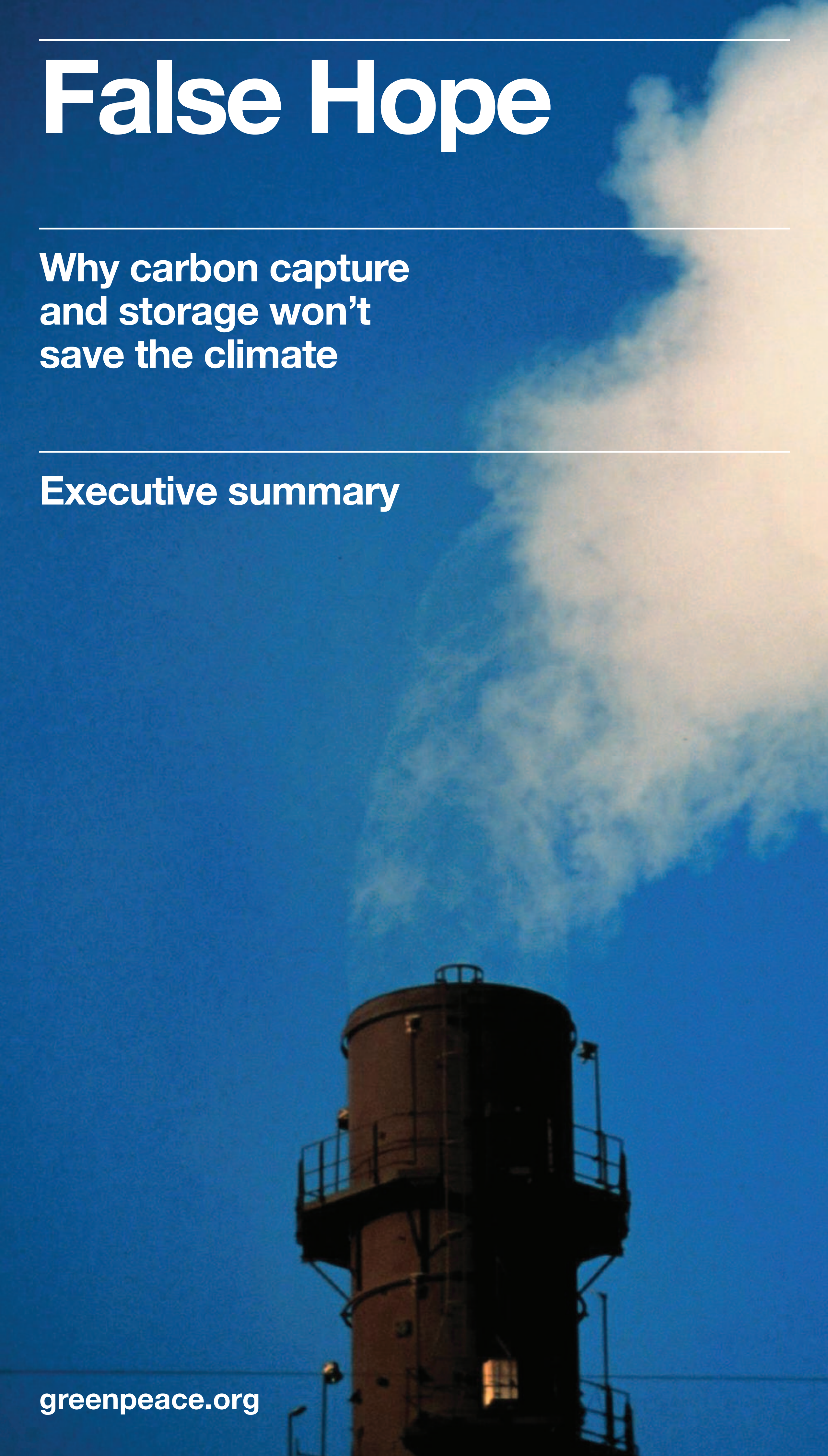
False Hope

Why carbon capture and storage won't save the climate

Executive summary



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Catalysing an energy revolution

For more information contact:
enquiries@int.greenpeace.org

Lead Author: Emily Rochon
Editor: Jo Kuper
Contributing Authors: Dr Erika Bjureby,
Dr Paul Johnston, Robin Oakley,
Dr David Santillo, Nina Schulz,
Dr Gabriela von Goerne

