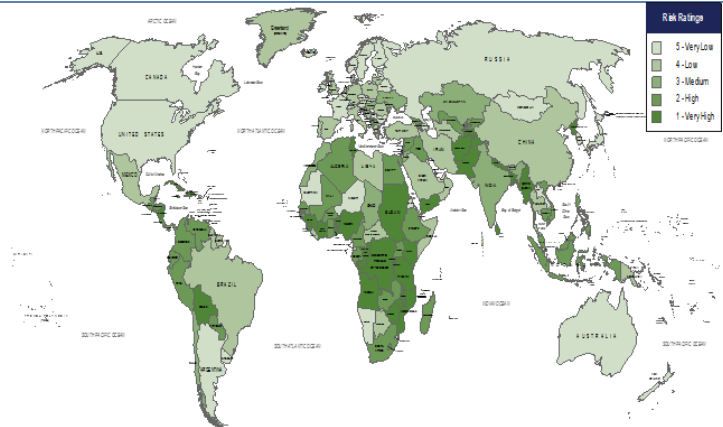
- **2H13 WTI price forecast at \$100/bbl** on the back of (1) lower Canadian and US domestic supplies, (2) US infrastructure line-fill, (3) a big surge in US refinery runs, and (4) an upcoming spec change to the NYMEX oil contract. While prompt WTI strength has remained a focal point, long-dated oil prices have moved in the exact opposite direction.
- **Long-dated contracts have fallen to '09 levels** - the drop in long-dated oil prices signals an impending normalization of energy sector returns. With costs of production for US shale and Canadian SAGD barrels in a \$45-65/bbl range, long-dated oil could still fall further from here as North American producers continue to actively hedge forward. Moreover, as core OPEC members such as Saudi Arabia, UAE, Kuwait, and Qatar bring their budget break-even price levels below \$80/bbl and profligate members are marginalized, the assumption that OPEC will defend \$100/bbl to support government spending is looking feeble.

[Global Energy Weekly: Superbackwardation and the collapse of long-dated oil 11 July 2013](#)

US\$38tn in future energy investments needed to 2035

The expected growth in world demand in 2035 would mean that US\$38tn in global investment in energy-supply infrastructure is required from 2011 to 2035, an average of US\$1.5tn per year. Oil and gas combined would be the biggest recipient, requiring nearly US\$20tn on the back of higher costs and a need for more upstream investment. The power sector would claim nearly US\$17tn of the total investment. Coal and biofuels account for the remaining investment. Two-thirds of the global amount is required in emerging markets (source: IEA).

Chart 36: High global energy infrastructure needs

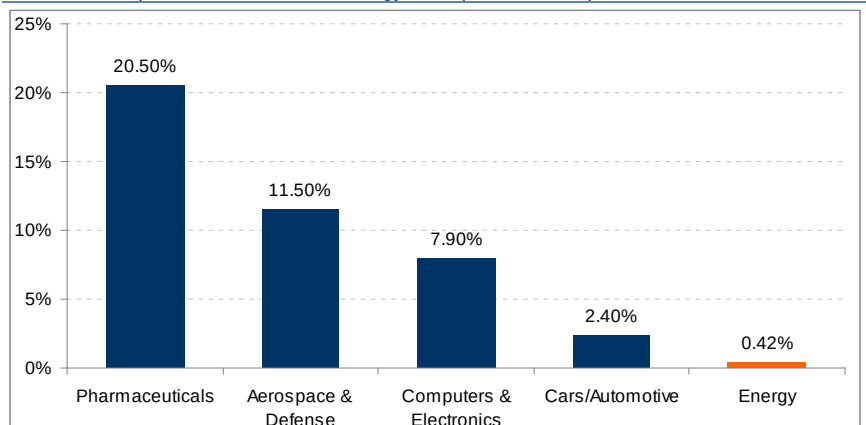


Source: CAMRADATA

Need to step up private investment

It is essential, in our view, that the private sector steps up its level of R&D in energy – with a consequent reduction in government investment. For instance, in the US, private investment in energy R&D (as a % of sales) was only 4.2% in 2012, compared with 20.5% for pharmaceuticals and 11.5% for aerospace & defence (source: American Energy innovation Council).

Chart 37: Low private investment in energy R&D (as % of sales)



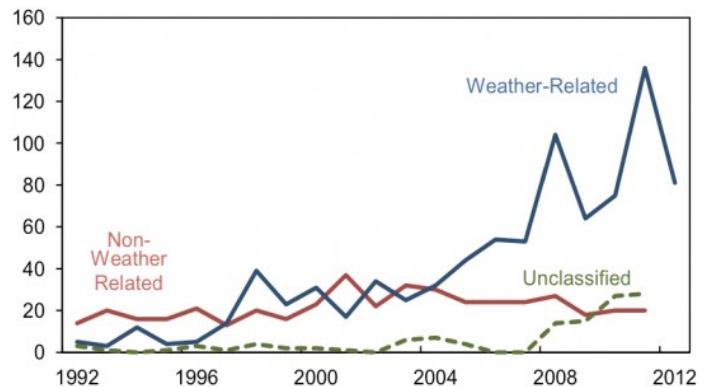
Source: American Energy Innovation Council, Catalyzing American Ingenuity, 2012, BofA Merrill Lynch Global research

The 679 U.S. power outages caused by extreme weather account for 58% of all outages observed since 2002, and 87% of all outages affecting 50,000+ customers (Source: US EIA)

Energy grid is at risk

A new report out of the President's Council of Economic Advisers and the U.S. Department of Energy found that economic damage from weather-related power outages now averages between US\$18bn-\$33bn per year – and as reached as high as \$75bn in 2008 and US\$52bn in 2012 off the back of Hurricanes Ike and Sandy, respectively. Such damages encompass lost output and wages, spoiled inventory, and restarting operations after outages had passed.

Chart 38: Observed outages in the U.S. bulk electric system 1992-2012 (no. of events)



Source: Energy Information Administration (U.S.)

Reiterates the importance of grid renewal

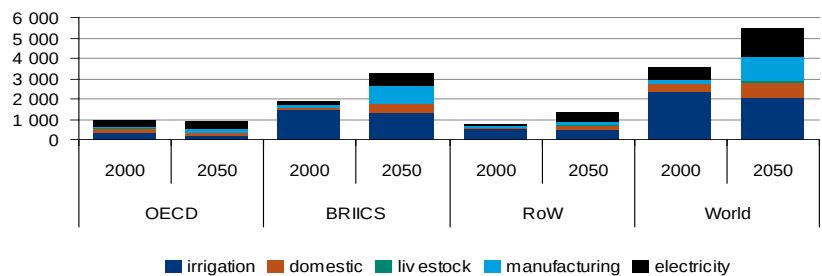
These impacts reiterate the need for grid renewal especially given that extreme weather is likely to continue because of climate change – and given that older T&D equipment and infrastructure is more vulnerable to weather damage. Increasing pressure (and funding) to create a grid which can better withstand extreme weather should benefit the smart grid (e.g. automated sensors, smart meters, microgrids, energy storage / backup power) as well as the traditional grid (newer and stronger materials, underground or above ground power lines and substations). The U.S. allocated US\$4.5bn to grid modernization in the 2009 Recovery Act.

ESG & Sustainability: A Blue Revolution – global water 14 December 2012

Global water crisis, demand to overshoot supply by 30% by 2030

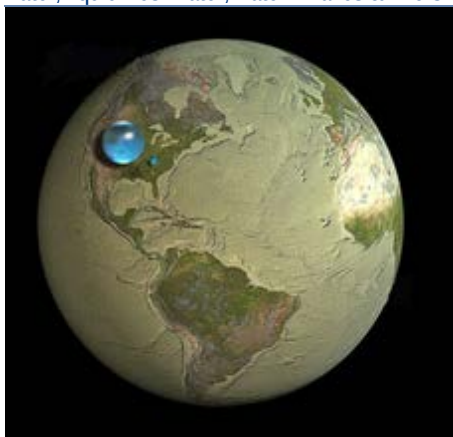
One billion people lack access to clean drinking water and water faces some of the toughest challenges of any natural resource or commodity – with significant supply and demand-side pressures. On the supply side, the world is facing a combination of insufficient freshwater, uneven distribution, widely varying quality, water losses, and adverse impacts from climate change. On the demand side, agricultural, industrial and municipal/ residential usage is set to grow fast over the next 20 years.

Chart 39: Global water demand 2000 vs. 2050



Source: OECD, BofA Merrill Lynch Global Research. The graph only measures blue water demand and does not consider rained agriculture.

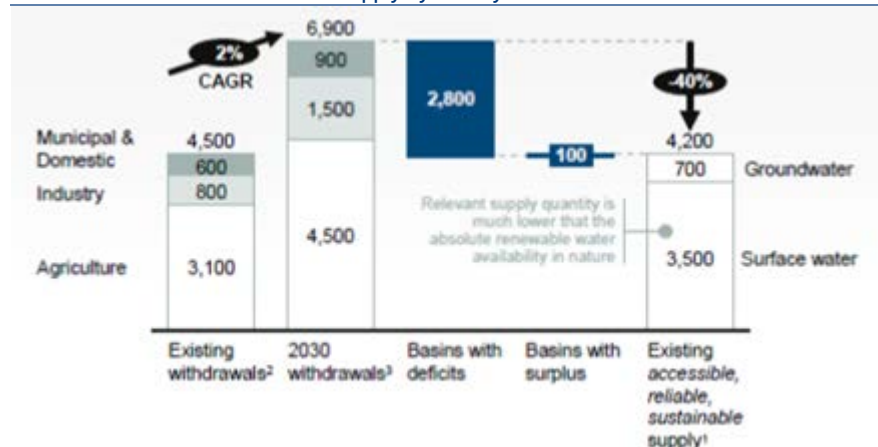
Chart 40: Spheres represent all of the Earth's water, liquid freshwater, water in lakes & rivers



Source: US Geological Survey

We have probably already arrived at “peak water” and if there are no major efficiency gains – global water demand is set to overshoot supply by 40% (Source: Water 2030) putting up to 3.9 billion people at risk of water stress. By 2050, 45% of projected global GDP (Source: Veolia) could be at risk and the supply/demand imbalance could make water scarcer than oil and manifest itself in increased domestic social unrest and trans-boundary disputes.

Chart 41: Water demand to exceed supply by 40% by 2030



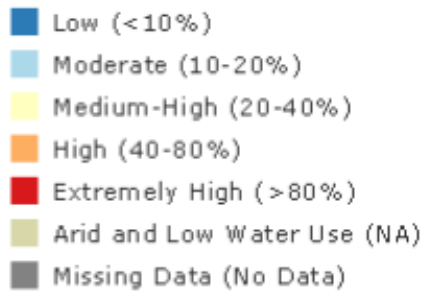
Source: Water 2030 Global Water , BofA Merrill Lynch Global Research

Supply-side water pressure

Global water supply has failed to keep pace with the rising world population, leading to chronic shortages in many regions around the world. The map below estimates the degree to which freshwater availability is an on-going concern (i.e. annual renewable supply of water withdrawn for human use). High levels of baseline water stress are associated with increased socioeconomic competition

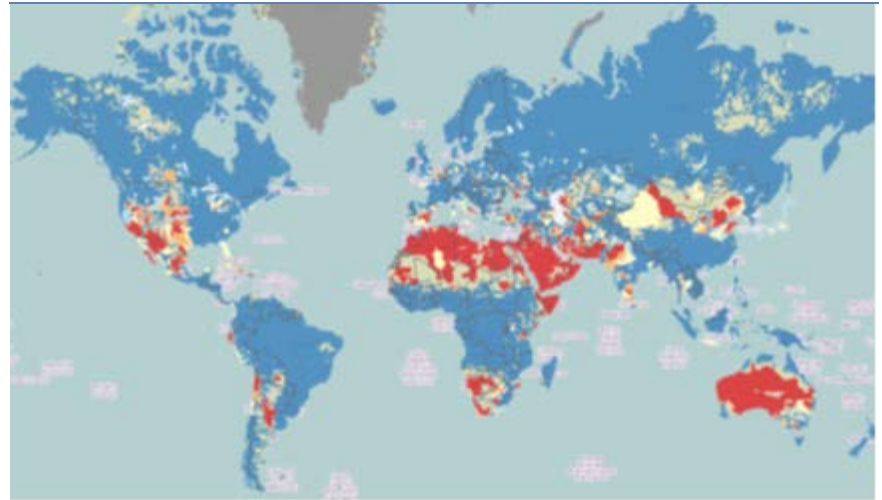
Chart 43: Baseline water stress

Baseline Water Stress



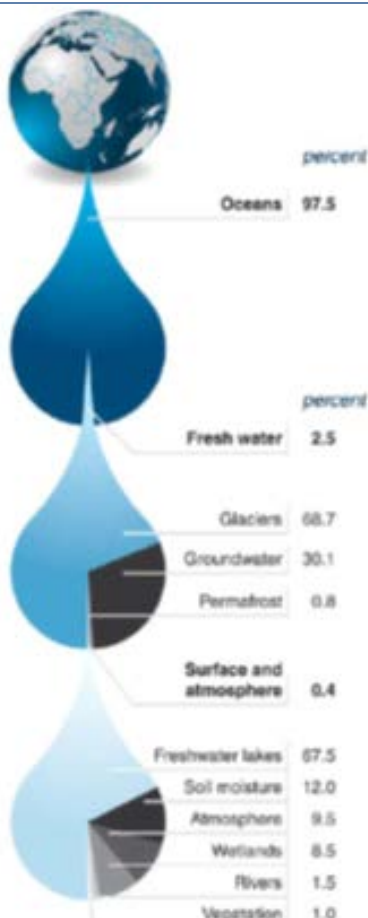
Source: World Resources Institute- Aqueduct Project

Chart 42: Global baseline water stress



Source: World Resources Institute- Aqueduct Project, The Coca-Cola Water Risk Data were provided to the World Resources Institute by The Coca-Cola Company in support of the Aqueduct project. ISciences L.L.C. performed the hydrological modeling.. * The baseline water stress indicator estimates the degree to which freshwater availability is an ongoing concern. High levels of baseline water stress are associated with increased socioeconomic competition for freshwater supplies and heightened political attention to issues of water scarcity.

Chart 44: Global freshwater distribution



Source: Office of the Director of National Intelligence (U.S.)

Freshwater, 2.5% of global water - insufficient

Freshwater accounts for only 2.5% to 3% of the total water on the planet, most of which is locked in the two polar ice caps. Freshwater ecosystems are also estimated to have declined by 37% since 1970 – with certain segments such as tropical freshwater having declined by 70% (Source: WWF):

Uneven distribution, 10 countries have 60% of freshwater

In theory, there is enough water to satisfy all human needs on a sustainable basis. However, in practice, water is not distributed evenly across the globe. Ten countries possess close to 60% of the world's freshwater resources.

Table 6: 10 countries with most renewable freshwater

Country	Total renewable water (10m ³ /person/yr)*
Brazil	8,233
Russia	4,508
United States	3,069
Canada	2,902
China	2,840
Colombia	2,132
Indonesia	2,019
Peru	1,913
India	1,911

Source: Aqstat. * Total annual actual renewable water resources: Natural resources that, after exploitation, can return to their previous stock levels by natural

46 countries suffering from water stress to water scarcity

In many ways, it can be argued that water is the wrong quantity and quality in the wrong places – with 46 countries suffering from water stress, water scarcity and absolute water scarcity.

Widely varying water quality

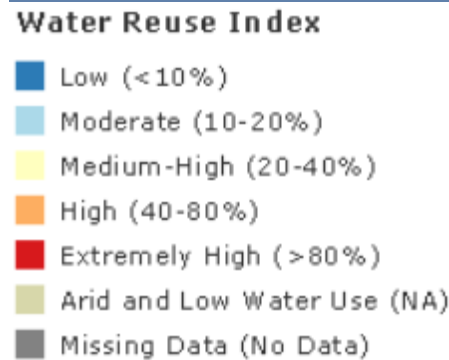
Beyond water quantity, water scarcity is emerging as a direct consequence of water quality issues. Some of the key challenges are inappropriate land use

activities and poor water treatment; chemical fertiliser run-offs; irrigation; and water sources being used as open sewers.

Inadequate water treatment = water quality concerns

The Water Reuse Index map below estimates the fraction of renewable freshwater supply that has been previously withdrawn and discharged as upstream wastewater. It measures the degree to which water quality is an on-going concern (Source: WRI).

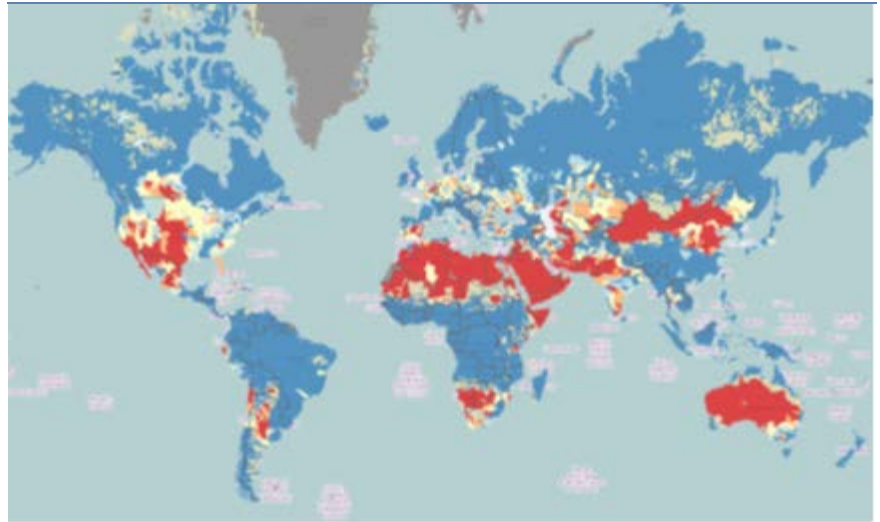
Chart 45: Water Reuse Index



Source: World Resources Institute- Aqueduct Project.

More than 50m m³ per day is lost through leakage. A further 30m m³ per day is not paid for. The total cost to water utilities worldwide is estimated at more than US\$20bn+ per annum (Source: World Bank)

Chart 46: Water Reuse Index

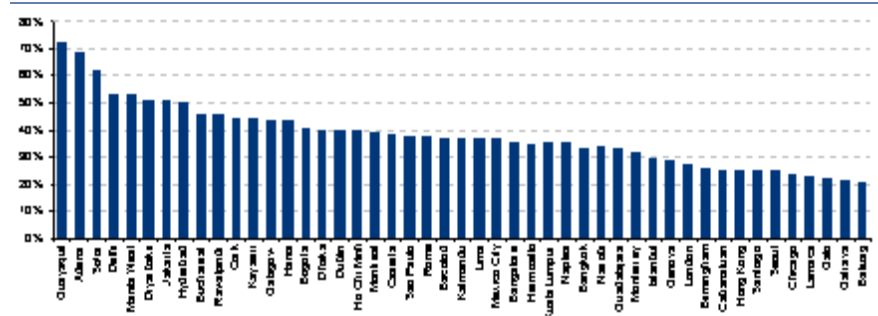


Source: World Resources Institute- Aqueduct Project. The Coca-Cola Water Risk Data were provided to the World Resources Institute by The Coca-Cola Company in support of the Aqueduct project. ISciences L.L.C. performed the hydrological modeling.

US\$20bn in lost water

Water loss or non-revenue water (NRW) – physical, commercial and unbilled authorise consumption – is a considerable problem around the world. For instance, in Asia, NRW averages 30% across cities and is as high as 65% in some urban areas, leading to losses of US\$9bn per year (Source: ADB).

Chart 47: Urban water networks with NRW of 20%+



Source: Smart water Networks Forum

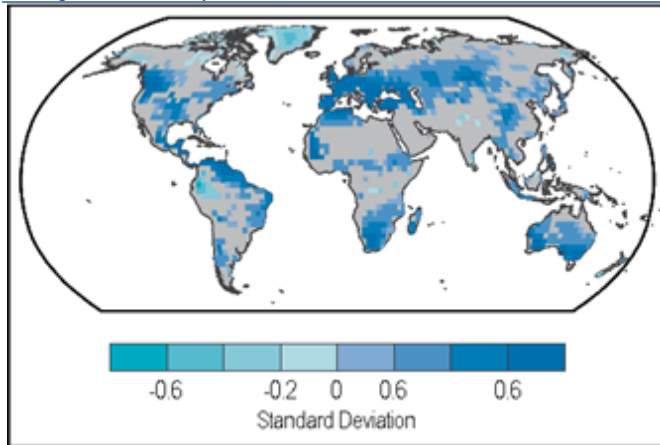
Climate change is making things worse

Climate change is exacerbating supply-side water pressure in three ways: water quality, water quantity and water timing. As temperatures rise: the hydrological cycle is expected to change, rainfall patterns will change, sea levels will rise and saltwater intrusion of freshwater aquifers will become a growing threat.

