The coming global gas super glut

Energy expert Dan Lewis argues that the world will soon see an abundance of clean, cheap gas, which will radically change current global strategic thinking and the UK will be among many countries set to reap the benefits.

Environmentalists, OPEC, 'peak oilers', energy security hawks, and cleaner coal, nuclear and renewables advocates, are about to suffer an enormous asymmetric shock – the arrival of huge quantities of clean and affordable gas.

This great disruption is going to happen because – for the first time – gas is starting to move beyond regional markets in quantity and, like oil and other commodities, will soon be much the same price all over the world. Make no mistake, gas's impending fungibility, combined with much lower prices, is going to turn the world's energy industry – and not far behind that, the strategic landscape – upside down.

BOX 1

Shale gas explained

- **What is shale gas?** Shale gas is the leading unconventional source of natural gas, the others of which are light sandstones, coalbed methane and methane hydrates under the ocean floor. Shale gas is tightly trapped in shale rocks up to thousands of feet underground.
- **How is it different from conventional gas?** Conventional gas is typically extracted from porous rocks like limestone, or as a by-product of producing oil, and has a long-established infrastructure for its exploitation.
- **How do you extract shale gas?** A combination of horizontal drilling of up to 10,000 feet and very high pressure blasting from a mixture of sand, water and some chemicals. This is known as hydraulic fracturing or 'fracking'.
- **What does it cost?** Proven costs are typically $3-6 per million BTU (British Thermal Units) in North America, possibly $8-16 in Poland and Germany and probably less in most other parts of the world.
- **How does that compare to now?** The current Henry Hub (the centralised point for natural gas futures trading in the US) spot price is around $4.00 (1,000,000 BTU). The current spot gas price in the UK is around 59 pence per therm (100,000 BTU), which translates to $9.74 – 2.5 times the current price of gas in the US

SNAPSHOT

- The global gas super glut is coming. The world will soon see the availability of huge quantities of clean and affordable shale gas.
- This widely unexpected new energy source will turn the world's energy industry – and not far behind that, the strategic landscape – upside down.
- The UK will be among those countries whose gas supply prospects will be transformed for the better, with enormous economic and political consequences.
- The consumer, businesses and the environment will be the winners, as gas increasingly takes over from other energy types.
- We will see a great many changes over the next 20 years. And most of us will lead richer, cleaner and safer lives as a result.

And the good news is that the consumer, businesses and the environment will be the winners.

It wasn't meant to be like this.

An astonishing synchronicity of technologies and economic circumstances have made this possible: hydraulic fracturing and horizontal drilling of unconventional gas; high gas prices making it affordable; the enormous growth of the ocean-going trade of liquefied natural gas (LNG); and the intense pressure to reduce carbon and polluting particulate emissions at much lower cost in cash-starved, post-recession economies.

So how did this all come to happen?

THE GLOBAL OVERVIEW

There is no question that proven global gas reserves have been increasing year by year and faster than those of oil.

TABLE 1

Global proven oil and gas reserves in the years 1989, 1999 and 2009

Fuel type	1989	1999	2009
Gas – trillion cubic metres*	122.40	148.55	187.49
Oil – thousand million barrels	1006.4	1085.6	1333.1

* In the US, gas is priced in dollars per million British thermal units (MMBtu) and is measured in quantity by cubic feet. In Britain it is priced in pence per therm, which is 100,000 British thermal units or an amount ten times smaller and is measured in quantity by cubic metres. There are 35.31 cubic feet in each cubic metre.

Source: *BP Statistical Review of World Energy 2010.*

These figures might lead the reader to believe in a linear progression over the next 10 years. In fact, for gas, it will be highly non-linear. Such a divergent trend has emerged clearly in just the last few years in the US, which has been leading the charge into unconventional, and specifically shale, gas.

The figures for 2010, when they are released later this year, are expected to show an even bigger jump.

Even then, proven reserves, based on sites where production has begun and future extraction can be very precisely anticipated, are by

TABLE 2

US proven natural gas reserves

Year	Quantity (billion cubic metres)
2006	5,974.85
2007	6,739.41
2008	7,220.80
2009	8,041.98

Source: US Energy Information Administration (EIA).

their nature a very conservative understatement. Further along the scale are 'technically recoverable resources' – in other words, commercially exploitable using today's technologies. And the recently released data in the table below from the US Energy Information Administration paint a game-changing scenario for what's still in the ground.

