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Tell people something they know already and they will thank you for it.  
Tell them something new and they will hate you for it.

### Towering Lunacy

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Green enthusiasm for vertical farms shows that no one is untouched by magical thinking.

By George Monbiot. Published in the Guardian 17th August 2010

No one is immune to it; in some respects it is the foundation of our lives. Magical thinking is a universal affliction. We see what we want to see, deny what we don't. Confronted by uncomfortable facts, we burrow back into the darkness of our cherished beliefs. We will do almost anything – cheat, lie, stand for high office, go to war – to shut out challenges to the way we see the world.

I spend much of my time confronting one aspect of denial: the virulent repudiation of environmental constraints by those who admit no challenge to their vision of the world. But it pains me to report that denial and wishful thinking are almost as common on the other side of the argument. I find myself at odds with other greens almost as often as I find myself fighting our common enemies. I've had bruising battles over a long series of miracle solutions supported by my friends: liquid biofuels(1), hydrogen cars and planes(2), biochar plantations(3,4), solar electricity in the UK(5), scrappage payments(6), feed-in tariffs(7). But no green delusion is as crazy as the one I am about to explain. The idea itself might not interest you. But the insight it gives into the filtering techniques human beings use is fascinating. So please bear with me while I spell out the latest madness.

That there's a problem is undeniable. As some of the papers published yesterday by the Royal Society show, farmland is in short supply, water shortages could impose ever tighter constraints on agriculture and there are grave questions about whether or not a growing population can continue to be fed(8). There are a number of plausible solutions. But none of them appeals to some environmentalists as much as the towering lunacy promoted by a parasitologist at Columbia University called Dickson Despommier.

Despommier points out that while horizontal space for growing crops is limited, vertical space remains abundant. So he proposes that crops should be grown in skyscrapers, which he calls vertical farms(9). These, he claims, will feed the growing population so efficiently that ordinary farmland will be allowed to revert to forest. Vertical farms will feed the urban populations that surround them, eliminating the need for long-distance transport.

You can, if you shield your eyes very carefully, see the attraction. But even a brief reading of Despommier's essays reveals a few trifling problems. He proposes that 30-storey towers should be built to feed local people in places like Manhattan. You wouldn't see any change from \$100m, possibly \$200m. The only crop which could cover such costs is high-grade cannabis. But a 30-storey hydroponic skunk tower would be quite hard to conceal.

Without offering any explanation for this amazing claim, Despommier asserts that his system will require "no herbicides, pesticides, or fertilizers"(10). Perhaps he has never seen a fungal infestation in

a greenhouse. And what does he expect the plants to grow on: water and air alone? He also insists that there will be “no need for fossil-fueled machinery”, which suggests that he intends to farm a 30-storey building without pumps, heating or cooling systems.

His idea, he says, is an antidote to “intensive industrial farming, carried out by an ever decreasing number of highly mechanized farming consortia” but then he calls on Cargill, Monsanto, Archer Daniels Midland and IBM to fund it(10). He suggests that “locally grown would become the norm”(11), but fails to explain why such businesses wouldn’t seek the most lucrative markets for their produce, regardless of locality. He expects, in other words, all the usual rules of business, economics, physics, chemistry and biology to be suspended to make way for his idea.

But the real issue is scarcely mentioned in his essays on the subject: light. Last week one of my readers, the film maker John Russell, sent me his calculations for the artificial lighting Despommier’s towers would require. You can read them in full below the references on this article. They show that the light required to grow the 500 grammes of wheat that a loaf of bread contains would cost, at current prices, £9.82. (The current farm gate price for half a kilo of wheat is 6p(12).) That’s just lighting: no inputs, interest, rents, rates, or labour. Somehow this minor consideration - that plants need light to grow and that they aren’t going to get it except on the top storey – has been overlooked by the scheme’s supporters. I won’t bother to explain the environmental impacts.

None of this has dented the popularity of Despommier’s dumb idea. It has featured in the New York Times(13), Time magazine(14), Scientific American(15), and on the BBC(16), CNN(17), Discovery Channel(18) and NBC(19). Three weeks ago the Guardian published a supportive piece, whose author appeared to be unaware that nutrients don’t magically regenerate themselves in an agricultural system (20). Environmentalists love it. Treehugger.com claimed that vertical farming would “help us stop the use of pesticides, herbicides, oil-based fertilizers”(21) and suggested, again unhindered by evidence, that it could produce a net output of energy(22). The Huffington Post said the idea is “so simple, so elegant that you wonder why you didn’t think of it yourself.”(23)

In my grouchier moments I feel that only those who grow some of their own food should write about food production. Horticulture, with its endlessly varied constraints and disappointments, is an excellent corrective to wishful thinking. But this is about much more than ignorance and inexperience. It’s about seeing something you like – local food for example – and allowing that idea to crowd out everything else. This is how we all live.