South Asia, Africa and the Mediterranean are most vulnerable to climate change-related water impacts

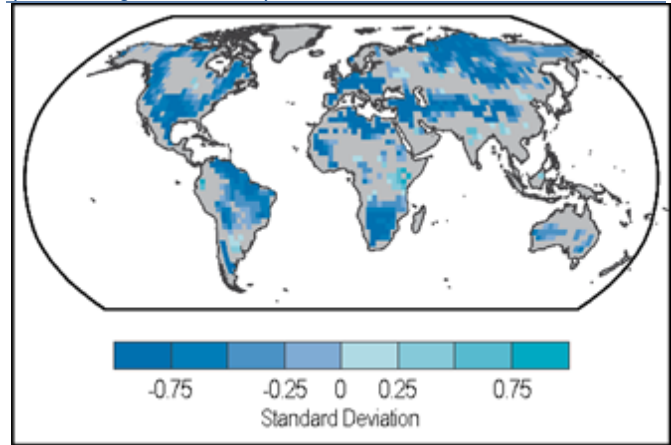
12 September 2013

Chart 48: Projected changes in dryness: consecutive dry days (June to August, 2081-2100)



Source: UN IPCC, BofA Merrill Lynch Global Research. Consecutive dry days = days with precipitation; <1 mm.

Chart 49: Projected changes in dryness: soil moisture anomalies (June to August, 2081-2100)



Source: UN IPCC, BofA Merrill Lynch Global Research. Soil moisture anomaly = anomaly in water stored in or at the land surface and available for evapotranspiration

Table 7: 20 cities where flood risk will increase most by 2050

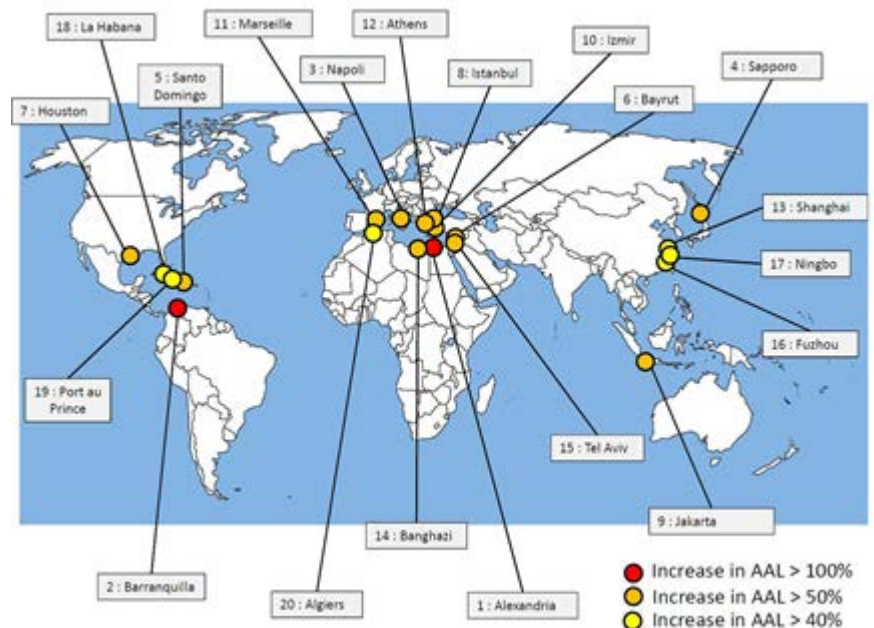
City	Ranking
Alexandria	1
Barranquilla	2
Napoli	3
Sapporo	4
Santo Domingo	5
Bayrut	6
Houston	7
Istanbul	8
Jakarta	9
Izmir	10
Marseille	11
Athens	12
Shanghai	13
Banghazi	14
Tel Aviv	15
Fuzhou	16
Ningbo	17
La Habana	18
Port au Prince	19
Algiers	20

Source: University of Southampton

Too much water in some places, coastal cities face \$1tn in losses

The world's 136 largest coastal cities could risk combined annual losses of US\$1tn from floods by 2050 unless they drastically raise their adaptation and flood protection defences vs. current losses of US\$6bn. Cities facing the greatest risks include Guangzhou, Miami, New York-Newark, New Orleans and Mumbai (Source: Hallegatte et. al., Nature Climate Change 2013).

Chart 50: 20 cities where flood risk will increase most by 2050



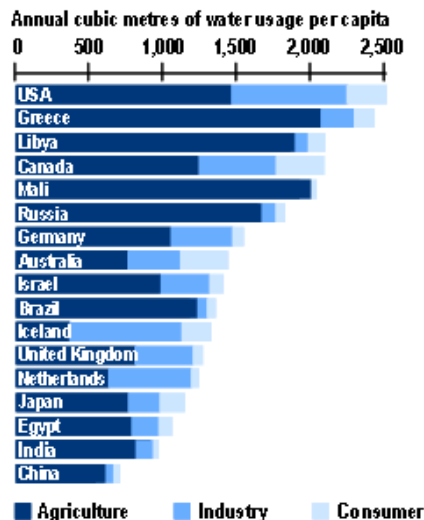
Source: University of Southampton

From 2000 to 2050, global water demand is set to change by:

- +406% for manufacturing
- +144% for electricity
- +127% for domestic
- +63% for livestock
- 14% for irrigation (Source: OECD)

The daily drinking water requirement per person is 2-4l, but it takes 2,000-5,000l to produce one person's daily food requirements (Source: FAO)

Chart 51: Farming accounts for the bulk of water use



Source: UN, BofA Merrill Lynch Global Research

Table 8: Estimated virtual water requirements for different crops

Crop	m³ water/ton crop*
Beef	16,726
Pork	5,469
Cheese	5,288
Poultry	3,809
Eggs	3,519
Rice	2,552
Soybeans	2,517
Wheat	1,437
Maize	1,020
Milk	738
Potatoes	133

Source: "BofA Merrill Lynch Global Research. * Average based on Hoekstra & Hung, Chapagain & Hoekstra, Zimmer & Renault, and Oki et al"

Demand-side water pressures

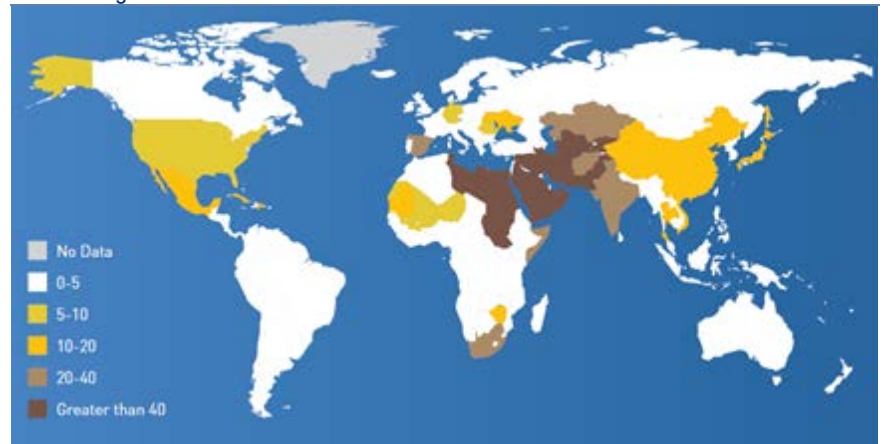
We anticipate growing demand-side pressures across the three largest users, with competition and trade-offs becoming increasingly likely.

Agriculture - today's biggest consumer

According to the FAO, it takes 1,000x more water to feed a population via agriculture than it does to satisfy thirst. This is leading to growing demand-side water pressure as food demand is expected to increase by 50% by 2025 to 2030 – meaning another 1,000km³ (1tn m³) of water per year (Source: InterAction Council). This will significantly exacerbate the imbalance between water demand and supply.

- **Farmers are extracting water at an unsustainable rate** as the area irrigated by groundwater has increased on the back of more reliable water delivery, a decline in extraction costs, and government subsidies for power and pump installation and water itself.

Chart 52: Agricultural water withdrawals as a % of total renewable water resource



Source: FAO (Withdrawals are critical when higher than 40% and indicative of water stress at 20-40%)

- **Water intensity varies depending on the crop or livestock.** Farming livestock is more water intensive than farming crops. It takes 15,500l of water to produce 1kg of beef, compared with 1,500l for 1kg of grain. However, we expect increasing demand for food to come from higher protein-based sources rather than more subsistence-based diets. Using current practices, the amount of water required for agricultural evapotranspiration to feed the world's population would increase from 7,130km³ currently to between 12,050km³ and 13,500km³, an increase of 70-90% by 2050. .

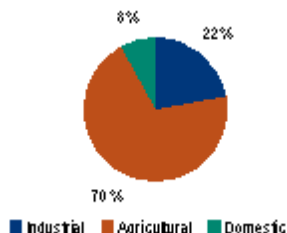
By 2025, the oil sector could be producing 5x more water than oil, with onshore crude oil having a ratio of up to 12x largely on the back of ageing wells and increased unconventional O&G such as EOR, shale gas and oil sands (Source: GWI)

Industry - tomorrow's biggest user

Demand from industry represents around 22% of global total demand, rising to as much as 59% in developed markets. Industrial water use arises as a raw material and as a constituent of the product itself as well as from cleaning, heating and cooling and power generation. Usage is expected to rise significantly as:

- **Emerging markets divert water from agriculture to industry** as they ramp up their economic growth efforts via large-scale industrialisation and industry and energy (especially coal) accounting for a disproportionately higher use of freshwater. Worryingly, this is often being carried out with scant regard for the environmental or social impact.

Chart 53: World water use



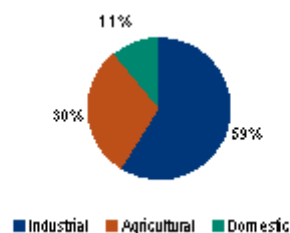
Source: World Bank, BofA Merrill Lynch Global Research

Chart 54: Low- & middle-income country use



Source: World Bank, BofA Merrill Lynch Global Research

Chart 55: High-income country use



Source: World Bank, BofA Merrill Lynch Global Research

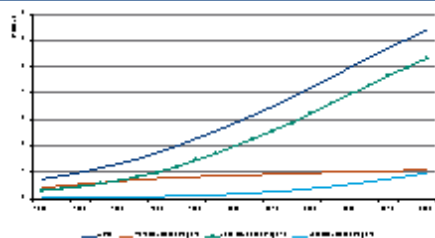
- **Energy infrastructure is highly dependent on water** – gas, coal and nuclear plants, in the US for example, consume an estimated 20% of non-agricultural water. In China, coal-fired electricity currently uses more than 114tn litres of water, c.20% of the country's total consumption, rising to 40% over the next decade if current trends continue.
- **Mining infrastructure is highly dependent on water** with over 2bn gallons of water per day used in the US alone – the processing of a ton of ore requires 1.5 tons of water. Tailings and acid rock drainage are also becoming major issues.

Residential & municipal - set to grow fast

While water for domestic use is the smallest demand segment of freshwater resources, there are some significant long-term drivers of growth:

- **The world's population is estimated to grow by 50%** to approximately 9bn by 2050, while the world's water resources will remain constant. Intuitively, we expect there to be significant growth in the high(er)-income brackets associated with greater water use.
- **Urbanisation is placing growing demands on groundwater** and, by 2025, 5bn people will be living in urban areas while 70% of the world's population will be living in cities by 2050 according to the UN. The prospect of "mega-regions" will have an impact on water quantity and quality, with increasing demand for efficient water infrastructure systems.

Chart 56: Global urban population 1950-2050 (bn people)



Source: Unpopulation

Table 9: Top 10 Megacities 2011-2025 (population in millions)

City	Country	Population – 2011	City	Country	Population - 2025
Tokyo	Japan	37.2	Tokyo	Japan	38.7
Delhi	India	22.7	Delhi	India	32.9
Mexico City	Mexico	20.4	Shanghai	China	28.4
NYC	USA	20.4	Mumbai	India	26.6
Shanghai	China	20.2	Mexico City	Mexico	24.6
São Paulo	Brazil	19.9	NYC	USA	23.6
Mumbai	India	19.7	São Paulo	Brazil	23.2
Beijing	China	15.6	Dhaka	Bangladesh	22.9
Dhaka	Bangladesh	15.4	Beijing	China	22.6
Kolkata	India	14.4	Karachi	Pakistan	20.2

Source: UNpopulation, BofA Merrill Lynch Global research

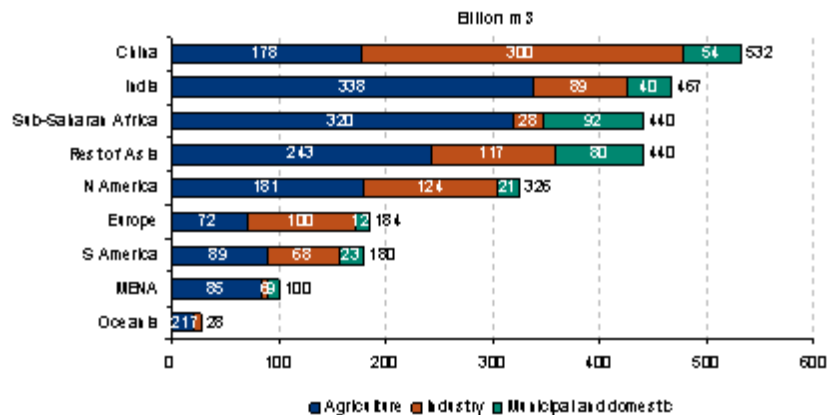
From 2005 to 2030, water demand will increase by:

- 283% for Sub-Saharan Africa
- 109% for Oceania
- 95% for South America
- 61% for China
- 58% for India
- 50% for Europe
- 47% for MENA
- 43% for North America

(Source: Water 2030)

- **More water-intensive commodities and foodstuffs** as a result of rising prosperity. As developing nations shift their appetite from subsistence- (starch) to protein-based (meat, dairy) diets, their water requirements are likely to increase markedly.
- **Property will amplify demands** for improved water quality for greater recreational and amenity uses and for the preservation of biodiversity.

Chart 57: Expected increase in global water demand by 2030



Source: 2030 Water Working group

Long-term changes in water stress

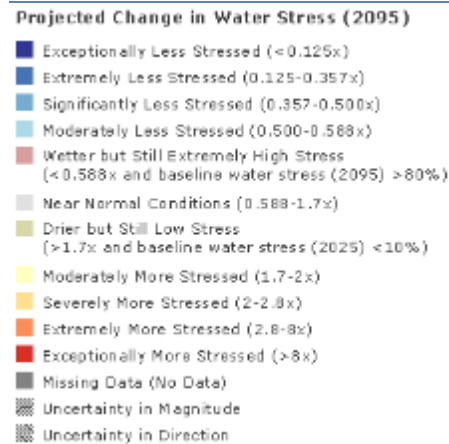
The map below projects the changes in water stress to 2095 due to shifting climate, population, and economic development. We have used the WRI-Aqueduct project's A2 scenario – which can be characterised as a “worst case” – where we see continuously increasing population and economic development, but slow and fragmented technological change.

Chart 58: Projected change in water stress indicator for year 2095 (A2 Scenario)



Source: World Resources Institute- Aqueduct Project. Water Risk Data were provided to the World Resources Institute by The Coca-Cola Company in support of the Aqueduct project. ISciences L.L.C. performed the hydrological modeling. * A2 Scenario describes a very heterogeneous world. Underlying theme is self-reliance and local identities. Continuously increasing population, Economic development and technological change is fragmented and slow.

Chart 59: Projected change in water stress



Source: World Resources Institute- Aqueduct Project,

"... We judge that as water shortages become more acute beyond the next ten years, water in shared basins will increasingly be used as leverage; these of water as a weapon or to further terrorist objectives also will become more likely beyond 10 years." – U.S. Office of the Director of National Intelligence

Growing risk of unrest & conflict

In the coming years, water shortages are likely to contribute to growing instability at national, regional and even international levels, especially as a large proportion of the world's freshwater is shared. The US Office of the Director of National Intelligence recently set out three potential drivers of conflict, or water being used as a political tool over the next 10 years including water as leverage, water as a weapon and water terrorism. While climate change does not drive political instability *per se*, it will affect drought patterns and glacier melt – thus decreasing water resources and exacerbating existing socio-economic, cultural and historical factors vis-à-vis shared water resources, potentially triggering conflicts

.30 countries on three continents at high risk

We have identified up to 30 countries on three continents as potential areas for conflict over water, including some located in Central Asia, Jordan River, Mekong Basin, Nile Basin, South Asia and Tigris-Euphrates. Some stakeholders say that as many as 50 countries on five continents may be facing such risks.

Table 10: Illustrations of potential water conflicts

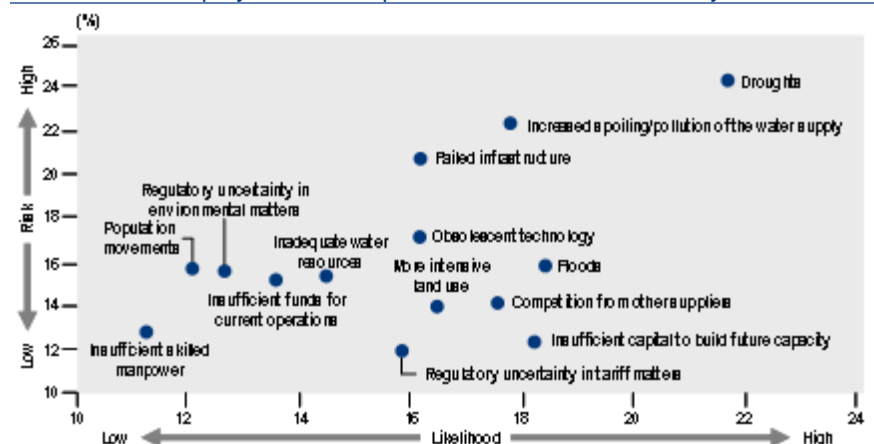
Region	Water basin	Countries	Overview of potential conflicts
Africa	Nile Basin	Burundi, DR Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, Uganda	- Land use – Rising demand for irrigation, large-scale farming (leased), dams - Population growth – Water needs to grow as population reaches 654m by 2030 - Water access – Egypt & Sudan hold rights to Nile's waters but 11 countries seeking greater access to region's #1 water source - Climate change – arid climate furthering water stress - Environment – discharge of untreated and poorly treated sewage; overexploitation and groundwater pollution
		Israel, Jordan, Palestinian Territories	- Climate change / Environment – Increasing desertification; extreme heat and water evaporation; contamination from pesticides, discharge of untreated sewage & excess salinity (low water levels) - Dams / Land use – Iraqi claims that hydro dams & irrigation have reduced water flow - Politics – Iran, Iraq & Syria want more equitable access & control from Turkey (where 98% of water originates)
Middle East	Jordan River	Iran, Iraq, Syria, Turkey	- Land use – Thirsty crops such as cotton & grain are main livelihood - Population growth – Kazakhstan, Turkmenistan, Uzbekistan - Politics – Lack of progress on new system to replace Soviet water management system - Water access – Kyrgyzstan & Tajikistan want greater control for hydro and irrigation - Dams – Most countries have been planning dams since 1980s; Cambodia, Laos, Thailand & Vietnam argue China's dam building on upper Mekong diverts/stores more than its fair share of water; environmental impacts to agriculture, fisheries, food because of plans by Cambodia & Laos to build 10 dams along Lower Mekong - Politics – National interests remain barrier to joint river management - Climate change/Dams/Environment – China building up to 28 dams in Tibet along Tsangpao; India & Bangladesh concerned China may divert water to its arid north; drought in western China flooding in east and south; industrialisation, urbanisation and water quality - Dams – Both countries building hydro dams in disputed Kashmir along Kishanganga; Pakistan fears disruption of water flow; India planning new projects to boost energy supply
	Tigris-Euphrates	Iran, Iraq, Syria, Turkey	
	Central Asia (Amu Daria & Syr Daria)	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	
	Mekong River South Asia (Brahmaputra, Tsangpo)	Cambodia, China, Laos, Myanmar (Burma), Thailand, Vietnam	
Asia	South Asia (Indus)	Bangladesh, China, India	
	India, Pakistan		

Source: Thomson Reuters Foundation, BofA Merrill Lynch Global research

Corporates are not doing enough on water risk

Investors and companies should be also looking at water from physical, reputational, regulatory and legal risk perspectives. But despite significant improvements over the last few years, an estimated 60% of the world's largest 250 companies across 34 countries do not have a long-term water strategy to tackle the global water scarcity challenge, despite discussing the issue in their reporting (Source: KPMG).