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Ottho Heldringstraat 5
1066 AZ Amsterdam
The Netherlands
Tel: +31 20 7182000
Fax: +31 20 5148151

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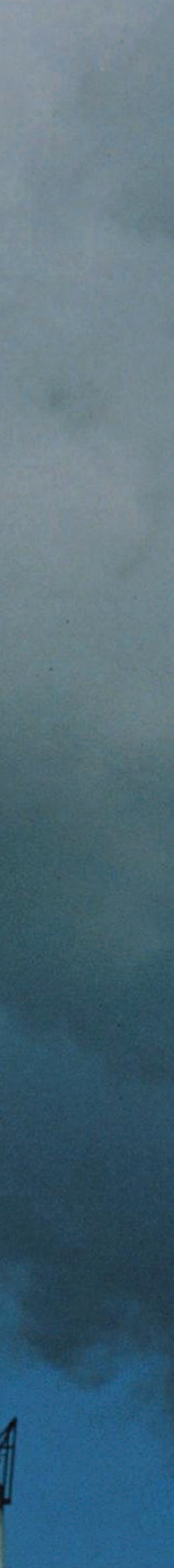

Executive summary

Carbon capture and storage (CCS) aims to reduce the climate impact of burning fossil fuels by capturing carbon dioxide (CO_2) from power station smokestacks and disposing of it underground. Its future development has been widely promoted by the coal industry as a justification for the construction of new coal-fired power plants. However, the technology is largely unproven and will not be ready in time to save the climate.

This report, based on peer-reviewed independent scientific research shows that:

CCS cannot deliver in time to avoid dangerous climate change. The earliest possibility for deployment of CCS at utility scale is not expected before 2030.[1] To avoid the worst impacts of climate change, global greenhouse gas emissions have to start falling after 2015, just seven years away.

CCS wastes energy. The technology uses between 10 and 40% of the energy produced by a power station.[2] Wide scale adoption of CCS is expected to erase the efficiency gains of the last 50 years, and increase resource consumption by one third.[3]

Storing carbon underground is risky. Safe and permanent storage of CO_2 cannot be guaranteed. Even very low leakage rates could undermine any climate mitigation efforts.

CCS is expensive. It could lead to a doubling of plant costs, and an electricity price increase of 21-91%.[4] Money spent on CCS will divert investments away from sustainable solutions to climate change.

CCS carries significant liability risks. It poses a threat to health, ecosystems and the climate. It is unclear how severe these risks will be.

The climate crisis requires urgent action. Climate scientists warn that to avoid the worst effects, global greenhouse gas emissions must peak by 2015 and then start falling by at least 50% by 2050, compared to 1990 levels. Coal is the most polluting of all fossil fuels, and the single greatest threat to the climate. If current plans to invest hundreds of billions of dollars in coal plants are realised, CO_2 emissions from coal could increase 60% by 2030.

Concerns about the feasibility, costs, safety, and liability of CCS make it a dangerous gamble. A survey of 1000 “climate decision-makers and influencers” around the world reveals substantial doubt in the ability of CCS to deliver. Just 34% were confident that retrofitting ‘clean coal technology’ to existing power plants could reduce CO_2 emissions over the next 25 years without unacceptable side effects, and only 36% were confident in its ability to deliver low-carbon energy from new power stations.[5]

The real solutions to stopping dangerous climate change lie in renewable energy and energy efficiency that can start protecting the climate today. Huge reductions in energy demand are possible with efficiency measures that save more money than they cost to implement. Technically accessible renewable energy sources – such as wind, wave and solar- are capable of providing six times more energy than the world currently consumes – forever.

"CCS will arrive on the battlefield far too late to help the world avoid dangerous climate change."[7]

Greenpeace's Energy [R]evolution[6] provides a practical blueprint that shows how renewable energy, combined with greater energy efficiency, can cut global CO_2 emissions by almost 50%, and deliver half the world's energy needs by 2050.

What is CCS?

CCS is an integrated process, made up of three distinct parts: carbon capture, transport, and storage (including measurement, monitoring and verification).

Capture technology aims to produce a concentrated stream of CO_2 that can be compressed, transported, and stored. Transport of captured CO_2 to storage locations is most likely to be via pipeline.