Some of the increases in gas resources are quite staggering to behold, particularly in some countries that have escaped major attention until now such as Argentina, South Africa and China.

For all that, this study still does not include some key

TABLE 3

Estimated shale gas technically recoverable resources for select basins in 32 countries, compared to existing reported reserves, production and consumption during 2009 (in billion cubic metres)

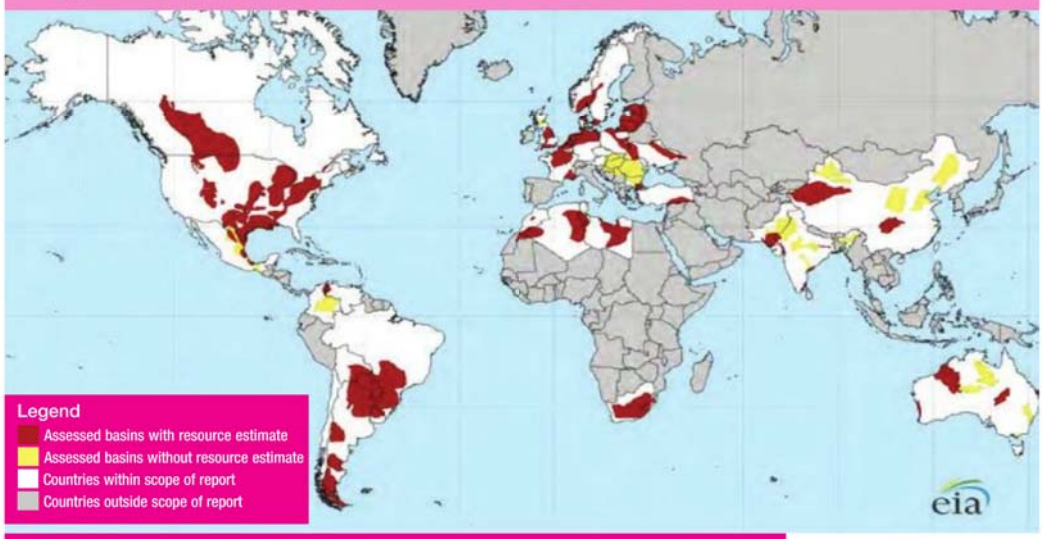
Country	Production	Consumption	Imports / Exports	Proven natural gas reserves	Technically recoverable shale gas resources	Years' worth of supply
France	0.85	48.99	98%	5.66	5,097.03	104
Germany	14.44	92.60	84%	175.56	226.53	2
Netherlands	79.00	48.70	-62%	1,387.53	481.39	10
Norway	103.36	4.53	-2,156%	2,038.81	2,350.30	519
U.K.	*59.18*	*88.07*	*33%*	*254.85*	*566.34*	*6*
Denmark	8.50	4.53	-91%	59.47	651.29	144
Sweden		1.13	100%		1,160.99	1,025
Poland	5.95	16.42	64%	164.24	5,295.25	322
Turkey	0.85	35.11	98%	5.66	424.75	12
Ukraine	20.39	44.17	54%	1,104.36	1,189.31	27
Lithuania		2.83	100%		113.27	40
Other Europe	13.59	26.90	50%	76.74	538.02	20
US	583.33	645.62	10%	7,716.34	24,409.12	38
Canada	159.42	85.23	-87%	1,755.64	10,986.94	129
Mexico	50.12	60.88	18%	339.80	19,283.77	317
China	82.97	87.22	5%	3,029.90	36,103.98	414
India	40.49	52.95	24%	1,073.21	1,783.96	34
Pakistan	38.51	38.51	-	841.01	1,444.16	38
Australia	47.29	30.87	-52%	3,114.85	11,213.47	363
South Africa	1.98	5.38	63%		13,733.67	2,553
Libya	15.86	5.95	-165%	1,548.93	8,211.89	1,381
Tunisia	3.68	4.81	26%	65.13	509.70	106
Algeria	81.55	28.88	-183%	4,502.38	6,541.19	226
Morocco	-	0.57	90%	2.83	311.49	550
Western Sahara					198.22	#N/A
Mauritania				28.32	-	#N/A
Venezuela	18.41	20.10	9%	5,065.88	311.49	15
Colombia	10.48	8.78	-21%	113.27	538.02	61
Argentina	41.34	43.04	4%	379.45	21,917.24	509
Brazil	10.19	18.69	45%	365.29	6,399.61	342
Chile	1.42	2.83	52%	99.11	1,812.28	640
Uruguay		-	100%		594.65	#N/A
Paraguay					1,755.64	#N/A
Bolivia	12.74	2.83	-346%	750.40	1,359.21	480
Total of above areas	**1,505.89**	**1,557.14**	**-20.36**	**36,064.62**	**187,514.16**	**120**