Chart 60: Water company executives' top concerns in terms of their severity and risk



Source: EIU and Oracle Utilities, BofA Merrill Lynch Global Research

Demand for cereals (for food and animal feed) is projected to reach 3bn tonnes by 2050. Annual cereal production will have to grow by 1bn tonnes and meat production by over 200mn tonnes to reach a total of 470mn tonnes in 2050, 72% of which will be consumed in EMs

In 1950, 1ha fed 2 people vs. 2030: 1ha will be needed to feed 5 people (Source: Syngenta)

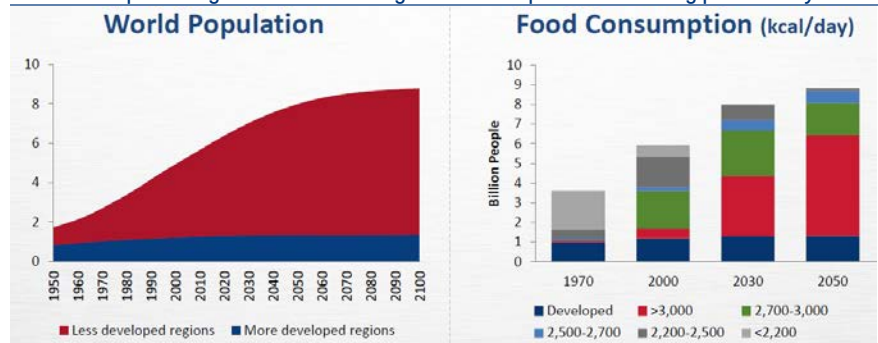
Global food crisis, food demand to increase by 40% by 2030

To date, global food production has broadly kept pace with growing population and demand. More efficient use of farmland including via technological innovation (crops, seeds, fertilisers, agricultural equipment etc.) and more efficient water-use has been key in this regard. But going forward, global food demand – as reflected by total crop and livestock demand and production – could rise by 40% by 2030 and double by 2050 – meaning that a 70% increase in production output would be needed to feed the world (Source: UN FAO). Maintaining adequate food and agricultural output in the face of increasing population and rising levels of income will become an increasingly important global challenge – especially given an environment of extreme weather and climate change.

Global food productivity on the decline

Demand for food over the next decade is expected to increase by 1% annually - and is expected to grow at 1.1% to 1.5% from the 2020s to 2050.

Chart 61: Population growth and income growth will require continued ag productivity

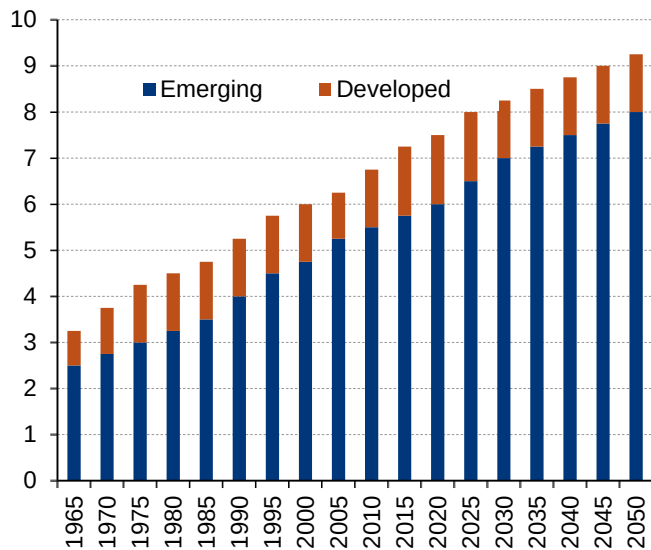


Source: DuPont based on United Nations

Drivers include:

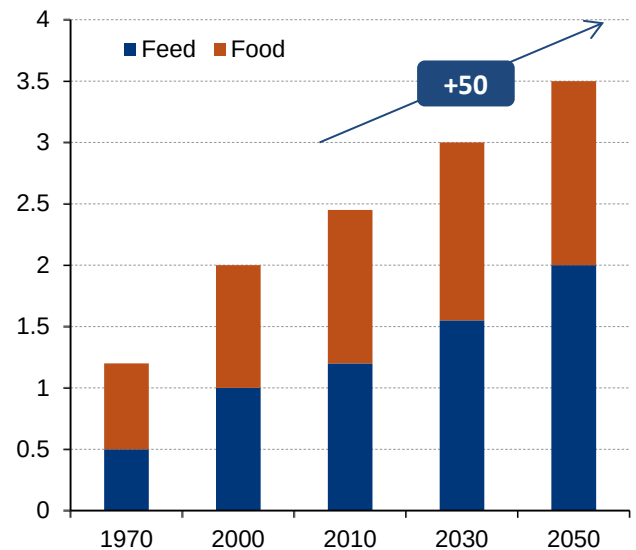
- **Population growth** – the world population grew from 2.5bn in 1950 to 7bn in 2011 and is expected to reach 9bn by 2050 – with over 80% of the growth coming from EMs (Source: UN)
- **Affluence and increases in per capita consumption** and
- **Changes in diets** including demand for greater variety - i.e. fruit, vegetables, meat, and dairy. The last decade has seen +17% growth in meat consumption. Demand for meat is expected to grow by 85% to 2030 – posing significant water challenges as it takes 15,500l of water to produce 1kg of beef, compared with 1,500l for 1kg of grain.

Chart 62: Global population (bn)



Source: FAO, Syngenta

Chart 63: World demand for major crops* (bn tonnes)



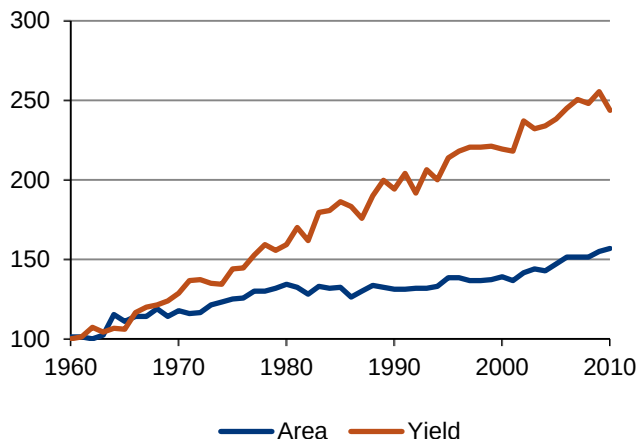
Source: FAO, Syngenta * Includes cereals, rice, corn and soybean

Global grain production has more than doubled while land used for arable agriculture has only increased 9% (Source: (Godfray, Beddington et al. 2010))

Food productivity gains not keeping up

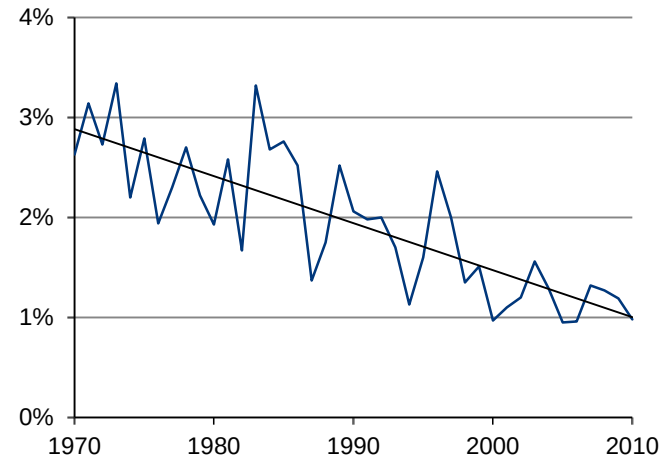
However, global food productivity gains have declined from 2% between 1970 and 2000 to c1% today and appear to be continuing to decline. A 2011 study reported that the world had consumed more than it had produced for seven out of the past eight years.

Chart 64: Acreage vs. yield growth



Source: Syngenta, BofA Merrill Lynch Global Research

Chart 65: Rolling 10 year average growth in crop yields



Source: Syngenta, BofA Merrill Lynch Global Research

Need to intensify agricultural production

There is ever increasing competition for arable land – notably from urbanisation and biofuels – which is set to increase in a climate change constrained world. Other factors which could further reduce productivity include declines in nutrient availability (e.g. phosphorus), the spread in pests and weed, and geographical shifts in production patterns resulting from the effects of global warming (Source: World Bank). This will necessitate an intensification of agriculture on the same or

Projected decreases in yields could be as high as 14-25% for wheat, 19-34% for maize, and 15-30% for soybeans (Source: Deryng et al. 2011, World Bank)

reduced quantities of land (Source: Godfray, Beddington et al. 2010; Smith et al. 2010, World Bank).

Increasing climate impacts dating back to 1960-80s

Global crop production has been negatively impacted by climate trends since the 1980s, with maize and wheat production down 3-8% and 5.5% respectively, compared to model simulation without climate trends (Source: World Bank). Sown areas for all major crops have increasingly experienced drought since the 1960s – with drought affected maize areas doubling to 18.6% (Source: Li, Ye, Wang, and Yan 2009, World Bank)

Table 11: Non-linear relationship between global warming and yields

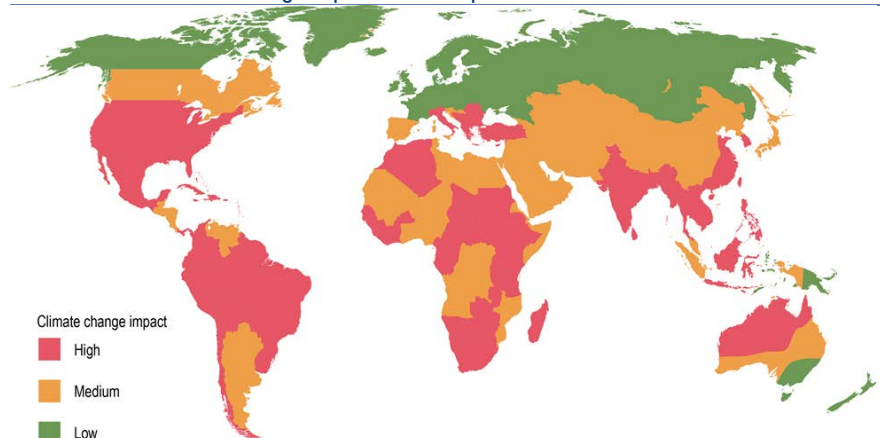
Country / region	Relationship
Africa	High sensitivity of yields to temperatures exceeding 30°C within the growing season.: maize trials have found that each "growing degree day" spent at a temperature above 30°C decreases yields by 1% under optimal (drought-free) rainfed conditions
Australia	Large negative effects of a "surprising" dimension have been found in Australia for regional warming variations of +2°C
India	Effect of extreme heat above 34°C: crop models probably underestimate yield losses for warming of 2°C or more by as much as 50 percent for some sowing dates, where warming of 2°C more refers to an artificial increase of daily temperatures of 2°C.
USA	Significant nonlinear effects are observed above local temperatures of 29°C for maize, 30°C for soybeans, and 32°C for cotton

Source: World Bank based on Lobell et al 2011, Asseng, Foster & Turner 2011, Lobell et al 2012, Schlenker and Roberts 2009, BofA Merrill Lynch Global Research

Global food security could be undermined in a +4°C world

Recent scientific evidence increasingly shows that there is a rapidly rising risk of crop yield reductions as the world warms. Worryingly, the potential for food production is projected to decrease – and global food security could be significantly undermined if we move to a 4°C world.

Chart 66: World climate change impact stress map: reduced water and arable land



Source: Syngenta, UNEP, Cline, BofA Merrill Lynch Global Research

There is an emerging risk of nonlinear effects on crop yields because of the damaging effect of temperature extremes (Source: World Bank)

Larger impacts at higher & more extreme temperatures

Recent research indicates that there may be larger negative effects at higher and more extreme temperatures. This raises growing concern vis-à-vis the sensitivity of crop yields to temperature increases and, in particular, extreme temperature events. There appears to be larger negative effects at higher temperatures such as has been documented in higher yield losses per degree of regional mean warming in Australia and India (Source: Semenov et al. 2012, Lobell et al., World

Bank). Crops are highly sensitive to extreme temperatures – which will be highly relevant in a 4°C world, and is not always accounted for in current crop models (Source: World Bank).

14-34% potential reductions in yields to 2050

Between 2000 and 2050, assuming warming levels of between 1.8°C and 2.8°C (2.2°C and 3.2°C vs. preindustrial temperatures), projected decreases in yields could be as high as 14 to 25 percent for wheat, 19 to 34 percent for maize, and 15 to 30 percent for soybean (without accounting for possible CO₂ fertilization effects) (Source: Deryng et al. 2011, World Bank).

Low latitude regions at highest risk

At highest potential risk are low-latitude regions – especially seasonally dry and tropical regions, where crop productivity is projected to decrease even with a 1°C to 2°C temperature increase (Source: UN IPCC). Areas at risk include Africa, Latin America, and India (Source: Zhang and Cai 2011, World Bank).

Lower impacts for high latitudes

Crop productivity is projected to increase slightly at mid- to high latitudes for temperature increases of up to 3°C depending on the crop, and then decrease beyond that in some regions (Source: UN IPCC).

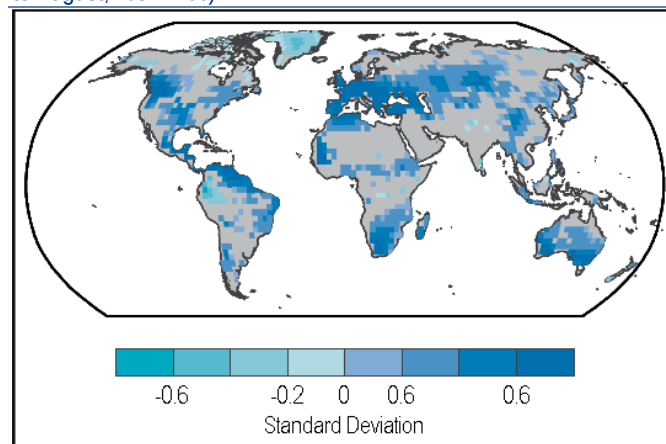
Increasing impact of drought

Recent projections and evaluations suggest a substantially increased risk of drought affecting large parts of the world. Increasing temperatures, higher evaporation, and decreasing precipitation in drought prone areas, especially in the tropics and subtropics, mean a greater threat to food security. The total “drought disaster affected” area is predicted to increase from currently 15.4 percent of global cropland to 44 ±6 percent by 2100 based on a modified Palmer Drought Severity Index. Africa and Oceania could be at highest risk – with projections of up to 59 percent of cropland being impacted by 2100 in each region (Source: Liu et al, World Bank)

Projections indicate a reduction of 3-10% for wheat yields per 1°C warming in the UK and China (Source: Mitchell et al 1999, You et al 2009, World Bank)

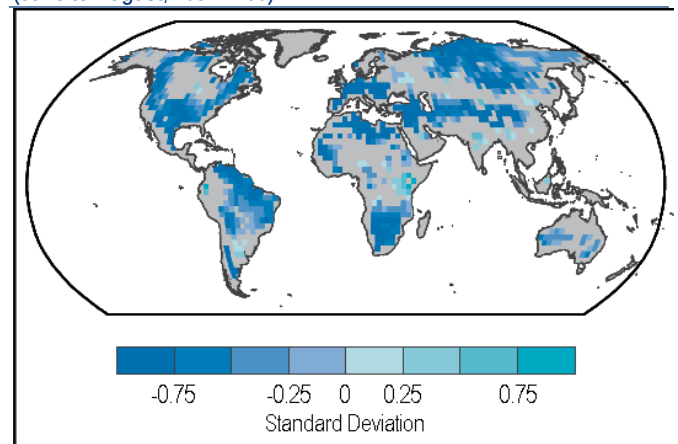
Southern Africa, the United States, southern Europe, Brazil, and Southeast Asia are all expected to see increasing drought through 2100 (Source: Dai 2012, World Bank)

Chart 67: Projected changes in dryness: consecutive dry days (June to August, 2081-2100)



Source: IPCC, BofA Merrill Lynch Global Research. Consecutive dry days = days with precipitation; <1 mm.

Chart 68: Projected changes in dryness: soil moisture anomalies (June to August, 2081-2100)

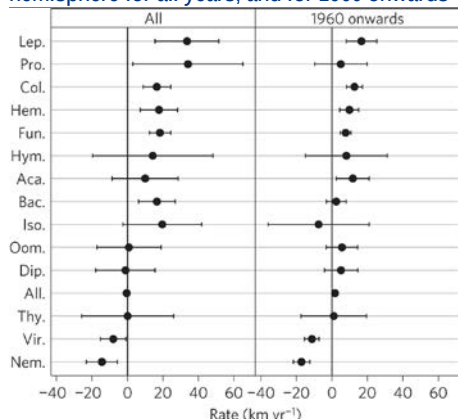


Source: IPCC, BofA Merrill Lynch Global Research. Soil moisture anomaly = anomaly in water stored in or at the land surface and available for evapotranspiration

Low lying coastal areas such as Africa, Bangladesh, Egypt and Vietnam would be at highest risk
5Source: World Bank)

It is argued that the earth's biosphere may have the capacity to sequester increased CO₂ in the atmosphere. This effect is known as "CO₂ fertilization" because, the higher ambient CO₂ concentrations in the atmosphere literally "fertilize" plant growth. Because plants in turn, via photosynthesis, convert CO₂ into oxygen, it is thus sometimes argued that such "CO₂ fertilization" could potentially provide a strong negative feedback on changing CO₂ concentrations (Source: RealClimate)

Chart 69: Mean latitudinal shift (km yr⁻¹) for pest taxonomic groups in the northern hemisphere for all years, and for 1960 onwards



Source: Bebber et. al. Nature Climate Change 2013

The 2012 USDA plant hardiness zone map showed that planting zones have been shifting northward as winters become milder.

Sea-level rises would make things even worse

The impact of 4°C warming would be exacerbated by rising sea levels. Mid-latitude, low lying coastal areas such as Africa, Bangladesh, Egypt and Vietnam would be at highest risk because of flooding and contamination of groundwater (Source: World Bank).

Uncertainty in CO₂-fertilisation effect

There is on-going debate and uncertainty about the magnitude of the CO₂ effect – and whether the effects of CO₂ fertilisation would help to increase or decrease global crop production.