Storage of the captured carbon is the final part of the process. The vast majority of CO_2 storage is expected to occur in geological sites on land, or below the seabed. Disposing of waste CO_2 in the ocean has also been proposed but this method has been largely discounted due to the significant impacts CO_2 would have on the ocean ecosystem and legal constraints that effectively prohibit it.

CCS cannot deliver in time

The urgency of the climate crisis means solutions must be ready for large-scale use as soon as possible. CCS simply cannot deliver in time. As the United Nations Development Programme (UNDP) says "CCS will arrive on the battlefield far too late to help the world avoid dangerous climate change"[8] At present, there are no large-scale coal-fired power plants in the world capturing carbon, let alone any that are integrated with storage operations.[9]

The earliest CCS may be technically feasible at utility scale is 2030.[10] The Intergovernmental Panel on Climate Change (IPCC) does not expect CCS to become commercially viable until at least the second half of this century.[11] Even then, plants responsible for 40-70% of electricity sector CO2 emissions will not be suitable for carbon capture'.[12]

Despite this, CCS is being used as an excuse by power companies and utilities to push ahead with plans to build new coal-fired power plants; branding them "capture-ready." The International Energy Agency (IEA) describes a "capture-ready" plant as one "which can be retrofitted with CO_2 capture when the necessary regulatory or economic drivers are in place".[13] This definition is broad enough to make any station theoretically "capture-ready", and the term meaningless.

The very real danger of "capture-ready" power stations is that promises to retrofit are unlikely to be kept. Retrofits are very expensive and can carry such high efficiency losses that plants become uneconomic.[14] Furthermore, even if a plant is technically suitable for carbon capture there is no guarantee that there will be accessible storage locations.

In the UK, a proposed new coal-fired power plant at Kingsnorth, Kent, is being sold as "capture ready"; able to incorporate CCS should the technology ever become available in the future. However, no one has any idea if and when this might be. In the meantime, and possibly for its entire lifetime, Kingsnorth (if built) will pump out around 8 million tonnes of CO_2 per year, an amount equivalent to the total annual CO_2 emissions of Ghana.[15]

If CCS is ever able to deliver at all, it will be too little, too late.

CCS wastes energy

Capturing and storing carbon uses lots of energy, anywhere from 10-40% of a power station's capacity.[16] An energy penalty of just 20% would require the construction of an extra power station for every four built.[17]

These reductions in efficiency will require more coal to be mined, transported, and burned, for a power station to produce the same amount of energy as it did without CCS.

CCS will also use more precious resources. Power stations with capture technology will need 90% more freshwater than those without. This will worsen water shortages, already aggravated by climate change.[18] Overall, wide-scale adoption of CCS is expected to erase the efficiency gains of the last 50 years, and increase resource consumption by one third.[19]

Storing carbon underground is risky

The IEA estimates that for CCS to deliver any meaningful climate mitigation effects by 2050, 6000 projects each injecting a million tonnes of CO_2 per year into the ground would be required.[20] At the moment, it is not clear that it will be technically feasible to capture and bury this much carbon, i.e. whether there are enough storage sites, or that they will be located close enough to power plants. Transport of CO_2 over distances greater than 100 kilometres is likely to be prohibitively expensive.[21]

image Smoke stacks of the lignite (brown coal) fuelled Mae Moh power plant discharging smoke, Mae Moh, Lampang province Thailand.

Efforts to capture CO_2 make no sense if there is not adequate accessible space to store it permanently. Even if it is feasible to bury hundreds of thousands of gigatonnes of CO_2 there is no way to guarantee that storage locations will be appropriately designed and managed over the timescales required.

As long as CO_2 is in geological sites, there is a risk of leakage. While it is not currently possible to quantify the exact risks, any CO_2 release has the potential to impact the surrounding environment; air, groundwater or soil. Continuous leakage, even at rates as low as 1%, could negate climate mitigation efforts.[22] Remediation may be possible for CO_2 leaks, but there is no track record or cost estimates for these measures.[23]

A natural example of the danger of CO_2 leakage occurred at Lake Nyos, Cameroon in 1986. Following a volcanic eruption, large quantities of CO_2 that had accumulated on the bottom of the lake were suddenly release, killing 1700 people and thousands of cattle over a range of 25 km.[24]

CCS is expensive and undermines funding for sustainable solutions

While cost estimates for CCS vary considerably, one thing is certain – it is extremely expensive.