Source: Adapted by author from *EIA World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the US*, available at: http://www.eia.gov/analysis/studies/worldshalegas/.

countries, most notably Iraq, Israel, Indonesia, Syria, Saudi Arabia and Russia. And Algeria's potential dwarfs everyone else with some estimates as high as 35,000 trillion cubic feet[1] or 991,089 billion cubic metres for the gigantic Ghadames basin – the largest in the world. Algeria is already openly planning to develop 28,317 billion cubic metres of shale in the years to come. Suffice to say that this is one country that is not going to run out of gas.

CHART 1

Map of 48 major shale gas basins in 32 countries



Source: *EIA World Shale Gas Resources*, available at: http://www.eia.gov/analysis/studies/worldshalegas/.

THE CRITICAL ROLE OF THE US

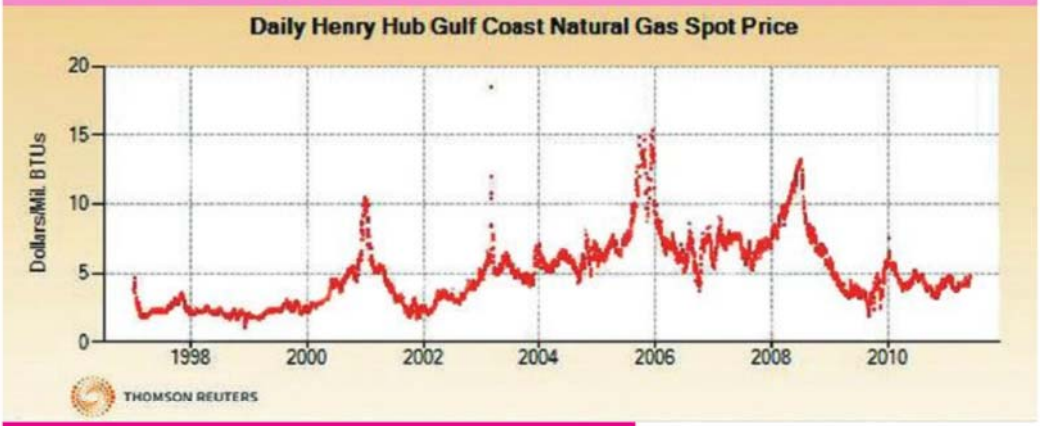
The US has played a decisive role in the shift to unconventional gas, with shale gas production rising sixteen-fold from 8.5 billion cubic metres in 1996 to 138.75 billion cubic metres in 2010. The historical background to this huge uplift goes back much further than many realise. America was the first to exploit shale gas over a hundred years ago in the Illinois and Appalachian basins, where there were natural fractures in the rock, drilling the first well in 1821. So the existence of this resource was known for a long time. Unlike oil, not much exploration was required. The challenge was to find a way to extract it economically.

In the early 1980s a lot of experimentation was led by George Phydias Mitchell, a Texan born to Greek parents, who came up with the radical idea of drilling much deeper into the gas-bearing shale rock. After nearly 20 years of experimentation with hydraulic fracturing and horizontal drilling, his company finally found the right formula for the economic exploitation of tight shale gas: a cheap combination of high pressure water, sand as a propping agent to open up the fractures, and some chemicals.

[1] See attribution to Chris Faulkner, CEO of Breitling Oil & Gas, 31st March 2011, "Shale gas could be game changer for African energy", http://www.businesslive.co.za/incoming/2011/03/31/shale-gas-could-be-game-changer-for-african-energy.

CHART 2

Gulf Coast natural gas prices



Source: http://www.eia.doe.gov/dnav/ng/hist/rngwhhdd.htm (including data series).