Table 12: Projected changes in median maize yields under different management options and global mean warming levels

	Option	1°C >1961-80	2°C >1961-80	3°C >1961-80
Irrigated maize	No CO ₂ fertilisation	-4.4% to -10.9%	-9.8% to -21.7%	-4.3% to -32.1%
	W/ CO ₂ fertilisation	-1.6% to -7.8%	-10.2% to -16.4%	-3.9% to -26.6%
Rainfed maize	No CO ₂ fertilisation	-1.0% to -22.2%	-7.9% to -27.6%	-4.6% to -33.7%
	W/ CO ₂ fertilisation	-0.7% to -10.8%	-5.6% to -18.1%	-1.6% to -25.9%

Source: World Bank based on Tao & Zhang 2010, BofA Merrill Lynch Global Research

Climate change driving spread of crop pests

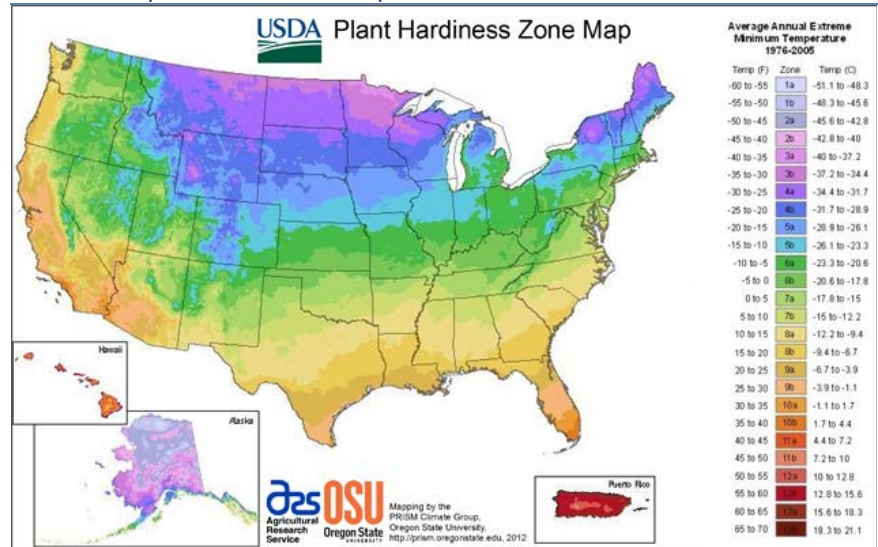
Insects and diseases that attack food crops are moving to higher latitudes as climate change alters their habitats, according to researchers at the universities of Exeter and Oxford (Source: Bebber et. al. Nature Climate Change 2013). The teams studied records of 612 crop pests and pathogens from around the world over a 50Y period –and found that since 1960, they had shifted toward the poles at an average rate of about 3km (1.86 miles) per year. With the bulk of the world's agricultural production today taking place in the temperate zones, the study raises questions about long-term food security. Plant diseases claim an estimated 10-16% of the world's crops in the field, experts say, and destroy another 6-12% post-harvest. Research has also shown wild plants and animals are moving toward the poles as the planet gets warmer.

Temperate zones could shift north

In 2012, the U.S. Department of Agriculture adjusted northward its "Plant Hardiness Zone Map" of the best places to grow certain plants and crops. Plant hardiness-zone designations represent the average annual extreme minimum temperatures at a given location during a particular time period – with low temperatures during winter a crucial factor in the survival of plants at specific locations.

The 2012 update shifted temperatures up one 5-degree increment across much of the lower 48 states – which may be partly attributed to better data and/or climate change. Beyond the impact on gardeners, farmers and agricultural input companies – the map helps to determine governmental standards for crop insurers.

Exhibit 1: U.S. plant hardiness zone map



Source: USDA Agricultural Research Service

Other researchers estimate that the USDA's map may already be outdated – and that one-third of the U.S. has already shifted half-zones by comparison with the map, and more than one-fifth has shifted a full zone (Source: Krakauer et. al., Advances in Meteorology 2012).

Huge impacts on economic growth & human development

Research into the knock-on effects of climate change on crop yields, poverty and welfare of climate change using the Global Trade Analysis Project model suggests that even a 1.5°C temperature increase as early as 2030 would be felt most in Sub-Saharan Africa, followed by China and the United States (Source: Hertel et al. 2010, World Bank).

Poor would be hit hardest

The projected increases in temperatures and extreme weather such as floods and droughts would have the greatest implications for food production and poverty reduction efforts on developing countries, with Africa and South Asia particularly sensitive to nutritional deficits, increased incidence of epidemic diseases, and water contamination among other factors (Source: World Bank)

Significant knock-on impacts for agriculture

As agriculture is the primary water consumer globally – responsible for c70% of water use – increasing water scarcity, fuelled by climate change, will put food security at growing risk. Water scarcity is very likely to be amplified due to climate change in many countries that are already water scarce today, mainly in Northern and Eastern Africa and South Asia.

Some regions will benefit

Some regions are expected to experience advantages because of such factors as regional precipitation increases, low population, or high agricultural water use efficiency (Source: World Bank).

The energy factor is also key to potential conflict

Another factor that could complicate the picture is related to water use in energy production. Increased demand in different parts of the world could lead to greater tensions and conflicts over claims to water sources and priority of water uses.

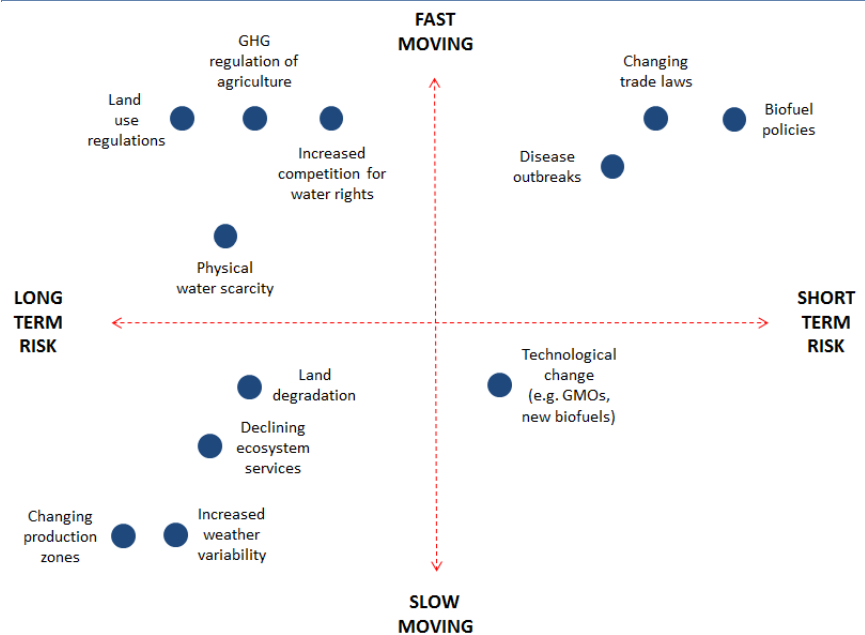
A 1.5°C temperature increase as early as 2030 would be felt most in Sub-Saharan Africa, followed by China and the U.S.

Climate worst case, \$6-11tn/y agricultural catastrophe

Environmental challenges posed by climate change and water constraints are increasingly seen as posing potential stranded assets' risks for the agricultural sector – where environmentally unsustainable assets could suffer from unanticipated or premature writeoffs, downward revaluations or are converted to liabilities. Research by the Stranded Assets Programme at the University of Oxford suggests that the amount of value potentially at risk globally is significant, and that the potential challenge of stranded assets in agriculture is currently being exacerbated by an on-going agricultural boom, which is feeding off high commodity prices and poor investment returns elsewhere in the economy to push farmland values to record highs in many markets:

- **Under a worst case extreme loss of natural capital scenario**, they found that the loss measured by the 0.5% VaR (value at risk) could almost double from US\$6.3tn to US\$11.2tn (i.e. a 0.5% chance of the annual loss being more than US\$11.2tn) (Source: Caldecott et. al., University of Oxford)

Chart 70: Time horizons for environment-related risks in agriculture



Source: Caldecott et. al., Smith School of Enterprise and the Environment

Adaptive measures will be key

Adaptations for heat and drought tolerance will be key in the coming years. By simulating adaptation with respect to changes in planting and harvesting date, as well as changes in cultivar type in terms of rates of maturation, adaptation can reduce losses by about a factor of two for spring wheat and maize and by 15% for soybeans (Source: World Bank).

Table 13: Projected impacts of different crops without and with adaptation

Crop	Without adaptation	With adaptation
Spring wheat	-14% to -25%	-4% to -10%
Maize	-19% to -34%	-6% to -18%
Soybean	-15% to -30%	-12% to -26%

Source: Deryng et al, World Bank

Weathering the perfect storm: 7 entry points for long-term solutions

For investors wishing to invest in the long-term theme of solution providers for the perfect storm of food-water-energy security in an extreme weather and climate change constrained world, we have created a list of seven entry points: 1) water; 2) fertilizers; 3) crop science; 4) farming; 5) energy efficiency; 6) second generation biofuels; and 7) renewables.

Water, a blue revolution

In our view, a number of stocks are well placed to benefit from the theme of Water as long-term solutions to the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. This includes stocks involved in water treatment, water management, and water infrastructure and supply, among other areas.

[ESG & Sustainability: A Blue Revolution – global water 14 December 2012](#)

Table 14: Extreme weather - Weathering the perfect storm exposure (WPS) - Water

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
IVRC IN	IVRCL Infrastruc	India	IIFRF	WATER INFRA. & SUPPLY	High
NJCC IN	Nagarjuna Const	India	NGRJF	WATER INFRA. & SUPPLY	Low
SBSP3 BZ	SABESP	Brazil	CSBJF	WATER INFRA. & SUPPLY	High
SBS US	Sabesp-ADR	Brazil	SBS	WATER INFRA. & SUPPLY	High
AGUAS/A CI	Aguas Andinas	Chile	XXSGF	WATER INFRA. & SUPPLY	High
AEG SJ	Aveng Ltd	South Africa	AVEPF	WATER INFRA. & SUPPLY	Low
CSMG3 BZ	COPASA	Brazil	CSAOF	WATER INFRA. & SUPPLY	High
IAM CI	Aguas Metropolit	Chile	XVNFF	WATER INFRA. & SUPPLY	High
KEP SP	KEP	Singapore	KPELF	WATER INFRA. & SUPPLY	Low
KEP SP	KEP	Singapore	KPELF	WATER INFRA. & SUPPLY	Low
OHL SM	OHL	Spain	OBSJF	WATER INFRA. & SUPPLY	Low
PNN LN	Pennon	United Kingdom	PEGRF	WATER INFRA. & SUPPLY	High
ROR LN	Rotork	United Kingdom	RTOXF	WATER INFRA. & SUPPLY	Low
SVT LN	Severn Trent	United Kingdom	SVTRF	WATER INFRA. & SUPPLY	High
SEV FP	Suez Environnement	France	SZEVF	WATER INFRA. & SUPPLY	Medium
UU/ LN	United Utilities	United Kingdom	UUGWF	WATER INFRA. & SUPPLY	High
URS US	URS Corp.	United States	URS	WATER INFRA. & SUPPLY	Low
VIE FP	Veolia	France	VEOEF	WATER INFRA. & SUPPLY	Medium
KSB3 GR	KSB AG	Germany	KSVRF	WATER INFRA. & SUPPLY	Low
363 HK	Shanghai Indus	Hong Kong	SGHIF	WATER INFRA. & SUPPLY	Low
ACM US	AECOM Technology	United States	ACM	WATER INFRA. & SUPPLY	Low
3 HK	HK&China Gas	Hong Kong	HOKCF	WATER INFRA. & SUPPLY	Low
270 HK	Guangdong Invest	Hong Kong	GGDVF	WATER INFRA. & SUPPLY	High
392 HK	Beijing Enterprises	Hong Kong	BJINF	WATER INFRA. & SUPPLY	Low
IDXX US	IDEXX	United States	IDXX	WATER MANAGEMENT	Low
DE US	Deere & Co	United States	DE	WATER MANAGEMENT	Low
ITRI US	Itron	United States	ITRI	WATER MANAGEMENT	Medium
SYNN VX	Syngenta	Switzerland	SYENF	WATER MANAGEMENT	Low
MRO LN	Melrose plc	United Kingdom	MLSPF	WATER MANAGEMENT	High
ALFA SS	Alfa Laval	Sweden	ALFVF	WATER TREATMENT	Low
BN FP	Danone	France	GPDNF	WATER TREATMENT	Low
DOW US	Dow Chemical	United States	DOW	WATER TREATMENT	Low
6370 JP	Kurita Water	Japan	KTWIF	WATER TREATMENT	High
LXS GR	Lanxess	Germany	LNXSF	WATER TREATMENT	Low
7011 JP	Mitsubishi Heavy	Japan	MHVYF	WATER TREATMENT	Low
PLL US	Pall Corp	United States	PLL	WATER TREATMENT	Low
SCI SP	SCI	Singapore	SCRPF	WATER TREATMENT	Low
6506 JP	Yaskawa Electric	Japan	YASKF	WATER TREATMENT	Low
VATW IN	Va Tech Wabag	India	XVWBF	WATER TREATMENT	High
034020 KS	Doosan Heavy	Korea, Republic Of	DOHIF	WATER TREATMENT	Low
ICL IT	ICL	Israel	ISCHF	WATER TREATMENT	Low
NESN VX	Nestle (Reg)	Switzerland	NSRGF	WATER TREATMENT	Low
GE US	General Electric	United States	GE	WATER TREATMENT	Low

Table 14: Extreme weather - Weathering the perfect storm exposure (WPS) - Water

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
ECL US	Ecolab Inc	United States	ECL	WATER TREATMENT	Medium
SRCL US	Stericycle	United States	SRCL	WATER TREATMENT	Low
KRA1V FH	Kemira	Finland	KMRAF	WATER TREATMENT	Low
HEXAB SS	Hexagon AB	Sweden	HXGBF	WATER TREATMENT	Low
DD US	DuPont	United States	DD	WATER TREATMENT	Low
3402 JP	Toray	Japan	TRYIF	WATER TREATMENT	Low
3405 JP	Kuraray	Japan	KURRF	WATER TREATMENT	Low

Source: BofA Merrill Lynch Global Research

Population increase, higher living standards, over-exploitation of water, water pollution, ecosystem degradation and adverse climate change will mean that water demand will overshoot supply

Water scarcity is a global reality

783mn people lack access to clean drinking water, 2.6 billion have no access to improved sanitation services and 1.4 million children under five die a year as a result of poor access to clean water and adequate sanitation. Water is under growing pressure both on the supply side (insufficient freshwater, uneven distribution, poor quality, non-revenue water, climate change) and the demand side (agriculture, industry, residential).

Peak water: the 21st century oil

In our Blue Revolution report, we set out our view that the long-term supply challenges are enormous – and with no improvement in the efficiency of agricultural, industrial and residential water use, demand is projected to overshoot supply by 40% in the next 20 years, with half the world's population living under conditions of water stress by 2030. In our view, water may become scarcer than oil, with potential for the supply/demand imbalance to manifest in increased domestic social unrest and trans-boundary disputes (30 countries on three continents are potential locations for future conflicts over water).

US\$500bn market with 6-7% CAGR, US\$1tn by 2020E

Water is a US\$500bn market today, which, despite the recession, is delivering a global CAGR of 6-7%, well above global growth rates. Growth drivers include a range of megatrends: water scarcity, climate change, extreme weather, population growth, urbanisation, industrial growth, infrastructure development and renewal, pricing, growing private sector investment, food and energy security, stakeholder pressure, tightening regulation. By 2020, we estimate that the water industry could be worth US\$1tn, with Asia and South America seeing the biggest growth.

Fighting the perfect storm via water stocks

Water treatment

In our view, a number of stocks are well placed to benefit from the theme of water treatment through their involvement in areas such as wastewater, industrial treatment, chemicals, desalination, ballast water treatment, analysis, water quality, PV solar, bottled water, life science tools, and testing, inspection and certification, among other areas.

Increasing levels of water treatment will be an expanding area in the coming years given rising water scarcity and growing demand from the agriculture, residential and industrial sectors. Agriculture currently accounts for 70% of water use and demand looks set to rise on the back of changing diets. Industry will be under pressure to treat water as global demand rises from 22% of total demand towards the current 59% in developed markets. Municipal and residential water use is also increasing on the back of urbanisation and EM growth.

There are significant opportunities around water treatment and the processes used to make water more acceptable for a desired end-use, such as drinking

water, usage or re-usage by industry, in irrigation, or return to the natural environment. Moreover, this market is barely tapped with insufficient wastewater treatment around the world. For instance, wastewater reuse stands at only 2.41% of all water withdrawals globally (Source: FAO Aquastat). The estimate of total global water reuse is less than the water used each day by US toilets at home. The goal needs to be to move to best-practice levels of water reuse of up to 75%.

We anticipate that some of the largest opportunities will emerge around the multi-billion dollar industrial water treatment market vis-à-vis sectors with heavy volumes and environmental constraints (utilities, oil & gas, mining), strict water constraints (FOB, cosmetics), variable effluents (petrochemicals, energy, breweries), as well as in emerging areas like ship ballast water treatment. Desalination is also set to emerge as a US\$25bn industry by 2025 (Source: GWI), with PV solar a long-term opportunity. Finally, bottled water is a US\$96bn market, with a 5% CAGR to 2015E.

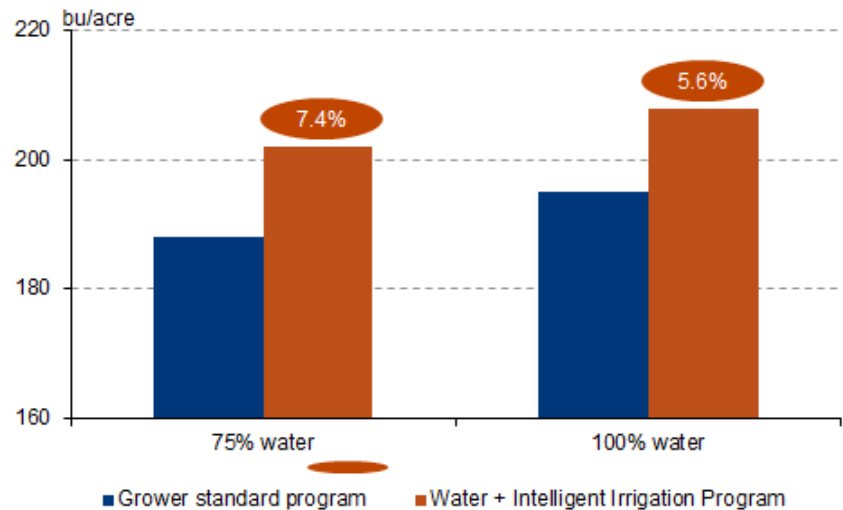
Water management

In our view, a number of companies are well placed to benefit from the theme of water management, vis-à-vis their involvement in areas such as irrigation, drought resistant seeds and crops, smart metering and household water efficiency.

Water management has assumed greater importance in recent years as a strategy to improve efficiency and the sustainable use of resources. Water usage is growing faster than population growth – with US usage alone increasing 207% from 1950 to 2000 and per capita usage growing by 20% during the same period (Source: EPA). In a situation of growing water scarcity, fragmented water management (and conflicting interests of stakeholders) is no longer cost effective or sustainable in the long term. There is growing recognition that the current water crisis is as much a consequence of weak policies and poor management as natural scarcity. Effective water management enables users to cut their demand, mitigate the risks associated with its shortage and reduce the need for capex-intensive solutions.

Given that agriculture accounts for 70% of global water use – as high as 95% in some EMs – and up to 60% of this water is wasted, smarter irrigation will be key to achieving more crop per drop. There is huge potential for the US\$5.6bn irrigation market given that gravity flow/furrow irrigation accounts for 91% of irrigation globally, and low energy precision application still has extremely low global penetration. Moreover, climate change and extreme weather will make increasing yields a pressing reality.

Chart 71: Water optimization allow farmers to grow more corn with less water



Source: Syngenta, BofA Merrill Lynch Global Research

More attention is now focused on water losses and unaccounted-for water, whether it is due to inefficient usage, leakages or information deficiencies. Leakage and non-revenue water also costs utilities upward of US\$20bn pa in lost revenues, which should create substantial downstream basic and smart meter demand from water utilities. We forecast a CAGR of 19% in water meter spending to 2016.

Finally, water efficiency will become as important as energy efficiency as 70% of the global population becomes urban by 2050. This will mean that household water management will become increasingly important. The potential is huge – if all US households installed water-saving features, the dollar-volume savings would be US\$11.3mn per day or more than US\$4bn pa (Source: American Water Works Association).

Water infrastructure and supply

In our view, a number of companies are well placed to benefit from the theme of water infrastructure and supply, vis-à-vis their involvement in areas such as engineering, procurement, construction and consulting, pipes, pumps and valves, and water, wastewater and sewage treatment utilities.

Water and sanitation infrastructure is sorely lacking in many emerging and developed markets, and water loss or non-revenue water (NRW) is a considerable problem around the globe. Crumbling and incomplete infrastructure in developed markets are a primary cause of this – with the US alone estimated to need US\$335bn in public water investments over the next 20 years in transmission and distribution, treatment and storage, among other areas (Source: US EPA). For EMs, the challenge is building out water infrastructure.