In a recent essay in New Scientist the psychologist Dorothy Rowe explained that none of us can see reality(24). We have to construct it from our interpretation of what we perceive, tempered by experience. As a result, each of us exists in our own world of meaning. It is constantly at risk of being shattered by inconvenient facts. If we acknowledge them, they can destroy our sense of self. So, to ensure that we won’t be “overwhelmed by the uncertainty inherent in living in a world we can never truly know”, we shut them out by lying to ourselves. Though it challenges my sense of self, I am forced to accept that my allies can lie to themselves as fluently as my opponents can.

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John Russell's calculations:

First to establish how much energy a crop needs to grow from planting out to maturity.

“In the UK when the latitude and cloud cover is taken into account we can expect a crop to be receiving an average of 150W/square metre during daylight hours during the growing season. [Source page 38 of — <http://www.withouthotair.com/> \* ] In the UK daylight hours are typically 12 hours/day averaged during the summer which would mean, for each square metre, 1.8kWh per day. Let's assume a typical crop needs 90 days to reach maturity, so sunlight requirement (90 x 1.8) = 162kWh per square metre of crop.

Of course some food crops need less light — mushrooms for instance — but most food crops prefer not to be in the shade. [Source: [http://www.bbc.co.uk/gardening/htbg/module7/setting\\_up\\_your\\_plot1.shtml](http://www.bbc.co.uk/gardening/htbg/module7/setting_up_your_plot1.shtml) & <http://www.pots2plots.com/Growing%20%20in%20Shade.htm> ]

So having established the amount of light crops need, the next question is; what is the yield of a sq metre?

The yield of wheat crops in the UK is on average 7.8 tonnes per hectare. [Source: [http://www.defra.gov.uk/evidence/statistics/foodfarm/enviro/observatory/indicators/b/b11\\_data.htm](http://www.defra.gov.uk/evidence/statistics/foodfarm/enviro/observatory/indicators/b/b11_data.htm) ] As there are 10,000 square metres in a hectare, this is equivalent to 0.78kg per square metre. ( 207kWh light requirement per kilo).

Here are some other crops and their yields ...

Potatoes: 4.4 kg per sq metre. [Source: [http://www.ukagriculture.com/crops/potatoes\\_uk.cfm](http://www.ukagriculture.com/crops/potatoes_uk.cfm) ] ... 36kWh light requirement per kilo.

Sugar beet: 5.6kg per sq metre. [Source: [http://www.ukagriculture.com/crops/sugar\\_beet\\_farming.cfm](http://www.ukagriculture.com/crops/sugar_beet_farming.cfm) ]... 29kWh light requirement per kilo.

Oil seed rape: 0.33kg per sq metre [Source: [http://www.ukagriculture.com/crops/oil\\_seed\\_rape.cfm](http://www.ukagriculture.com/crops/oil_seed_rape.cfm) ] ... 490kWh light requirement per kilo.

Peas: 0.35kg per sq metre [Source: [http://www.ukagriculture.com/crops/peas\\_uk.cfm](http://www.ukagriculture.com/crops/peas_uk.cfm) ] ...462kWh light requirement per kilo.

Beans: 0.35kg per sq metre [Source: [http://www.ukagriculture.com/crops/field\\_beans\\_uk.cfm](http://www.ukagriculture.com/crops/field_beans_uk.cfm) ] ... 462kWh light requirement per kilo.

Oats: 0.55kg per sq metre [Source: [http://www.ukagriculture.com/crops/oats\\_uk.cfm](http://www.ukagriculture.com/crops/oats_uk.cfm) ] ...294kWh light requirement per kilo.

A loaf of bread contains 500gm of wheat (current approx cost at the farm gate: 10p) . Each square metre of land produces approx 1.5 loaves of bread and has required 162 kWh of sunlight to grow. This means each loaf of bread embodies 108 kWh of energy.

So that's conventional growing now growing the same amount under artificial light...

To grow these crops indoors, the same amount of energy –162/kWh per square metre — will be required in the form of electricity.\*

However ‘grow bulbs’ are not 100% efficient; 1 kW of light output at the bulb requires 1.3 units of electricity at the socket. This means all figures for power need to be lifted by 1.3. [Source: <http://urbangardenmagazine.com/2010/02/plasma-grow-lights-the-promises-of-full-spectrum-plant-lighting/> ]

Assuming the commercial price of electricity is 7p/unit the costs for a crop such as peas — for light alone will be 462units x £0.07 x 1.3 = £0.42 per kilo. For a single loaf of bread the electricity required just for the light will cost £9.82 (108 units x 1.3 x £0.07). [Source of electricity price <http://www.businessenergyprices.com/> ].

\*However it seems that the energy issue might be reduced by the introduction of a new generation of LED grow lights which reduce the energy required by just providing the plants with the part of the radiation spectrum that they require for growth. [ <http://www.ledgrowlight.co.uk/?page=better> ] Currently they are very expensive [ <http://www.growlightsled.co.uk/hydroponic-lamp-225-led-grow-light-panel-board-bulb-kit-p-36.html> ] but in the long term they might provide significant savings in power consumption. [ [http://en.wikipedia.org/wiki/Light-emitting\\_diode](http://en.wikipedia.org/wiki/Light-emitting_diode) ].”

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