Devon Energy – which bought his company for $3.5bn in 2002 – took the technology further with more effective horizontal drilling. Horizontal drilling is more cost-effective than vertical drilling because fewer wells need to be drilled to collect the same quantity of gas. In a vertical well, only gas that is on or near the well bore can be recovered. Horizontal wells still require a vertical bore hole but then spread outwards in all directions for a number of miles, effectively creating many wells out of one. This is also known as multi-well pad drilling.

At the beginning of the decade the technology was therefore ready for shale, but it was still expensive. Fortuitously, a decade of rapid industrialisation of the developing world led by China, war in Iraq, energy security concerns and declining US oil and gas reserves, created ten years of steadily rising oil prices – which were linked to gas prices.

Even so, few in the US gas industry thought that shale represented the future. They instead believed it to be liquefied natural gas (LNG) – which made sense when gas prices in the US were high.

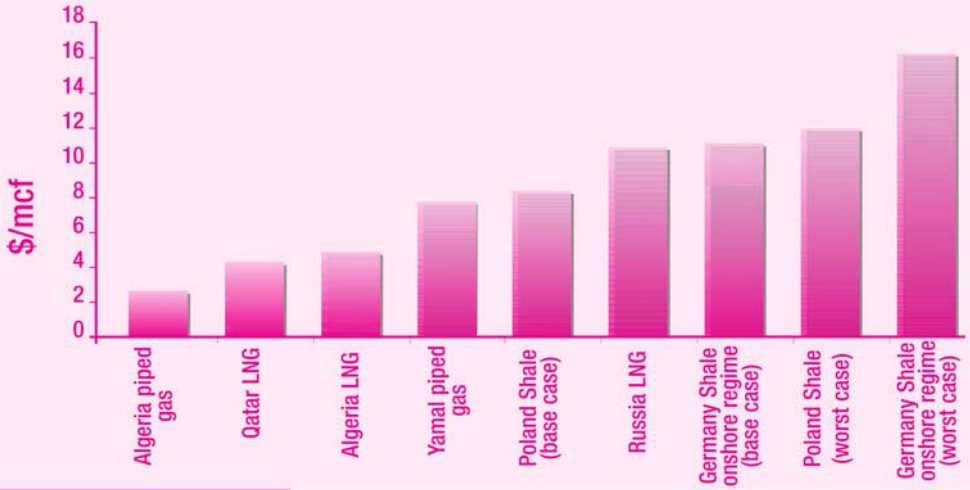
Exceptionally high and volatile natural gas prices in the US, $10 and above, led to a huge investment in LNG import facilities for when it was anticipated America would be unable to meet domestic demand. LNG required higher prices because of the cost of the liquefaction plant that freezes the gas into liquid, transporting it across the ocean and then regasification at the LNG terminal for distribution into the network. LNG imported gas probably cost up to an extra $1-2 per MMBtu. According to Leigh Bolton of Holmwood Consulting, a company that specialises in consultancy on LNG and natural gas, many of the US LNG terminals were predicated on a minimum of around $6-plus Henry Hub gas price.

At the same time, the high gas prices were driving small independent companies to experiment and innovate with new ways of extracting gas from shale. The development of a combination of hydraulic fracturing and horizontal well drilling made possible for the first time the cost-effective extraction of shale gas at $4-7 per MMBtu. This was especially so after Hurricane Katrina in November 2005 which sent the price to an all time high of $15.38 per MMBtu in December 2005.

The enormous investment in LNG import terminals, particularly in the Gulf of Mexico, turned out to be a massive waste of resources. In a few short years, US LNG import capacity rose eight times from 2 billion cubic feet per day to 17.4 billion. At one point, some 47 terminals were in the planning stages. Most of the completed LNG terminals are now either idle or working well below capacity. In 2010, the US imported 431 billion cubic feet of LNG, well down from the 2007 peak of 771 billion cubic feet.

CHART 3

Shale gas in Europe – some comparative production costs



Source: *IEA World Energy Outlook 2009.*

Holmwood Consulting estimates that only LNG imports from Qatargas and probably Peru are still profitable.

SO WHAT PROSPECTS BECKON FOR SHALE GAS IN EUROPE AND THE UK?