Annual water investment needs are estimated to rise to more than US\$770bn for the OECD and BRICs by 2015 (Source: Ashley and Cashman). Globally, addressing the challenge of developing, modernising and upgrading systems, maintaining service quality, ensuring the security of water supplies in response to climate change, pollution and growing populations and, in some cases, overcoming the neglect and under-financing of earlier years could cost 0.35%-1.2% of GDP pa over the next 20 years (Source: OECD). With public funding

increasingly under financial pressure, we believe the private sector will need to play an increasingly important role – and is expected to account for 30% of investments by 2016 compared with 19% today (Source: Global Water Fund).

Water infrastructure is currently a US\$360bn+ market and is registering a CAGR of up to 6% in some segments. Growth rates are lower but more stable for the highly fragmented utilities sector where around only 10% of customers are served by investor-owned companies – and performance depends on regulatory factors as well as fundamental drivers of revenue and cost. The global water utilities industry is estimated to grow 4.5% to a volume of 3,007.4bn m³ and by 20.5% to a value of US\$874.2bn (Source: Reportlinker). The prospects for this segment are very different between DMs and EMs – but we see some of the biggest growth opportunities in China, Brazil and the US.

Fertilizers

In our view, a number of stocks are well placed to benefit from the theme of Fertilizers as long-term solutions to the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. This includes stocks involved in agribusiness, ammonia, fertilizers, nitrogen, phosphates, potash, potassium chloride and urea, among other areas.

Table 15: Extreme weather - Weathering the perfect storm exposure (WPS) - Fertilisers

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
AKRN LI	Acron	Russian Federation	XACJF	FERTILISERS	High
PHOR LI	Phosagro	Russian Federation	XTAZF	FERTILISERS	High
VALE US	Vale ON	Brazil	VALE	FERTILISERS	Low
CF US	CF Industries	United States	CF	FERTILISERS	High
AGU US	Agrium Inc.	Canada	AGU	FERTILISERS	High
URKA LI	Uralkali	Russian Federation	URALL	FERTILISERS	High
SABIC AB	SABIC	Saudi Arabia	XAUBF	FERTILISERS	Low
ICL IT	ICL	Israel	ISCHF	FERTILISERS	High
3983 HK	China BlueChem	China	CBLUF	FERTILISERS	High
BG US	Bunge	United States	BG	FERTILISERS	Low
FFBL PA	Fauji Bin Qasim	Pakistan	FJDFF	FERTILISERS	High
FFC PA	Fauji Fertilizer	Pakistan	FAUJF	FERTILISERS	High
FHER3 BZ	Heringer	Brazil	XFTLF	FERTILISERS	High
IPL AU	Incitec	Australia	ICPVF	FERTILISERS	High
SDF GR	K+S Group	Germany	KPLUF	FERTILISERS	High
PCEM MK	PCG	Malaysia	XOPNF	FERTILISERS	Low
OCIC EY	OCI	Egypt	ORSCF	FERTILISERS	Medium
POT US	Potash Corp	Canada	POT	FERTILISERS	High
SAFCO AB	SAFCO	Saudi Arabia	XDUAF	FERTILISERS	High
SQM US	SQM	Chile	SQM	FERTILISERS	High
297 HK	Sinofert HLDG	Hong Kong	SNFRF	FERTILISERS	High
MOS US	Mosaic	United States	MOS	FERTILISERS	High

Source: BofA Merrill Lynch Global Research

"It is inconceivable that the world can meet the growing demand for food, feed and fibre without judicious use of inputs, especially fertilizers."
(Source: UN Food and Agriculture Organization)

Up to 60% of food production possible via fertilisers

Food production has increased by c50% since the Asian Green Revolution of the 1960s and 1970s, which has been credited to fertiliser use. Today, approximately 40-60% of the world's food production is made possible through the effective use of fertilizers and the impact of their primary plant nutrients and secondary nutrients on soil. A well-balanced supply of nutrients increases yields and enhances crop quality, both of which are necessary to support growing demand. Fertilizers are thus key to improving a plant's root production, leaf and stem growth, flowering and fruiting, healthy root growth, earlier crop maturity, increased water use efficiency, and resistance to extreme temperatures, droughts, pests and disease. The global fertilizer industry totalled \$190 billion in sales during 2011.

Over the last ten years:

- +12% growth in world population
- +32% growth in global income
- +26% growth in crop consumption (soybean +37%, corn +39%, wheat +13%, rice +15%, cotton +8%)
- +17% growth in meat consumption (beef +2%, pork +15%, chicken +32%) (Source: Dupont)

Fertilizer use in the majority of food insecure countries is low

Megatrends tend to drive long-term growth

Rising population and increasing demand for protein on a per capita basis will drive long-term demand for fertilizers higher in our view. Since demand for protein (beef, poultry, pork, etc.) tends to correlate positively with increases in wealth, we expect it to rise commensurate with increases in real income per capita in developing markets. Grains will be required for animal feed, and agricultural inputs (seeds, fertilizers and crop protection chemicals) will be needed to grow the grain in a manner that maximizes yield and farm income. At the present level of crop production technology, about 160 million tonnes of fertilizer nutrients are consumed each year. By 2050, an estimated 215 million tonnes will be required per year to meet agricultural production needs (Source: UN FAO)

Long-term demand...

We expect demand for fertilizers to rise a bit more rapidly than for corn and soybeans as agronomic practices in emerging markets converge gradually with those in the developed world. Our Chemicals team is looking for a rebound in global fertilizer demand in 2013 and expects global demand for potash to rebound 8-10% to 55-56mn metric tons from a depressed base of ~51mn tons in 2012. Meanwhile, they expect global nitrogen demand to grow 2-3%, albeit with concurrent supply concerns related to natural gas constraints in Trinidad and Egypt. They expect nitrogen to remain tight through 2015 followed by a US nitrogen renaissance in 2016-2019.

Longer-term, we project volume growth of approximately 3.0-3.5% a year for potash, 2.5-3.0% for phosphates and 2% for nitrogen. Taking into account price inflation, we anticipate long-term industry sales growth of approximately 5% that should support net earnings growth of nearly 7% after operating and financial leverage is taken into account.

Extreme weather & drought will fuel demand

The 2012 U.S. drought and crop damage is a sign of things to come vis-à-vis fertiliser demand. For the US, the drought meant nutrient deficiencies in soil, dips in 2012 crop production, and tight stocks for certain crops – all of which created conditions for high crop plantings and plant nutrient demand in 2013. Long-term, increasing instances of drought will mean strong demand for fertilizers as farmers focus on soil fertility – one of the factors they can seek to control in a drought – and seek to maximize their next crops in the following season. Historical trends bear this out with US fertilizer use spiking by up to 20% after declines in corn yields, for instance, in the early 1980s (Source: Potash Corp).

There is however a risk that farmers could be so hard hit that they forego investing in agricultural inputs – and at the least they will take a harder look at how much fertilizer they can afford. However, globally, there is still strong unfilled fertilizer demand from markets such as China, India, Southeast Asia and South America.

Need to be used with caution

Policies are however needed to curb overuse of fertilizers that, in some cases, can cause serious ecosystem damage

Crop science, more crop per drop

In our view, a number of stocks are well placed to benefit from the theme of Crop Science as long-term solutions to the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. This includes stocks involved in agronomy, crop protection chemicals, enzymes, field crops,

fungicides, genetically modified (GM) crops, herbicides, insecticides, pesticides, seeds (conventional and genetically modified), seed treatment and protection products, among other areas.

Table 16: Extreme weather - Weathering the perfect storm exposure (WPS) – Crop science

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
BAYN GR	Bayer	Germany	BAYZF	CROP SCIENCE	Low
BAS GR	BASF	Germany	BFFAF	CROP SCIENCE	Medium
DOW US	Dow Chemical	United States	DOW	CROP SCIENCE	Low
NUF AU	Nufarm Limited	Australia	NUFMF	CROP SCIENCE	High
MON US	Monsanto	United States	MON	CROP SCIENCE	High
SYNN VX	Syngenta	Switzerland	SYENF	CROP SCIENCE	High
DD US	DuPont	United States	DD	CROP SCIENCE	Medium

Source: BofA Merrill Lynch Global Research

Global food production needs to double to 2050

To date, global food production has broadly kept pace with growing population and demand. More efficient use of farmland including via technological innovation (crops, seeds, fertilisers, agricultural equipment etc.) and more efficient water-use has been key in this regard. But going forward, global food demand – as reflected by total crop and livestock demand and production – could rise by 40% by 2030 and double by 2050 – meaning that a 70% increase in production output would be needed to feed the world (Source: UN FAO). Maintaining adequate food and agricultural output in the face of increasing population and rising levels of income will become an increasingly important global challenge – especially given an environment of extreme weather and climate change. For instance, the FAO ranks drought as the most common cause of severe food shortages in developing countries.

Global food productivity on the decline

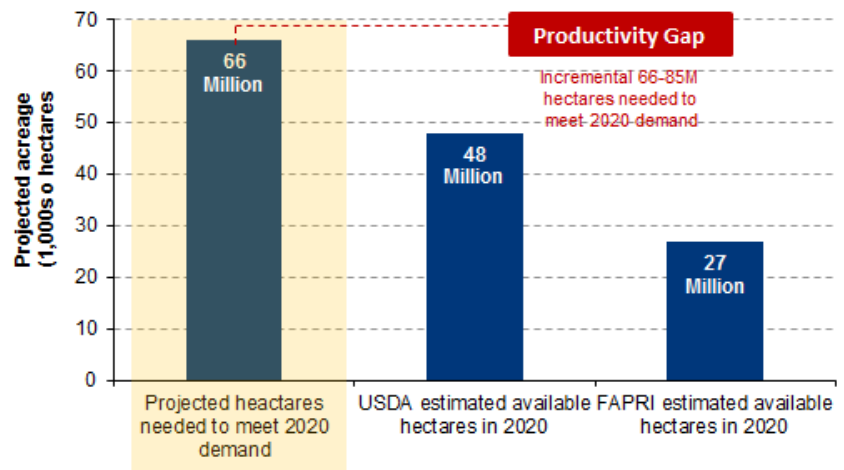
Demand for food over the next decade is expected to increase by 1% annually - and is expected to grow at 1.1% to 1.5% from the 2020s to 2050 – largely off the back of population growth, affluence, increases in per capita consumption, and changes in diets (protein demand).

In 1950, 1ha fed 2 people vs. 2030: 1ha will be needed to feed 5 people (Source: Syngenta)

Global grain production has more than doubled while land used for arable agriculture has only increased 9% (Source: (Godfray, Beddington et al. 2010)

However, global food productivity gains have declined from 2% between 1970 and 2000 to c1% today and appear to be continuing to decline. For instance, from 2007-2012, global corn production saw 1.1% CAGR vs. global corn demand which grew by 2.0% CAGR (Source: Monsanto). A 2011 study reported that the world had consumed more than it had produced for seven out of the past eight years.

Chart 72: Acreage projections for 10 major crops



Source: Monsanto, BofA Merrill Lynch Global Research

Need to intensify agricultural production

There is ever increasing competition for arable land – notably from urbanisation and biofuels – which is set to increase in a climate change constrained world. Other factors which could further reduce productivity include declines in nutrient availability (e.g. phosphorus), the spread in pests and weed, and geographical shifts in production patterns resulting from the effects of global warming (Source: World Bank). This will necessitate an intensification of agriculture on the same or reduced quantities of land (Source: Godfray, Beddington et al. 2010; Smith et al. 2010, World Bank) – and more yield per acre globally through improved productivity.

Climate change adaptation is becoming key

With drought one of the most important limitations for global agriculture, there is widespread consensus that agriculture needs to adapt to the threat with hardier plants and animals specially engineered to survive in conditions of intense heat and little rain. The last 40-50 years have seen farming practices and crop science make inroads to improve crop resistance to insects, weeds and diseases – and genetically engineered insect- and herbicide-resistant crops now dominate agriculture. Such efforts have helped to boost the drought tolerance of US corn by 1% a year over the last few decades (Source: Centre for Agricultural and Rural Development). It is certain that the damage of the current US drought would be much worse without these crop science advancements.

Need more crop per drop, drought tolerant seeds & crops

There is now a growing need to achieve more crop per drop – to develop new crop and plant varieties which can tolerate mild drought such as larger roots to absorb more water, and smaller tassels to save more energy for making kernels, leaves that use less water for transpiration – and resume normal biology and output when normal precipitation patterns resume.

Controversy vs. food pressure

Although controversial in some stakeholder circles – especially in the EU and Japan – these include seeds and plants genetically modified to be tolerant of drought. While it is too early to say whether drought-tolerant crops have a sure-fire future and whether seeds can be developed to endure the most severe droughts, since biotech crops were first introduced in the 1990s, the technology

“... crop adaptation could conceivably play a major role in ensuring food security in a changing climate, although realization of this potential will likely require substantial investment in developing suitable cultivars.” (Source: World Bank 2012)

has proved to be increasingly efficient. For 2013, companies stepping up their efforts in this space include Monsanto (DroughtGard Hybrids), DuPont Pioneer (Optimum Aquamax), Syngenta –Agrisure Artesian) and Dow (genetically screened corn hybrids with drought tolerant traits).

Table 17: Dupont's US Optimum AQUAmax hybrid yield data

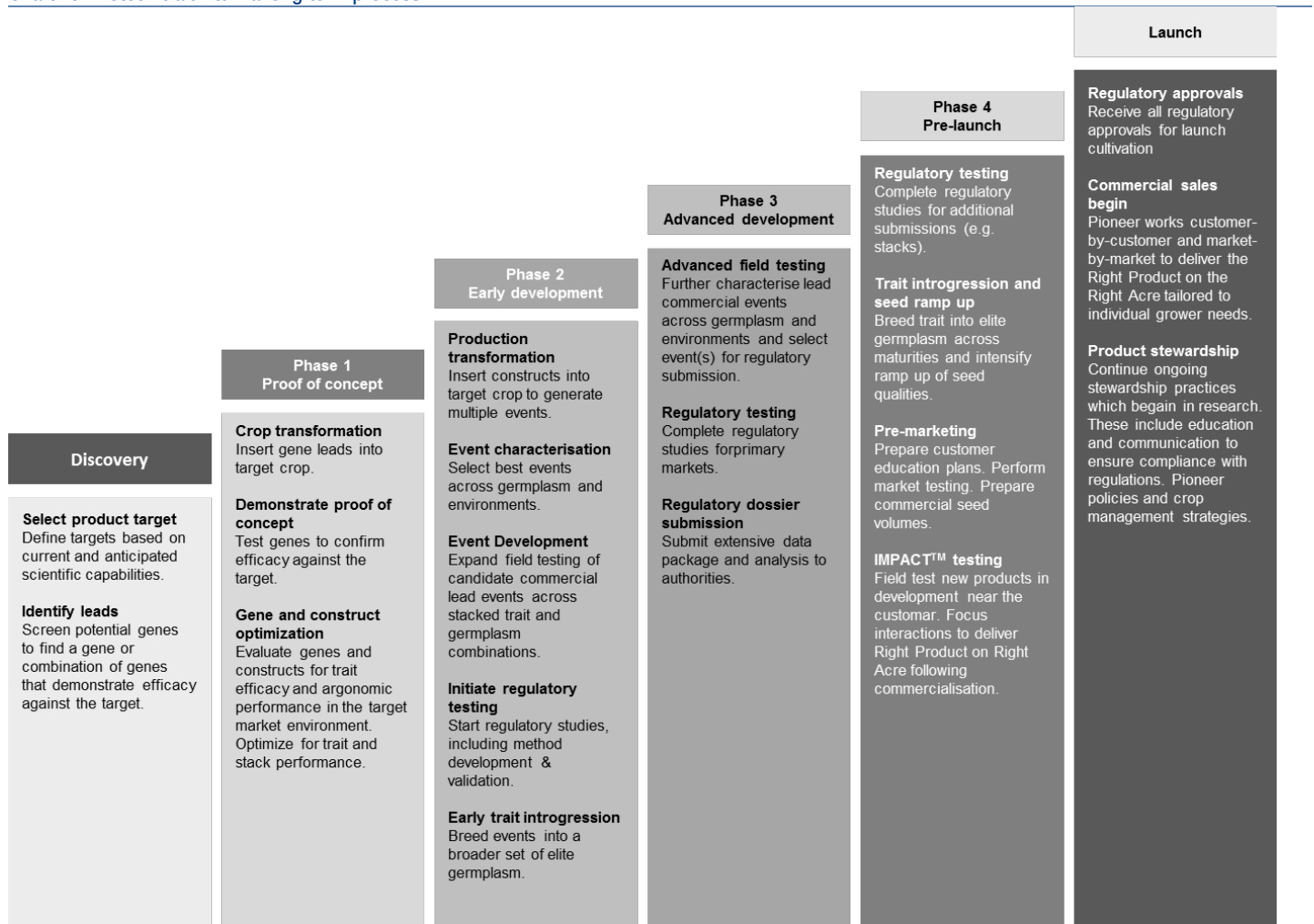
Category	% Yield Advantage	Pioneer bu/ac Yield Advantage	% Wins	# of Comps
Water limited	+8.9	8.5	69%	3,606
Favourable	+1.9	4.2	59%	7,663

Source: DuPont, BofA Merrill Lynch Global Research

From corn to other crops

The initial focus will be on corn given its importance to the agro-food industry –up to 75% of grocery products contain corn and it is a key feed for livestock and ethanol. Corn is the most studied and engineered grain – and the first large scale tests are currently under way in the US Midwest. Other crops gaining attention include: alfalfa because hay is key for feeding livestock; wheat; and resurrection plants, which can be deprived of water for weeks but spring back to life when watered, with the goal of isolating genes that allow those plants to recover quickly from drought and transfer those traits to crops such as corn. Similar ideas are in use to breed drought tolerance into livestock herds, such as cattle being bred with genes from African and Indian varieties accustomed to hot climates and poorer forage.

Chart 73: Biotech trait R&D: a long-term process



Source: DuPont, BofA Merrill Lynch Global Research

Farming & agricultural equipment

In our opinion, a number of stocks are well placed to benefit from the theme of Farming and Agricultural Equipment as long-term solutions to the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. This includes stocks involved in agribusiness, agricultural equipment, biofuels, commercial farming, farmland, fertilisers, grain origination and processing, irrigation, precision farming, protein production processing, and supply chain management, among other areas.

Table 18: Extreme weather - Weathering the perfect storm exposure (WPS) - Farming & Agricultural Equipment

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
DE US	Deere & Co	United States	DE	AGRICULTURAL EQUIPMENT	High
AGCO US	AGCO Corp	United States	AGCO	AGRICULTURAL EQUIPMENT	High
CNH US	CNH Global	Netherlands	CNH	AGRICULTURAL EQUIPMENT	High
FI IM	Fiat Industrial	Italy	FNDSE	AGRICULTURAL EQUIPMENT	High
RBA US	Ritchie Bros	Canada	RBA	AGRICULTURAL EQUIPMENT	High
6326 JP	Kubota	Japan	KUBTF	AGRICULTURAL EQUIPMENT	High
AGRO US	Adecoagro	Luxembourg	AGRO	FARMING	High
FR SP	First Resources	Singapore	XUOEF	FARMING	High
GGR SP	Golden Agri	Singapore	GARPF	FARMING	High
SIMP IJ	Salim Ivomas Pratama	Indonesia	XLMPF	FARMING	High

Source: BofA Merrill Lynch Global Research

Need to intensify agricultural production

There is ever increasing competition for arable land – notably from urbanisation and biofuels – which is set to increase in a climate change constrained world. Other factors which could further reduce productivity include declines in nutrient availability (e.g. phosphorus), the spread in pests and weed, and geographical shifts in production patterns resulting from the effects of global warming (Source: World Bank). This will necessitate an intensification of agriculture on the same or reduced quantities of land (Source: Godfray, Beddington et al. 2010; Smith et al. 2010, World Bank).

More efficient equipment & automation of processes

With acreage for major crops significantly trailing yields – and the productivity gap for ten major food crops set to hit 66-85mn ha to meet 2020 demand (Source: Monsanto), improved agricultural efficiency via equipment and automation is a must. This includes support for new farming techniques like conservation or no-till farming, micro and drip irrigation. More efficient equipment and automation of farming processes will lead to greater efficiency reduce manpower demands and lower production costs.

Better storage

Given the major losses during post-harvest storage and transportation – especially in emerging markets – better storage facilities and more efficient food distribution and supply chain networks can play a key role in increasing food crops for consumption.

Getting grains to where they need to be

Demand for grains and oilseeds are expected to increase over time as a result of population growth, rising incomes in emerging markets and urbanization. The primary drivers of demand growth will be demand for feed and biofuels. However, the regions where the demand growth is coming from is different than the regions capable of growing grains and oilseeds due to land or weather constraints. The ability to originate, store and transport grains will become more important over time, especially companies with scale, as being able to source different feedstuffs from different regions provides a competitive advantage.

According to the USDA, global trade of wheat, coarse grains, soybeans and soybean products are expected to increase by between 16% and 37% over the next 10 years. North America, South America, and the EU are expected to be the largest exporters, while China, Mexico, Africa and the Middle East are the regions projected to have the strongest demand for agricultural trade over the next 10 years.

Increasing demand for biofuels

Demand for biofuels is forecasted to increase over the next several years due to increasing energy demand and government policies. According to the USDA, a majority of the production and consumption of biofuels will be driven by the US, Brazil, EU, Argentina, Canada, China and Indonesia from 2013 to 2022. Over that time frame in the EU, biodiesel and ethanol production are projected to increase 45 and 60 percent, respectively. In Brazil, ethanol production is forecasted to increase 90% for domestic consumption, while biodiesel production is expected to increase 50%. Biodiesel production in Argentina is forecasted to increase 80% from 2013 to 2022 due to increasing domestic demand and export demand.

Protein consumption to increase

Global meat consumption is forecasted to increase 1.8% annually over the next 10 years, with poultry consumption rising faster than beef or pork consumption, according to the USDA. Poultry has the highest growth prospects in the emerging markets as it is the cheapest protein, with chickens being the most efficient converters of feed. It takes roughly 2lbs of feed for a chicken to gain 1lb, compared to 3lbs of feed per 1lb of gain for hogs and 8lbs for cattle.

According to the USDA, global meat trade is projected to increase 19% over the next ten years. Similar to grain production and exports, protein production and exports are primarily concentrated in grain producing regions such as the US and Brazil, as they are the low cost producers. Demand growth for protein imports is primarily driven by Asia, Africa, the Middle East, and Mexico.

Advanced or next generation biofuels

In our view, a number of stocks are well placed to benefit from the theme of Advanced or Nextgen Biofuels as long-term solutions to the perfect storm of food-water-energy security in an extreme weather and climate change constrained world. This includes stocks involved in cellulosic ethanol, algae fuel, biohydrogen, biomethanol, BTL from solid biowaste, DMF, BioDME, Fischer-Tropsch diesel, biohydrogen diesel, mixed alcohols and wood diesel, among other areas.

The world has the ability to produce close to half a trillion liters of cellulosic ethanol using agricultural residues and forest products that are available today (Source: Novozymes)

Table 19: Extreme weather - Weathering the perfect storm exposure (WPS) - Farming & Agricultural Equipment

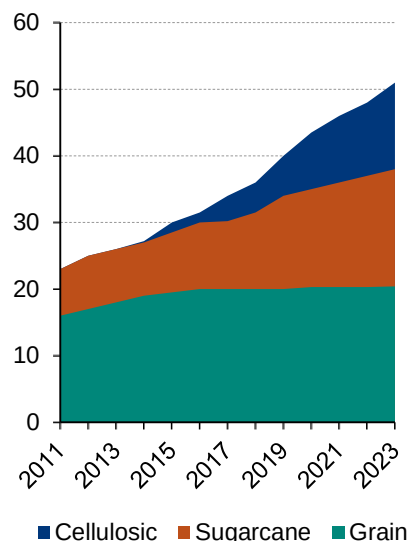
Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
CZZ US	Cosan Ltd	Brazil	CZZ	ADVANCED BIOFUELS	Low
CSAN3 BZ	Cosan SA Ind Com	Brazil	CSIDF	ADVANCED BIOFUELS	Low
NES1V FH	Neste Oil	Finland	NTOIF	ADVANCED BIOFUELS	High
RDSB LN	Royal Dutch Shell	United Kingdom	RYDBF	ADVANCED BIOFUELS	Low
DD US	DuPont	United States	DD	ADVANCED BIOFUELS	Low

Source: BofA Merrill Lynch Global Research

Today's biofuels

Today's biofuels – known as first generation biofuels – are easily made from the sugars, starches, and vegetable oils found in arable crops such as corn, palm oil, rapeseed and sugarcane, among others. Global biofuel production remained static in 2011 and 2012 with approximately 110bn litres 29.6bn gallons) (Source: IEA). Biofuels accounted for c2.3% of world liquid fuels for transport (Source: IEA). This was partly spurred by government mandates for blending biofuels in 31 countries (Source: Ren 21).

Chart 74: Biofuel demand by type, 2011-23e



Source: DuPont, BofA Merrill Lynch Global Research

Drought is heating up the food vs. fuel debate

Since the 2007-08 global food crisis and the 2012 US drought, first gen. biofuels have come under growing attack for diverting crops to produce biofuels – the so-called food vs. fuel debate. A 2011 report to the G20 by the United Nations' Food and Agriculture Association (FAO) warned that, "government-imposed consumption mandates [of biofuels] aggravate the price inelasticity of demand that contributes to volatility in agricultural prices," and that G20 countries should, "remove provisions of current national policies that subsidise (or mandate) biofuels production or consumption."

US RFS under pressure

The 2012 US drought brought this debate back on to the US political agenda with bipartisan calls to scrap the Renewable Fuel Standard (with ethanol consuming 42% of the 2012 US corn crop). 2013 has also seen a push to lower quotas as part of plans to raise federal borrowing limits. This debate is set to expand globally with global vehicle numbers expected to double to 1.5bn in the next 10 years.

EU proposing a cap on first generation biofuels

In September 2013, the EU Parliament is proposing a limit on the use of first generation agricultural biofuels (with the environment committee having voted to limit the use of biofuels to 5.5% of transport fuel, and the industry committee voting for a 6.5% limit vs. previous goal of 10% by 2020). This could have significant effects on food prices, with the EU's Joint Research Centre (JRC) estimating that if biofuels received no EU policy support, the price of food stuffs such as vegetable oil would be 50% lower in Europe by 2020 than at present – and 15% lower elsewhere in the world.

Nextgen. biofuels, turning trash into treasure

This has led to growing calls for the development of second generation or nextgen biofuels that are made from "sustainable" or "renewable" feedstocks – in terms of availability, GHG emissions, and impacts on land use and biodiversity. Cellulosic ethanol production – although more challenging technically than firstgen biofuels – is particularly attractive as it uses non-food crops or inedible waste products such as corn stover (stalks, leaves and husks), wood chips, switchgrass, wheat straw, and does not divert crops away from the food chain. Most of these feedstocks are currently considered waste. The most relevant feedstocks vary by region - including corn stover in North America, sugarcane bagasse in Latin America, wheat straw in Europe, and rice straw in Asia-Pacific.

Huge potential

Their potential is huge – with 20% of the agricultural and forest residue available in the EU, for instance, able to support half of its gasoline demands (Source: Novozymes). The technology could free up crops for food, reduce water demand, promote energy security and create agricultural and industrial jobs. That said, sustainability issues around land use still need to be tackled.

Increasing traction

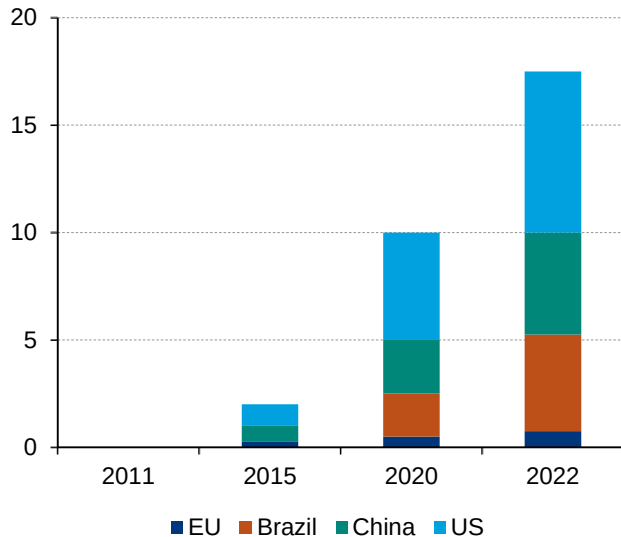
Advanced biofuel global capacity reached 4.5bn litres in 2012, up approximately 33% from 2011 capacity (Source: IEA). Cellulosic biofuels are also starting to play a small role in contributing to the U.S. RFS, with the EPA announcing in August 2013 that it expects 6mn gallons in 2014. A number of companies including Abengoa Bioenergy, BlueFire Renewables, Fibrigh, Fulcrum Bioenergy, LanzaTech, Mascoma, and POET-DSM are scheduled to go into production of cellulosic ethanol in the U.S. within the next eighteen months (Source: Cellulosic

Biofuels Industry Progress Report). By 2022, the U.S. alone could require 150-200 plants to produce cellulosic bio-ethanol from corn crop residue (Source: DSM).

50bn gallons and US\$50bn by 2022

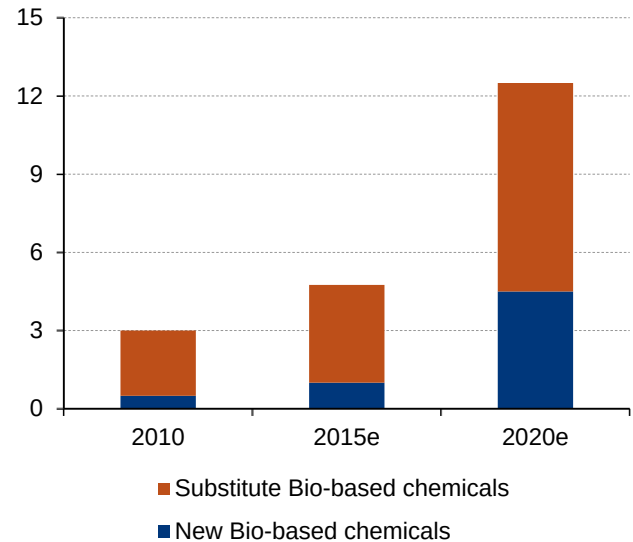
The global cellulosic bio-ethanol market is expected to grow to 68.1bn litres (18bn gallons) by 2022, giving it a market value of ~US\$50bn (Source: DSM). This should create opportunities for cellulosic bio-ethanol, enzymes and yeasts, advanced biodiesel, industrial biogas and bio-based chemicals and materials.

Chart 75: Market: cellulosic bio-ethanol (global demand in bn gallons)



Source: Hart's Global Energy Study, BofA Merrill Lynch Global Research

Chart 76: Growth: selected renewable chemicals (MV in US\$bn)

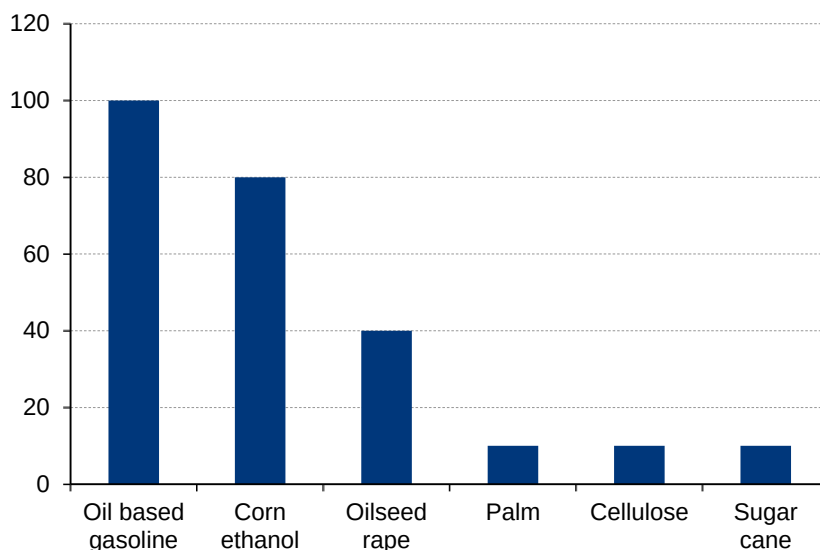


Source: Hart's Global Energy Study, BofA Merrill Lynch Global Research

Key to reducing CO2 emissions

With transport considered to be the fastest growing CO2 emitter and the main driver of global emissions growth, biofuels can play a role in reducing emissions. Today's biofuels can reduce CO2 emissions by 30-70% compared to gasoline, while cellulosic ethanol can reduce CO2 emissions by approximately 90% (Source: Novozymes). The IEA believes that biofuel capacity must more than double to 2020 to meet the 2°C climate change target (i.e. cutting energy-related CO2 emissions by over 50% in 2050 vs. 2009 levels) – with biofuels accounting for 80% of the portfolio of 6% of low carbon alternative fuels for global transportation.

Chart 77: Biofuels: CO2 balance of current liabilities



Source: Syngenta, BofA Merrill Lynch Global Research

Energy efficiency, less is more

We have mapped energy efficiency exposure across a number of sectors' value chains to highlight the diverse range of entry points available to those wishing to invest in energy efficiency: 1) automobiles; 2) buildings; 3) industrials and integrated; 4) IT; 5) lighting and LEDs; 6) smart grid and energy storage; and, 7) transport: bus, rail and shipping.

Table 20: Extreme weather - Weathering the perfect storm exposure (WPS) - Energy Efficiency

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
SOLB BB	Solvay	Belgium	SVYSF	EFFICIENCY – AUTO	Low
MGA US	Magna Intl	Canada	MGA	EFFICIENCY – AUTO	Medium
AQP LN	Aquarius Platinum	United Kingdom	AQPB	EFFICIENCY – AUTO	Low
CON GR	Continental AG	Germany	CTTAF	EFFICIENCY – AUTO	Medium
JCI US	Johnson Controls	United States	JCI	EFFICIENCY – AUTO	Medium
JMAT LN	Johnson Matthey	United Kingdom	JMPLF	EFFICIENCY – AUTO	Low
LXS GR	Lanxess	Germany	LNXS	EFFICIENCY – AUTO	Low
LKQ US	LKQ Corp.	United States	LKQ	EFFICIENCY – AUTO	Low
TSLA US	Tesla	United States	TSLA	EFFICIENCY – AUTO	High
VCT LN	Victrex	United Kingdom	VTXPF	EFFICIENCY – AUTO	Low
BWA US	BorgWarner	United States	BWA	EFFICIENCY – AUTO	High
3402 JP	Toray	Japan	TRYIF	EFFICIENCY – AUTO	Low
CSR AU	CSR Ltd	Australia	CSRLF	EFFICIENCY – BUILDINGS	Medium
IR US	Ingersoll-Rand	United States	IR	EFFICIENCY – BUILDINGS	High
JCI US	Johnson Controls	United States	JCI	EFFICIENCY – BUILDINGS	Medium
KNEBV FH	Kone OYJ	Finland	KNYJF	EFFICIENCY – BUILDINGS	High
5202 JP	Nippon Sheet Glass	Japan	NPSGF	EFFICIENCY – BUILDINGS	Medium
UTX US	United Tech	United States	UTX	EFFICIENCY – BUILDINGS	Low
PHIA NA	Philips	Netherlands	PHGFF	EFFICIENCY - INDS. & INTEG.	Medium
SIE GR	Siemens	Germany	SMAWF	EFFICIENCY - INDS. & INTEG.	Medium
PRY IM	Prysmian	Italy	PRYMF	EFFICIENCY - INDS. & INTEG.	Low
RXL FP	Rexel	France	RXLSF	EFFICIENCY - INDS. & INTEG.	Low
ABBV VX	ABB Ltd.	Switzerland	ABLZF	EFFICIENCY - INDS. & INTEG.	Medium
MEO1V FH	Metso	Finland	MXTOF	EFFICIENCY - INDS. & INTEG.	Low
NEX FP	Nexans	France	NXPRF	EFFICIENCY - INDS. & INTEG.	Medium
SU FP	Schneider	France	SBGSF	EFFICIENCY - INDS. & INTEG.	Medium
SIEM IN	Siemens Ltd	India	SMNBF	EFFICIENCY - INDS. & INTEG.	Low

12 September 2013

Table 20: Extreme weather - Weathering the perfect storm exposure (WPS) - Energy Efficiency

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
SPX LN	Spirax-Sarco	United Kingdom	SPXSF	EFFICIENCY - INDS. & INTEG.	High
VK FP	Vallourec	France	VLOUF	EFFICIENCY - INDS. & INTEG.	Low
6273 JP	SMC	Japan	SMECF	EFFICIENCY - INDS. & INTEG.	High
ALO FP	Alstom	France	AOMFF	EFFICIENCY - INDS. & INTEG.	Medium
ALFA SS	Alfa Laval	Sweden	ALFVF	EFFICIENCY - INDS. & INTEG.	Medium
ATCOA SS	Atlas Copco	Sweden	ATLKF	EFFICIENCY - INDS. & INTEG.	Low
CRG IN	Crompton Greaves	India	CPGZF	EFFICIENCY - INDS. & INTEG.	Low
2308 TT	Delta Elect	Taiwan	DLTEF	EFFICIENCY - INDS. & INTEG.	High
ELUXB SS	Electrolux	Sweden	ELUXF	EFFICIENCY - INDS. & INTEG.	Medium
HXL US	Hexcel Corp	United States	HXL	EFFICIENCY - INDS. & INTEG.	High
GE US	General Electric	United States	GE	EFFICIENCY - INDS. & INTEG.	Medium
G1A GR	GEA	Germany	GEAGF	EFFICIENCY - INDS. & INTEG.	High
HEXAB SS	Hexagon AB	Sweden	HXGBF	EFFICIENCY - INDS. & INTEG.	Low
ETN US	Eaton Corp PLC	United States	ETN	EFFICIENCY - INDS. & INTEG.	Low
ISYS LN	Invensys	United Kingdom	IVNSF	EFFICIENCY - INDS. & INTEG.	Low
VMW US	VMware Inc	United States	VMW	EFFICIENCY - IT	High
EMC US	EMC Corp	United States	EMC	EFFICIENCY - IT	High
INTC US	Intel	United States	INTC	EFFICIENCY - IT	High
AMZN US	Amazon.com	United States	AMZN	EFFICIENCY - IT	Low
ARM LN	ARM Holdings	United Kingdom	ARMHF	EFFICIENCY - IT	High
CRM US	Salesforce.com	United States	CRM	EFFICIENCY - IT	High
EQIX US	Equinix	United States	EQIX	EFFICIENCY - IT	High
CSCO US	Cisco Systems	United States	CSCO	EFFICIENCY - IT	Medium
GOOG US	Google	United States	GOOG	EFFICIENCY - IT	Low
AMD US	Advanced Micro	United States	AMD	EFFICIENCY - IT	High
HPQ US	Hewlett-Packard	United States	HPQ	EFFICIENCY - IT	Low
IBM US	IBM	United States	IBM	EFFICIENCY - IT	Low
ASML NA	ASML NA	Netherlands	ASMLF	EFFICIENCY - IT	High
INXN US	InterXion	Netherlands	INXN	EFFICIENCY - IT	High
TCY LN	Telecity	United Kingdom	TLCTF	EFFICIENCY - IT	High
PHIA NA	Philips	Netherlands	PHGFF	EFFICIENCY - LED & LIGHT.	Medium
SIE GR	Siemens	Germany	SMAWF	EFFICIENCY - LED & LIGHT.	Medium
046890 KS	Seoul Semiconductor	Korea, Republic Of	SLSOF	EFFICIENCY - LED & LIGHT.	High
CREE US	CREE	United States	CREE	EFFICIENCY - LED & LIGHT.	High
2448 TT	Epistar	Taiwan	EPIPF	EFFICIENCY - LED & LIGHT.	High
2393 TT	Everlight	Taiwan	EVLEF	EFFICIENCY - LED & LIGHT.	High
ITRI US	Itron	United States	ITRI	EFFICIENCY - SMART GRID	High
MRO LN	Melrose plc	United Kingdom	MLSPF	EFFICIENCY - SMART GRID	High
SQM US	SQM	Chile	SQM	EFFICIENCY - SMART GRID	Low
ALO FP	Alstom	France	AOMFF	EFFICIENCY - TRANSPORT	Medium
3898 HK	Zhuzhou CSR	China	ZHUZF	EFFICIENCY - TRANSPORT	High
NEX LN	National Express	United Kingdom	NXPGF	EFFICIENCY - TRANSPORT	High
BBD/B CN	Bombardier Inc.	Canada	YBBD B	EFFICIENCY - TRANSPORT	High
CNI US	Canadian Natl	Canada	CNI	EFFICIENCY - TRANSPORT	High
1186 HK	CRCC	China	CWYCF	EFFICIENCY - TRANSPORT	Medium
390 HK	CRG	China	CRWOF	EFFICIENCY - TRANSPORT	High
1766 HK	CSR	China	CSRGF	EFFICIENCY - TRANSPORT	High
FGP LN	FirstGroup Plc	United Kingdom	FGROF	EFFICIENCY - TRANSPORT	High
GOG LN	Go-Ahead Group	United Kingdom	GHGUF	EFFICIENCY - TRANSPORT	High
525 HK	Guangshen Railway	China	GNGYF	EFFICIENCY - TRANSPORT	High
SGC LN	Stagecoach Group	United Kingdom	SAGKF	EFFICIENCY - TRANSPORT	High
VOS GR	Vossloh	Germany	VOSSF	EFFICIENCY - TRANSPORT	High
YZJSGD SP	Yangzijiang	Singapore	YSHLF	EFFICIENCY - TRANSPORT	Low

Source: BofA Merrill Lynch Global Research

Global energy crisis

We believe the world is facing a global energy crisis, with primary energy demand accounting for 7-9% of GDP and demand expected to grow by at least one-third by 2035. As a result, energy-related CO2 emissions are likely to increase by 20%, following a trajectory consistent with a long-term average global temperature

increase of up to 4.0°C – making irreversible climate change a reality, according to the IEA and World Bank.