There is certainly quite a lot of new appetite for shale gas in Europe and the UK. But it doesn't follow that it can be produced at the same price as in the US, although the market bar is lower which compensates for the higher taxes and regulations implicit in European resource exploitation. And whilst Algerian and Qatar LNG cargoes can be produced at half the price of the best projected rate of Polish shale, the diversification of supply that shale could bring remains a very attractive proposition at a national level for countries like Poland which are keen to reduce their 60% import of Russian gas.

Understanding the UK's position in the current and future global pricing of gas

So how does this all affect the UK? The key words are price convergence. Unlike oil, there is no single price for gas. It is a very regionally traded product. There are three main prices operating out of three main regions:

The National Balancing Point – this is what the UK uses and is priced in pence per therm. Today it prices at the equivalent of $9.50 per MMBtu. The NBP also covers Belgium, Holland and Germany. Further east into the European mainland towards Russia, gas prices tend to be more oil-linked.

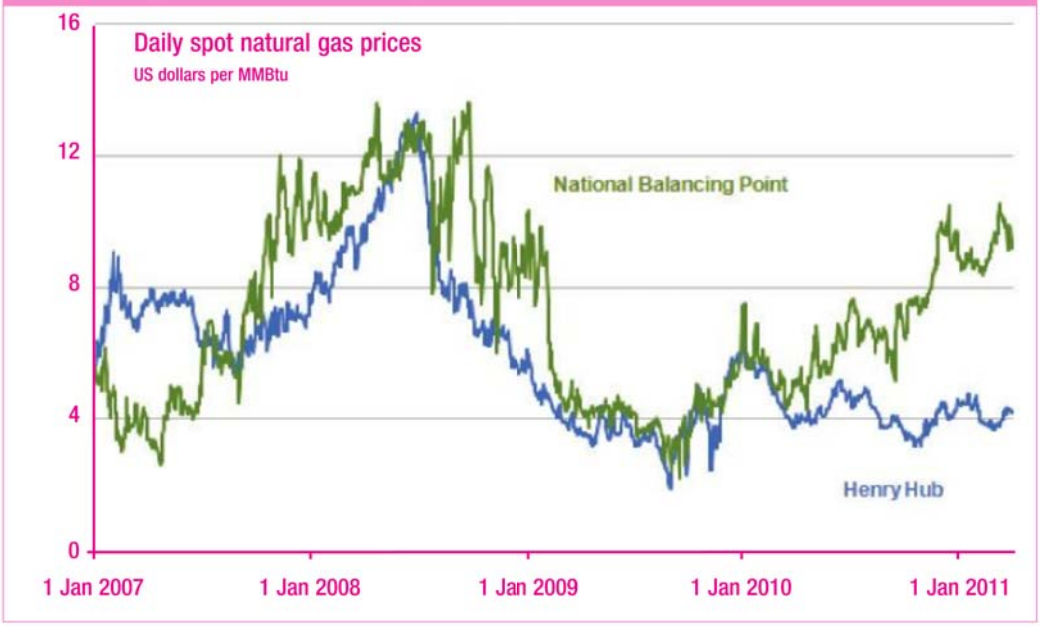
Henry Hub – this is what the US uses and is priced in dollars per MMBtu, currently at around $4.

Asia-Pacific LNG – this is where most LNG traffic exists, led by Japan, the world's biggest importer of LNG and followed by South Korea and others in the Pacific basin. In the wake of the surge of demand from Japan after the recent earthquake, spot prices have risen above $12 per MMBtu. Nearly all of this trade is based on oil price-linked contracts. As China and India's gas demand grows they will, unlike Japan and Korea, be able to arbitrage lower prices from pipeline and shale gas.

Over the next two decades, as LNG trade and shale gas take off, these three prices are going to converge nearer the American end.

CHART 4

The divergence of UK and US gas prices since 2010



The most exciting opportunity for the UK is where the convergence will happen first: between the UK (and Europe) and the US. Since early 2010, gas prices have moved in opposite directions on either side of the Atlantic. There are three main reasons for this:

i) **The UK's gas supplies are on oil price-linked contracts – which has risen substantially from $80 to $120 per barrel – whereas in the US the oil-gas price link has been decoupled, permanently;**

ii) **US shale gas developments;**

iii) **Higher LNG import prices due to the diversion of additional cargoes to Japan.**

With the Henry Hub at $4, most US and Canadian shale gas plays are below their break-even price of around $5.5. So a huge opportunity exists to export that gas to Europe. By 2012, Europe

will have an LNG import capacity of 17 billion cubic feet a day. Already, LNG cargoes destined by planners some years ago for the US are being turned around and diverted to Europe and Asia. The hold up for the export of North American shale gas is actually a lack of LNG export facilities and gas export licences on the Eastern seaboard. This is changing, with the first export permit granted by the US Department of Energy to Cheniere Energy Partners last September and a number of other players now seeking to convert their LNG import terminals into export capable ones by adding liquefaction plants alongside the gasification plants. Exports will then start flowing from the US in scale from 2015.