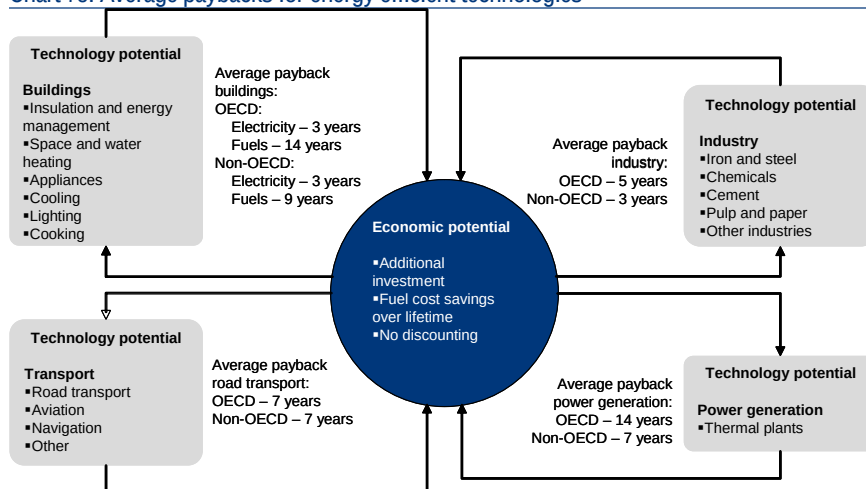
Energy efficiency is the answer

In a resource-constrained world, energy demand needs to adjust to limited supply. The rationale for change includes: economic development and competitiveness, rising energy costs, and protecting the environment. We believe that energy efficiency – reducing the amount of energy required to provide products and services – is the logical response. We also believe that the recession is making “less is more” the maxim of our era, and that energy independence and security are contingent on energy efficiency.

Greatest potential for energy, cost and emissions savings

End-use energy efficiency offers the greatest potential to lower both energy demand and CO2 emissions. It offers considerable low-hanging fruit given that two-thirds of the economic potential to improve energy efficiency remains untapped (source: IEA). Cost will be the key driver, in our view, with a general rule of thumb across sectors that every dollar spent on energy efficiency means US\$2-4 in lifetime cost savings – and paybacks averaging 3-7 years

Chart 78: Average paybacks for energy efficient technologies



Source: : IEA WEO Outlook 2012

Autos, green “transficiency” evolution

We believe that a number of stocks are well placed to benefit from the theme of energy and fuel efficiency in the auto sector through their involvement in areas such as autocatalysts, diesel, electric vehicles (EVs), engine and transmission components, gasoline direct injection (GDI), light-weighting, li-ion batteries, natural gas, specialty polymers, turbochargers, tyres and fleet management, among other areas.

Globally, road transport-related CO2 emissions represented almost 17% of the total CO2 emissions from fuel combustion in 2009 according to the IEA. Road transport was thus the third highest source of CO2 emissions from fuel combustion. Within road transport, automobiles and light trucks produce well over 60% of emissions (source: IEA). With non-OECD and emerging market car sales set to exceed those in the OECD by 2020, and the global passenger car fleet set to double to reach almost 1.7bn by 2035, the auto sector is coming under growing pressure on oil consumption, energy security and CO2 emissions. With limited near-term scope for oil substitution in transport – and a robust increase in oil

demand expected for the next five years – we think the sector will need to make significant gains on fuel economy via efficiency gains and upgrading the fleet.

We believe that ultimate path towards automotive fuel efficiency will be more of an evolution than a revolution. It could involve a three stage transition including: (1) leveraging technology to improve the efficiency of the internal combustion engine and light weighting of the vehicle; (2) increasing use of hybrid and hybrid electric powertrains; and (3) exogenous technology shock. Growing fuel efficiency and CO2 regulations around the world are placing an increasingly significant R&D burden on all auto OEMs, but we do not believe that regulation alone will be a driver of material changes. We anticipate the evolution will be market driven as consumers demand more fuel efficient vehicles to ultimately reduce personal expenditure on fuel.

Buildings, easiest & largest efficiency gains

We believe a number of stocks are well placed to benefit from the theme of energy efficiency in buildings, including those with exposure to: building automation, energy services (ESCOs), efficient HVAC systems, insulation materials and technologies, high-efficiency lighting (including LEDs) and appliances, windows (including multiple glazing and low-e), and the distribution of building products.

Energy consumption within buildings is the single largest component of global energy use and CO2 emissions, at c.40% and c.30%, respectively. The biggest culprits are heating and cooling, which, together with lighting, can account for up to 60% of a building's energy consumption. We believe that improved energy efficiency in the buildings sector offers the greatest potential of any sector to make cost savings and reduce energy use – by 30% to 50% by 2030-50, respectively, according to the IEA. Moreover, little of this has been captured – with 80% of the economic potential of energy efficiency in buildings remaining untapped, largely due to challenging non-technical barriers (source: IEA).

In addition to a housing sector rebound, the biggest driver for improving energy efficiency in buildings is reduced energy use and therefore costs; it also lowers the capex needed in energy infrastructure, and promotes energy security. The average payback for efficient building technologies is only three years in terms of electricity and 9-14 years for fuels (source: IEA). Long-term growth drivers are extremely favourable, in our view, and include: high energy and electricity prices, stricter regulations and building codes, ageing stock, increasing renovation/DIY, EM urbanisation and growth, favourable demographics, efforts to lower CO2 emissions, affordable housing, tackling fuel poverty, realising a green premium on green buildings, the low-risk nature of financing efficiency, and the economic importance of the sector in terms of GDP and jobs.

The global market for energy-efficient building technologies is expected to increase from US\$68bn in 2011 to US\$103.5bn in 2017 – a CAGR of 7.25% (source: Pike Research). The “green” or energy-efficient building market in the US alone has grown from US\$10bn in 2005 to US\$85bn in 2012, and is expected to reach US\$98-106bn in 2013 and US\$204-248bn by 2016 (source: McGraw-Hill Construction)

Industrials and integrated investments, the enablers

We believe that a number of stocks are well placed to benefit from the theme of energy efficiency for industrials and integrated plays through their involvement in areas such as automation (building and industrial), controls, grid and smart grid,

heat transfer, lighting, power distribution and generation, process management, renewable interconnections, and T&D, among others.

Industry accounts for 28% of global energy consumption and 32% of CO₂ emissions (source: IEA). The long-term case for energy efficiency is clear – with 80% of energy lost across the value chain from inefficiencies between the gathering of energy sources and their eventual consumption in industry (source: ABB). The IEA estimates that industry could improve its energy efficiency by almost a third and reduce CO₂ emissions by up to 32% via the adoption of currently available best practices and technologies. Moreover, the cost savings are significant – with paybacks for industry, an estimated three years in OECD countries and five years in non-OECD countries (source: IEA).

Industrial and integrated plays – and the Cap Goods sector in particular – are key enablers for improving the energy efficiency of equipment and power, and thus industrial productivity. We expect efficiency to be a long-term growth driver for the sector on the back of megatrends such as: rising energy prices, EM growth in power and automation, expanding production volumes, grid and generation build out, renewable interconnections, and CO₂ and environmental regulations.

While energy efficiency should drive product replacement cycles, we assume that the Capital Goods sector currently faces lower growth prospect than between 2004 and 2011. Among the strongest growth outliers are structural opportunities (shale gas, resource scarcity, food/beverage and pharma capex, LNG, transmission, aerospace), the aftermarket and recovery plays (US housing, commercial construction, lighting/LEDs appliances and power). The weakest are those impacted by austerity (government-related spending) and a tougher competitive environment (power, construction equipment, appliance, railway equipment), and GDP plays (European trucks and industrial production).

IT, “big data” & semis

We believe that a number of stocks provide exposure to the theme of energy efficiency in IT through their involvement in areas such as cloud computing, consolidation, data centre design and operation, DCIM, heating and cooling, power management, thin provisioning, virtualisation, and semiconductors.

The global boom in “big data” on the back of explosive growth in unstructured traffic (aka big data) driven by smartphones (1bn by 2015), internet users (50% of global population by 2016), and mobile traffic growth (13x growth expected in the next five years) is seeing the global IT sector emerge as a new target area in terms of energy efficiency. Data volumes are projected to grow up to 50x to 2020E (source: IDC). This means a significant increase in electricity consumption, with the sector consuming 1.5% of the world's energy (source: Pike Research) and upwards of 3-5%+ of electricity in markets such as the EU, the US and Japan (source: ACEEE). Between 2011 and 2012, power requirements grew by 63% globally to 38GW (source: Datacenter Dynamics). Its global CO₂ emissions – c.2% of the world's total – are already on a par with the aviation sector.

Growing energy consumption and prices mean that energy costs are leading to business and capacity constraints, particularly for energy-hungry data centres. The combination of rigid, hierarchical structures in networking and storage domains in data centres and the fact that data centres are scaling up to massive sizes (10x growth) means there is an increasing need to lower power costs. Investment in data centres grew globally by 22% to US\$105bn in 2012 (vs. US\$86bn in 2011) and investment is projected to increase by a further 14.5% in

2013 (source: Datacenter Dynamics). We expect this to create significant opportunities for the 'greening' of data centres, with the market having grown from US\$7.5bn in 2010 to US\$17.1bn in 2012. By 2016E, the market is expected to reach US\$45.4-69.7bn (source: Pike Research, Wintergreen Research). We believe that this should benefit two larger IT trends – virtualisation and cloud computing, both of which help to improve data centre energy efficiency.

We also expect energy efficiency to become a major growth driver for the US\$117bn addressable cloud computing market, as well as virtualisation, as they can help to lower energy use and emissions by 30-90%.

We regard semiconductors as a key enabler of realising energy efficiency in the automobiles, buildings, IT, capital goods, and transport sectors – as well as aiding the business case for renewables. We believe the c.US\$300bn sector is returning to robust growth on the back of a combination of increasing demand from a gradual economic recovery, improving confidence in distribution/retail to carry more inventory, pricing recovery in sectors such as memory, and secular tailwinds from product cycles.

Lighting, LED growth

We believe that a number of companies are well placed to benefit from the theme of energy efficiency in LEDs and lighting through their involvement in areas such as chips, CFLs, CCFLs, components, deposition equipment, LEDs, lighting management, lighting solutions, luminaries, MOCVD equipment, process equipment, and sapphire ingot/wafer manufacturers among others.

Lighting consumes 19% of electricity output; 30% to 75% systems inefficient. New technologies can reduce electricity consumption by up to two-thirds. Moreover, energy efficiency lighting sources such as LEDs, luminaries, control gear and intelligent lighting control tools and concepts can thus make significant contributions to reducing electricity use and cutting CO2 emissions. We anticipate strong growth for energy efficient lighting solutions. This should help the global lighting market to grow from €55-60bn in 2011 to €80bn by 2015 (Source: Philips). Long-term drivers include favorable legislation and a further reduction in costs with better performance.

Lighting consumes 19% of the world's electricity output and is extremely wasteful with up to 30% to 75% of lighting systems considered inefficient (source: IEA). Without efficiency breakthroughs, it is estimated that electricity consumption by lighting will increase by 60% in the next 20 years (source: UNEP). New technologies can reduce electricity consumption by up to two-thirds. Moreover, energy efficiency lighting sources such as CFLs, LEDs, luminaries, control gear and intelligent lighting control tools and concepts can thus make significant contributions to reducing electricity use and cutting CO2 emissions.

We anticipate strong growth for energy efficient lighting solutions, helping the global lighting market to grow at 5-7% CAGR to become a €75-89bn market by 2015 (source: Philips). While a lacklustre macro economy has impacted the general lighting market in the near term, LEDs in lighting are finally emerging as the biggest growth opportunity in the medium to long term. Short-term LED usage will be driven by mobile phones, TVs and PCs, with 60-70% of new TVs having LED backlighting. While oversupply and low utilisation remain issues, albeit easing, we see the industry pulling into a healthier supply/demand balance past 2014. A speedier drop in LED lighting prices – including the 2013 magic price point breakthrough of Cree's sub-US\$10 LED bulb for Home Depot – could be a

major breakthrough for residential solutions. Spurred on by regulation, LEDs could represent 45% of the global lighting market by 2015 (source: Phillips) and residential LEDs could represent 70% of the general light market by 2020 (source: McKinsey).

Smart grid & energy storage, the “Electrinet”

We believe that a number of stocks are well placed to benefit from the theme of energy efficiency via smart grid and energy storage from their involvement in areas such as AMI, automatic meter reading (AMR), batteries for grid storage, control rooms, customer-side systems, distributed grid management, electric vehicle (EV) charging infrastructure, ICT integration, li-ion batteries, network management systems, smart power electronics, renewables integration, substation automation, and wide-area monitoring and control.

The smart grid represents the main segment of growth in the grid management industry for the next decade, in our view. It is growing at an 11% CAGR from 2012-16E (source: Alstom) and our Alternative Energy team estimates it could represent a global market of up to US\$63bn by 2020. Key market drivers include improving grid reliability and stability, increasing distributed generation, renewable energy integration (intermittency), reducing consumption peaks, increasing energy efficiency, EV integration, a greater focus on cyber security, and reducing CO₂ emissions. The smart grid should also facilitate and improve prospects for greater energy efficiency in buildings, IT, power generation and T&D, and transport.

AMI – “internetization” of utility services. An important element of the smart grid is advanced metering infrastructure (AMI), including the rollout of smart electric, gas and water meters. Of the combined 2.7 billion electric, gas, and water meters worldwide, less than 15% are automated. While North America is expected to remain a leader, achieving 50% smart electric meter penetration this year opportunities in EMS – particularly in Asia – provide the greatest long-term upside, in our view. Based on announced projects alone, we expect more than 200 million meters to be installed in traditional markets by 2018 with the global smart meter market reaching US\$15bn.

Longer term, we believe that grid storage could be a technological breakthrough that could change how energy is produced, consumed and valued. Electricity storage is the ultimate goal of cleantech because it enables: (1) the electrification of transport, (2) the smoothing of renewable intermittency, and (3) the elimination of spatial and temporal price disparities. High cost remains an inhibitor to adoption near term, with utilities considering grid storage in demonstration projects, but we believe investors should become familiar with grid storage technologies and vendors.

Transport - rail, bus, shipping & lightweighting

We believe that a number of stocks are well placed to benefit from the theme of energy efficiency in rail, bus and shipping via their involvement in areas such as lightweighting, locomotives, passenger rail operators, rail services, railway signalling and control systems, rail transport for freight, public bus and coach operators, rolling stock and fuel efficient shipbuilders.

The transport sector accounts for more than 50% of world consumption of liquid fuels, and this share is forecast to increase to over 60% by 2035 (source: International Union of Railways). It also accounts for 23% of global emissions – i.e., 6.5bn tonnes of CO₂ – or the equivalent of 1t of CO₂ per inhabitant of the planet. The carbon footprint of transport is linked to the fact that almost 20% of the world's total delivered energy is used in the sector, where liquid fuels are the

dominant source (i.e., gasoline, diesel and LPG on roads, kerosene in the air, and fuel oil for shipping). With oil substitution not a reality in the near term, this means growing pressure in terms of fuel costs and energy efficiency.

The long-term environment for rail, bus and coach, shipping – and lightweighting for air and road transport – is the most positive it has been in years. High fuel and labour prices, energy security concerns, rising household bills, urbanisation, congestion, environmental concerns and deregulation are all leading to greater investments and utilisation of rail and bus in particular. They are seen as solution providers, transporting more people further and faster, with lower emissions and congestion impacts. While changing mobility behaviour will be key to realising the efficiency opportunity, rail is set for strong growth, including via the switch from truck to rail in the US. The accessible rail market is set to register a 2.7% to 2.8% CAGR to reach €124bn by 2015-16E (source: Bombardier, UNIFE). MENA and Latin America are seeing the fastest growth (source: UNIFE). Bus and coach is also growing at a compound annual rate of 5-6.2% and should become a US\$61.5bn market by 2016E (source: Fredonia). Finally, new environmental regulations from the IMO should see efficiency emerge as a major opportunity in the shipping sector.

Cleantech & renewables

In our view, a number of stocks are well placed to benefit from the theme of cleantech and renewables as a way of fighting drought through their involvement in areas such as electric vehicles (EVs), wind, solar, among others.

Table 21: Extreme weather - Weathering the perfect storm exposure (WPS) - Cleantech & Renewables

Ticker	Company Name	Country	BofAML Ticker	WPS sub-sector	WPS exposure
YGE US	Yingli Green Energy	China	YGE	CLEANTECH	High
ENPH US	ENPH	United States	ENPH	CLEANTECH	High
TSL US	Trina Solar	China	TSL	CLEANTECH	High
FSLR US	First Solar	United States	FSLR	CLEANTECH	High
3800 HK	GCL-Poly	Hong Kong	GCPEF	CLEANTECH	High
JASO US	JA Solar	China	JASO	CLEANTECH	High
PWER US	PWER	United States	PWER	CLEANTECH	High
SOL US	ReneSola	China	SOL	CLEANTECH	High
SQM US	SQM	Chile	SQM	CLEANTECH	High
SPWR US	SunPower Corp.	United States	SPWR	CLEANTECH	High
STP US	Suntech Power	China	STP	CLEANTECH	High
TSLA US	Tesla	United States	TSLA	CLEANTECH	High
EGPW IM	Enel Green Power	Italy	XENLF	CLEANTECH	High
EDPR PL	EDP Renovaveis	Spain	EDRVF	CLEANTECH	High
ANA SM	Acciona	Spain	ACXIF	CLEANTECH	High
VWS DC	Vestas	Denmark	VWSYF	CLEANTECH	High
SCTY US	SCTY	United States	SCTY	CLEANTECH	High
NEE US	NextEra Energy	United States	NEE	CLEANTECH	High
TSL US	Trina Solar	China	TSL	CLEANTECH	High
YGE US	Yingli Green Energy	China	YGE	CLEANTECH	High
CREE US	CREE	United States	CREE	CLEANTECH	High
FSLR US	First Solar	United States	FSLR	CLEANTECH	High
SPWR US	SunPower Corp.	United States	SPWR	CLEANTECH	High
ITRI US	Itron	United States	ITRI	CLEANTECH	High
2208 HK	Goldwind	China	XJNGF	CLEANTECH	High
916 HK	China Longyuan	China	CLPXF	CLEANTECH	High
1798 HK	Datang Renewable	China	XGDRF	CLEANTECH	High
SUEL IN	Suzlon Energy	India	XZULF	CLEANTECH	High
CPFE3 BZ	CPFL Energia S.A	Brazil	XPFGF	CLEANTECH	High
CPL US	CPFL Energia	Brazil	CPL	CLEANTECH	High

Source: BofA Merrill Lynch Global Research

The Fukushima nuclear accident has demonstrated the vulnerability of energy systems to extreme weather

[Renewable Energy: Wind turbine market likely to improve for big players 28 August 2013](#)

"As their costs continue to fall, renewable power sources are increasingly standing on their own merits versus new fossil-fuel generation. This is good news for a global energy system that needs to become cleaner and more diversified, but it should not be an excuse for government complacency, especially among OECD countries." - Maria van der Hoeven, IEA Executive Director

Key to balancing energy mix & boosting energy security

With global energy use expected to grow by up to 50% in the coming 20 years, it is clear that renewables will need to play an increasingly important role in meeting energy demand via diversifying sources, increasing flexibility, and greater resistance to central shocks. Given booming demand, uneven distribution of supply and the raft of threats to supply (geopolitical through to extreme weather), they are also key to ensuring energy security. They also have a significant advantage over fossil fuels in terms of CO2 emissions, water intensity, and overall stresses on the food-water-energy nexus.