BOX 2

Gas and the UK

The UK's experience of gas has seen extreme shifts over the last two decades. In 1990, the UK was still flaring vast quantities of gas from its North Sea oilfields while generating power from coal and nuclear. The invention of cheap, modular Combined Cycle Gas Turbines saw the dash for (electric) gas in the 1990s. Gas exports and North Sea production then peaked in 2001, and the UK today is now a large importer of LNG and pipeline gas.

In 2009, natural gas accounted for 40% of the UK's primary energy consumption, 45% of its electricity and most of its heating. In 2010, a new annual record was set for the consumption of gas at 104.3 billion cubic metres.

Located at the wrong end of the European gas pipeline network, a long way from the major LNG trading hub of the Pacific basin and with paltry gas storage facilities, many analysts worried that the UK was poorly situated to command affordable prices for imported gas.

The UK's gas supply prospects have been radically changed for the better by: the success of shale gas in North America, driving down prices; turning LNG cargoes back to Europe whilst it prepares for export from 2015; and the anticipated arrival of shale gas from the rest of the world.

SWITCHING FROM OIL TO GAS FOR TRANSPORT

But it's not just for power generation where the use of gas lowers costs. For the first time, petrol and diesel will face growing competition from cleaner-burning natural gas vehicles.

If oil and gas prices precisely reflected their relative energy content, the oil price per barrel would be equal to 5.83 MMBtu of natural gas. However, with oil at $125 a barrel, we would expect gas to cost $21.44 per MMBtu. But for its relative energy content, natural gas is actually 5.3 times cheaper than oil in America and 2.5 times cheaper in the UK.

So it's no accident that compressed natural gas vehicles are having a quiet boom, growing by 10% per annum, far, far more extensively than electric cars. As of last November, there were already 12.6 million in use, curiously led by developing or semi-developed nations.

In many other countries, compressed natural gas (CNG) vehicles such as buses or taxis are used for public transport in

TABLE 4

Top 10 countries for natural gas vehicles

Nation	Number of vehicles
Pakistan	2,740,000
Iran	1,954,925
Argentina	1,901,116
Brazil	1,664,847
India	1,080,000
Italy	730,000
China	450,000
Colombia	340,000
Thailand	218,459
Ukraine	200,000

Source: International Association for Natural Gas Vehicles.

urban areas to reduce city centre pollution. This has already caught on in parts of the US like Santa Monica in California. Unlike with diesel, very few particulates are produced from the combustion of CNG and these are the key components of smog.

THE NEW GAS FUTURE AND WHAT IT MEANS FOR THE UK

It should now be clear that there is great potential for the UK, from midway through the 2010s, to reduce carbon emissions at much lower cost by using more gas in its power supply, and just possibly in transport fuel soon afterwards. For all that, it will take some time for the existing range of gas supply contracts with UK suppliers to expire or be renegotiated along market price lines and to decouple gas and oil prices as in the US.

Currently, North Sea contracts are oil-linked, Norwegian gas is oil formula-linked and LNG contracts tend to be a combination of both National Balancing Point and oil-linked. The recent £2bn Qatargas supply deal with Centrica linked to the NBP marks the first departure of hopefully many to come.

Lower gas prices will also create for the first time some external pressure to lower the prices of other low carbon sources of power such as renewables and nuclear. For all the low carbon technologies throughout the last decade, in almost every case apart from solar, prices have risen considerably – arguably because of, rather than in spite of, government subsidies. With copious suppliers of gas, the UK will also start to reconsider the energy security element of its energy policy. Russia will no longer be leading the price – and to a very small extent, the supply – of gas from the European mainland to the UK.

The global gas super glut is coming. We will see a great many changes over the next 20 years. And most of us will lead richer, cleaner and safer lives as a result. [ϕ]

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