Economics are becoming competitive, especially wind

From an economic perspective, our Utilities & Cleantech teams' analysis suggests that the unsubsidised levelised cost of energy (LCOE) of renewables is becoming increasingly competitive. For onshore wind, it is in the range of €57-73/MWh, varying by region. This is very competitive against thermal (€55-90) in most regions except in the US and also relative to offshore wind or solar. Chinese turbines are 30-40% cheaper, but LCOEs seem similar versus advanced turbines (from players like Vestas) once adjusted for performance, installation costs and service offerings.

Table 22: Levelised cost of energy comparison for new plants

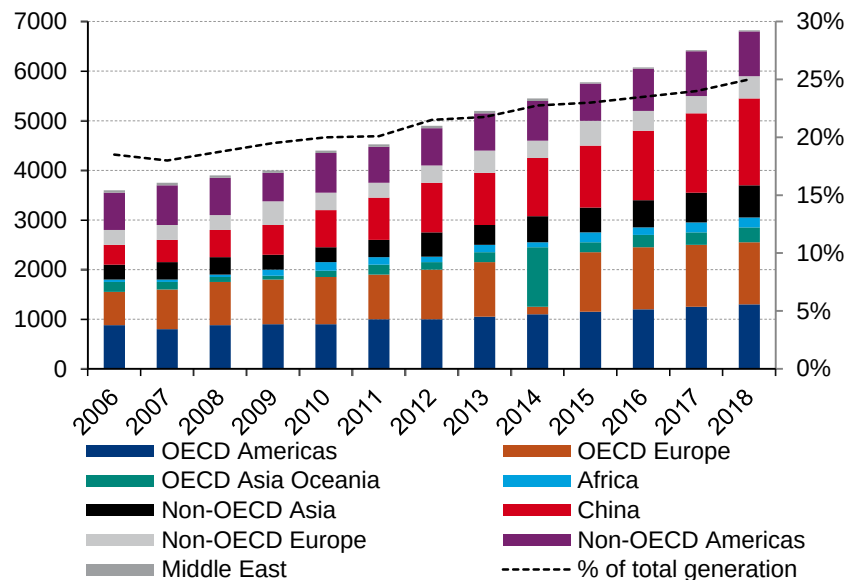
	Europe €/MWh	US €/MWh	US €/MWh	LatAm €/MWh
	With tax benefit		Ex tax benefit	
Onshore Wind	73	49	59	57
Gas near term	69	35	35	94
Gas mid term	69	42	42	94
Gas mid term + CO2 floor	76	46	46	94
Coal	56	45	45	58
Coal + CO2 floor	72	55	55	58
Solar	133	64	92	99
Offshore wind	145	na	Na	na
Wholesale prices	35-60	27-35	27-35	30-60

Source: BofAML Global Research, Assumptions: Europe gas \$10/mmbtu and LatAm gas \$15/mmbtu, US gas \$3.5/mmbtu near term and \$5/mmbtu mid-term; Coal \$90/t in Europe/LatAm and \$60/t in US, CO2 €4/t in Europe and €0/t in US/LatAm, CO2 floor €25/t in Europe, €10/t in US and €0/t in LatAm, Onshore wind load factors 26% in Europe, 32.5% in US and 40% in LatAm, Gas load factors 60% and coal 75%. Solar Load factors 13% in Europe and 20% in US/LatAm, Offshore wind load factor 35%, Cost of newbuild €1.3m/MW for onshore wind, €1.5m/MW for coal, €1.3-1.4m/MW for solar and €0.6m/MW for gas, Pre-tax WACC 8.5% in Europe/US and 10.5% in LatAm.

Renewables set to be fastest growing source, 25% of mix by 2018e

According to the IEA's June 2013 Medium-Term Market Report, renewables' share of the global energy mix continues to grow. From 4,492 TWh or 20.2% of total generation in 2011 – it is expected to reach 6,851TWh or 25% of power generation by 2018e. The two key drivers are: i) accelerating investment and deployment in EMs, which are keen to address balance energy demand, energy security and environmental considerations; and ii) cost competitiveness (described above).

Chart 79: Global renewable electricity production by region



Source: IEA, BofA Merrill Lynch Global Research

"Policy uncertainty [on renewables] is public enemy number one" for investors... Many renewables no longer require high economic incentives. But they do still need long-term policies that provide a predictable and reliable market and regulatory framework compatible with societal goals.. And worldwide subsidies for fossil fuels remain six times higher than economic incentives for renewables." - Maria van der Hoeven, IEA Executive Director

Renewables to surpass gas & double nuclear by 2016

Global renewable electricity generation is expected to surpass natural gas and double nuclear by 2016 – becoming the second most important global electricity source after coal (Source: IEA). Wind and solar are expected to grow fastest and are expected to double to 8% of generation by 2018 (vs. 4% in 2011 and 2% in 2006) (Source: IEA)

Table 23: World renewable electricity generation and projection (TWh)

	2006	% of total gen, 2006	2011	% of total gen, 2011	2012	2013	2014	2015	2016	2017	2018
Hydropower	3,122	16.4%	3,567	16.1%	3,792	3,888	4,010	4,136	4,276	4,423	4,570
Bioenergy	209	1.1%	352	1.6%	373	396	428	463	498	530	560
Wind	133	0.7%	438	2.0%	519	626	725	840	952	1,080	1,220
Onshore	131	0.7%	428	1.9%	505	606	697	803	906	1,020	1,144
Offshore	2	0.0%	10	0.0%	13	20	28	36	46	59	76
Solar PV	6	0.0%	62	0.3%	100	138	178	221	267	316	368
Solar CSP	1	0.0%	3	0.0%	6	9	14	18	22	28	34
Geothermal	60	0.3%	70	0.3%	72	77	80	83	88	93	97
Ocean	1	0.0%	1	0.0%	1	1	1	1	2	2	2
Total	3,531	18.6%	4,492	20.2%	4,862	5,136	5,436	5,762	6,104	6,471	6,851

Source: IEA, BofA Merrill Lynch Research

Designed for water-scarce era

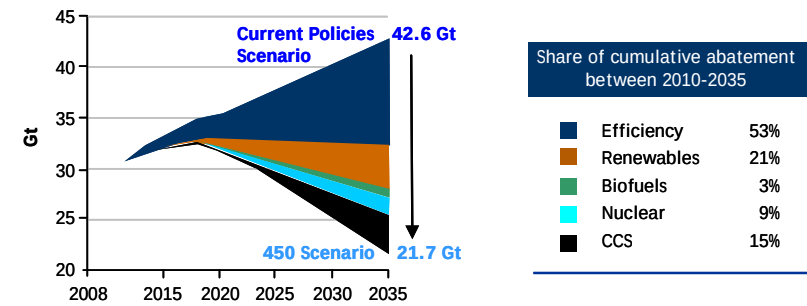
The current power sector is designed for a water-rich world, which will become an increasingly unsustainable challenge in the coming years. In the US, power plants account for up to 40% of all freshwater withdrawals (Source: UCS), with nuclear, coal, oil, gas and biofuels all using 600 gallons of water or more per MWh (Source: EFRI). The oil industry currently produces 2.5x more water than oil, which is expected to increase to a factor 5x by 2025 (with unconventional such as shale gas and oil sands particularly water intensive). Extreme weather and climate change will pose growing challenges in terms of accessing sufficient water and sufficient cool water to cool plants and in terms of accessibility in many water-stressed areas. In contrast, renewables have a significant advantage over fossil fuels in that they reduce the water scarcity and water treatment intensity

challenges associated with fossil fuels – and lessen the burden on the water-energy nexus.

Greatest potential to reduce emissions after efficiency

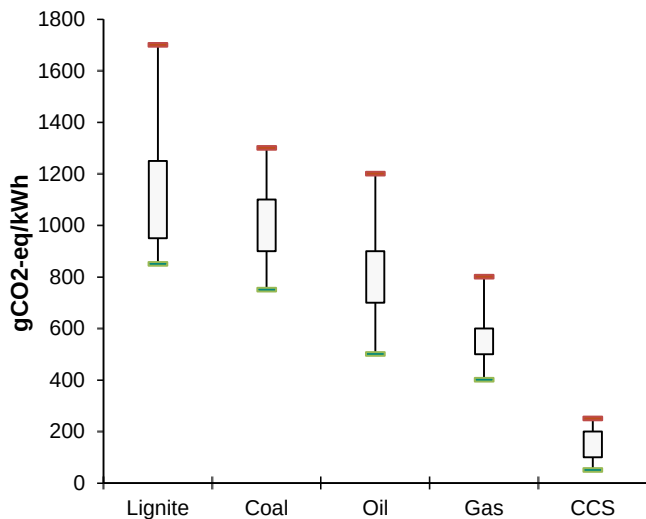
After energy efficiency's low hanging fruits, renewables offer the second largest greatest potential of any current technology to contribute to CO₂ emissions abatement by 2030-35, accounting for 21% of the total CO₂ savings in the IEA's 450 Scenario. Under this scenario, we would see relatively optimistic implementation of national energy plans and pledges made by countries, including on their future emissions of GHGs.

Chart 80: World energy-related CO₂ emission savings by technology in the 450 Scenario



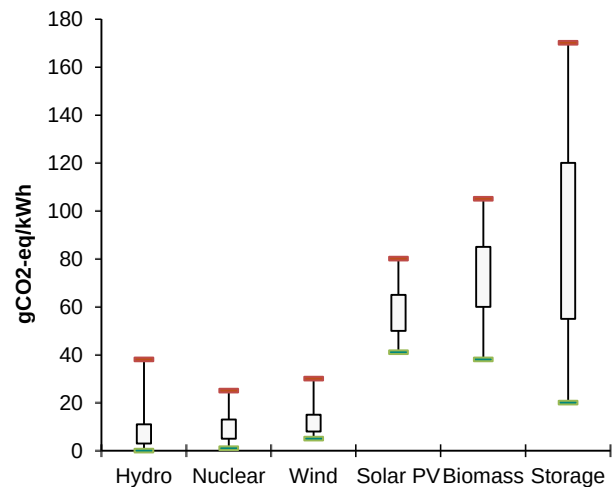
Source: IEA WEO

Chart 81: GHG emissions of various electricity generating options



Source: International Atomic Energy Agency

Chart 82: GHG emissions of various electricity generating options



Source: International Atomic Energy Agency

Link to Definitions

Industrials

Click [here](#) for definitions of commonly used terms.

Macro

Click [here](#) for definitions of commonly used terms.

Important Disclosures

BofA Merrill Lynch Research personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking revenues.

Other Important Disclosures

Officers of MLPF&S or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.

BofA Merrill Lynch Global Research policies relating to conflicts of interest are described at <http://www.ml.com/media/43347.pdf>.

"BofA Merrill Lynch" includes Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") and its affiliates. Investors should contact their BofA Merrill Lynch representative or Merrill Lynch Global Wealth Management financial advisor if they have questions concerning this report.

"BofA Merrill Lynch" and "Merrill Lynch" are each global brands for BofA Merrill Lynch Global Research.

Information relating to Non-US affiliates of BofA Merrill Lynch and Distribution of Affiliate Research Reports:

MLPF&S distributes, or may in the future distribute, research reports of the following non-US affiliates in the US (short name: legal name): Merrill Lynch (France): Merrill Lynch Capital Markets (France) SAS; Merrill Lynch (Frankfurt): Merrill Lynch International Bank Ltd., Frankfurt Branch; Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd.; Merrill Lynch (Milan): Merrill Lynch International Bank Limited; MLI (UK): Merrill Lynch International; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited; Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd.; Merrill Lynch (Canada): Merrill Lynch Canada Inc; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa; Merrill Lynch (Argentina): Merrill Lynch Argentina SA; Merrill Lynch (Japan): Merrill Lynch Japan Securities Co., Ltd.; Merrill Lynch (Seoul): Merrill Lynch International Incorporated (Seoul Branch); Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd.; DSP Merrill Lynch (India): DSP Merrill Lynch Limited; PT Merrill Lynch (Indonesia): PT Merrill Lynch Indonesia; Merrill Lynch (Israel): Merrill Lynch Israel Limited; Merrill Lynch (Russia): OOO Merrill Lynch Securities, Moscow; Merrill Lynch (Turkey I.B.): Merrill Lynch Yatirim Bank A.S.; Merrill Lynch (Turkey Broker): Merrill Lynch Menkul Değerler A.Ş.; Merrill Lynch (Dubai): Merrill Lynch International, Dubai Branch; MLPF&S (Zurich rep. office): MLPF&S Incorporated Zurich representative office; Merrill Lynch (Spain): Merrill Lynch Capital Markets Espana, S.A.S.V.; Merrill Lynch (Brazil): Bank of America Merrill Lynch Banco Multiplo S.A.; Merrill Lynch KSA Company, Merrill Lynch Kingdom of Saudi Arabia Company.

This research report has been approved for publication and is distributed in the United Kingdom to professional clients and eligible counterparties (as each is defined in the rules of the Financial Services Authority) by Merrill Lynch International and Banc of America Securities Limited (BASL), which are authorized and regulated by the Financial Services Authority and has been approved for publication and is distributed in the United Kingdom to retail clients (as defined in the rules of the Financial Services Authority) by Merrill Lynch International Bank Limited, London Branch, which is authorized by the Central Bank of Ireland and is subject to limited regulation by the Financial Services Authority – details about the extent of its regulation by the Financial Services Authority are available from it on request; has been considered and distributed in Japan by Merrill Lynch Japan Securities Co., Ltd., a registered securities dealer under the Financial Instruments and Exchange Act in Japan; is distributed in Hong Kong by Merrill Lynch (Asia Pacific) Limited, which is regulated by the Hong Kong SFC and the Hong Kong Monetary Authority; is issued and distributed in Taiwan by Merrill Lynch Securities (Taiwan) Ltd.; is issued and distributed in India by DSP Merrill Lynch Limited; and is issued and distributed in Singapore by Merrill Lynch International Bank Limited (Merchant Bank) and Merrill Lynch (Singapore) Pte Ltd. (Company Registration No.'s F 06872E and 198602883D respectively) and Bank of America Singapore Limited (Merchant Bank). Merrill Lynch International Bank Limited (Merchant Bank) and Merrill Lynch (Singapore) Pte Ltd. are regulated by the Monetary Authority of Singapore. Bank of America N.A., Australian Branch (ARBN 064 874 531), AFS License 412901 (BANA Australia) and Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distributes this report in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of BANA Australia, neither MLEA nor any of its affiliates involved in preparing this research report is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this report in Brazil and its local distribution is made by Bank of America Merrill Lynch Banco Multiplo S.A. in accordance with applicable regulations. Merrill Lynch (Dubai) is authorized and regulated by the Dubai Financial Services Authority (DFSA). Research reports prepared and issued by Merrill Lynch (Dubai) are prepared and issued in accordance with the requirements of the DFSA conduct of business rules.

Merrill Lynch (Frankfurt) distributes this report in Germany. Merrill Lynch (Frankfurt) is regulated by BaFin.

This research report has been prepared and issued by MLPF&S and/or one or more of its non-US affiliates. MLPF&S is the distributor of this research report in the US and accepts full responsibility for research reports of its non-US affiliates distributed to MLPF&S clients in the US. Any US person receiving this research report and wishing to effect any transaction in any security discussed in the report should do so through MLPF&S and not such foreign affiliates.

General Investment Related Disclosures:

Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Merrill Lynch.

This research report provides general information only. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This report is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of any specific person. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this report and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this report.

Securities and other financial instruments discussed in this report, or recommended, offered or sold by Merrill Lynch, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

This report may contain a short-term trading idea or recommendation, which highlights a specific near-term catalyst or event impacting the company or the market that is anticipated to have a short-term price impact on the equity securities of the company. Short-term trading ideas and recommendations are different from

and do not affect a stock's fundamental equity rating, which reflects both a longer term total return expectation and attractiveness for investment relative to other stocks within its Coverage Cluster. Short-term trading ideas and recommendations may be more or less positive than a stock's fundamental equity rating.

BofA Merrill Lynch is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned in this report. Investors in such securities and instruments, including ADRs, effectively assume currency risk.

UK Readers: The protections provided by the U.K. regulatory regime, including the Financial Services Scheme, do not apply in general to business coordinated by BofA Merrill Lynch entities located outside of the United Kingdom. BofA Merrill Lynch Global Research policies relating to conflicts of interest are described at <http://www.ml.com/media/43347.pdf>.

Officers of MLPF&S or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.

MLPF&S or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. MLPF&S or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Merrill Lynch, through business units other than BofA Merrill Lynch Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented in this report. Such ideas or recommendations reflect the different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Merrill Lynch is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this report.

In the event that the recipient received this report pursuant to a contract between the recipient and MLPF&S for the provision of research services for a separate fee, and in connection therewith MLPF&S may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom MLPF&S has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by MLPF&S). MLPF&S is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities mentioned in this report.

Copyright and General Information regarding Research Reports:

Copyright 2013 Merrill Lynch, Pierce, Fenner & Smith Incorporated. All rights reserved. IQmethod, IQmethod 2.0, IQprofile, IQtoolkit, IQworks are service marks of Merrill Lynch & Co., Inc. IQanalytics®, IQcustom®, IQdatabase® are registered service marks of Merrill Lynch & Co., Inc. This research report is prepared for the use of BofA Merrill Lynch clients and may not be redistributed, retransmitted or disclosed, in whole or in part, or in any form or manner, without the express written consent of BofA Merrill Lynch. BofA Merrill Lynch Global Research reports are distributed simultaneously to internal and client websites and other portals by BofA Merrill Lynch and are not publicly-available materials. Any unauthorized use or disclosure is prohibited. Receipt and review of this research report constitutes your agreement not to redistribute, retransmit, or disclose to others the contents, opinions, conclusion, or information contained in this report (including any investment recommendations, estimates or price targets) without first obtaining expressed permission from an authorized officer of BofA Merrill Lynch.

Materials prepared by BofA Merrill Lynch Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Merrill Lynch, including investment banking personnel. BofA Merrill Lynch has established information barriers between BofA Merrill Lynch Global Research and certain business groups. As a result, BofA Merrill Lynch does not disclose certain client relationships with, or compensation received from, such companies in research reports. To the extent this report discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this report. BofA Merrill Lynch Global Research personnel's knowledge of legal proceedings in which any BofA Merrill Lynch entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving companies mentioned in this report is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Merrill Lynch in connection with the legal proceedings or matters relevant to such proceedings.

This report has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of MLPF&S, any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Merrill Lynch Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Merrill Lynch and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This report may contain links to third-party websites. BofA Merrill Lynch is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this report and is not incorporated by reference into this report. The inclusion of a link in this report does not imply any endorsement by or any affiliation with BofA Merrill Lynch. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Merrill Lynch is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

Subject to the quiet period applicable under laws of the various jurisdictions in which we distribute research reports and other legal and BofA Merrill Lynch policy-related restrictions on the publication of research reports, fundamental equity reports are produced on a regular basis as necessary to keep the investment recommendation current.

Certain outstanding reports may contain discussions and/or investment opinions relating to securities, financial instruments and/or issuers that are no longer current. Always refer to the most recent research report relating to a company or issuer prior to making an investment decision.

In some cases, a company or issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such company or issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with MLPF&S or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Merrill Lynch nor any officer or employee of BofA Merrill Lynch accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this report or its contents.