CCS will require significant funding to construct the power station and necessary infrastructure to transport and store carbon. Existing policy mechanisms, such as a price on carbon, would need to be significantly increased (by as much as five times higher than their current levels) and supplemented by additional policy commitments and financial incentives.[25]

The US Department of Energy (US DOE) calculates that installing carbon capture systems will almost double plant costs.[26] This will lead to electricity price hikes of anywhere between 21 and 91%.[27]

Providing the substantial levels of support needed to get CCS off the ground comes at the expense of real solutions. Current research shows electricity generated from coal-fired power stations equipped with CCS will be more expensive than other less-polluting sources, such as wind power and many types of sustainable biomass.[28]

In recent years, coal's share of research and development budgets in countries pursuing CCS has ballooned. Meanwhile, funding for renewable technologies and efficiency has stagnated or declined.

In the US, the Department of Energy has asked for a 26.4% budget increase for CCS-related programmes (to US$623.6 million) while at the same time scaling back renewable energy and efficiency research by 27.1% (to US$146.2 million).[29] Australia has three research centres for fossil fuels, including one committed to CCS; there is not one for renewable energy technology.[30] The Norwegian government recently committed 20 billion NOK (US$4 billion) for two CCS projects at the expense of investment in renewable technologies.

Spending money on CSS is diverting urgent funding away from renewable energy solutions for the climate crisis. Even assuming that at some stage carbon capture becomes technically feasible, commercially viable, capable of long-term storage and environmentally safe, it would still only have a limited impact and would come at a high cost. In contrast, as Greenpeace's Futu[r]e Investment report shows, investing in a renewable energy future would save US$180 billion annually and cut CO_2 emissions in half by 2050.[31]

CCS and liability: risky business

Large-scale applications of CCS pose significant liability risks, including negative health effects and damage to ecosystems, groundwater contamination including pollution of drinking water, and increased greenhouse gas emissions resulting from leakage. There is no reliable basis for estimating the probability or severity of these risks. As current regulations are not designed to adequately manage them, significant questions as to who is liable remain unanswered[32]

Industry views liability as a barrier to wider deployment of CCS[33] and is unwilling to fully invest in CCS without a framework that protects it from long-term liability. The risk is so great that some utilities are unwilling to make CO_2 available for storage unless they are relieved of ownership upon transfer of the CO_2 off the property of the power station.[34] Potential operators are urging that they only retain legal liability for permanently stored carbon for ten years.[35]

A survey of 1000 "climate decision-makers and influencers" around the world reveals substantial doubt about CCS. Just 34% were confident that retrofitting 'clean coal technology' could reduce CO_2 emissions over the next 25 years without unacceptable side effects, and only 36% were confident in its ability to deliver low carbon energy with new power stations. In contrast, 74% expressed confidence in solar hot water, 62% in offshore wind farms, and 60% in onshore wind farms.[36]

CCS proponents are demanding almost complete legal protection from governments, including mechanisms that completely shield operators from legal challenges, transfer ownership to government and/or limit the amount of money that can be recouped should damage occur.[37] It is expected that the public will assume the risk for, and pay for the damages resulting from, CO_2 storage projects.

The extent of support offered to the recently collapsed FutureGen project in the US gives some idea of the real costs of CCS. FutureGen was the Bush Administration's flagship CCS project, a public-private partnership between the US government and industry giants including Rio Tinto and American Electric Power Service Corp. FutureGen not only was promised unprecedented public funds (to the tune of US$1.3 billion) but was also protected from financial and legal liability in the event of an unanticipated release of carbon dioxide,[38] indemnified from lawsuits, and even had its insurance policies paid for.[39]

The world already has the solutions to the climate crisis

Investment in CCS risks locking the world into an energy future that fails to save the climate. Those technologies with the greatest potential to provide energy security and reduce emissions, and to provide renewable energy and energy efficiency, need to be prioritised.

Greenpeace's Energy [R]evolution blueprint shows how renewable energy, combined with greater energy efficiency, can cut global CO_2 emissions by almost 50%, and deliver half the world's energy needs by 2050.[40]

The renewable energy market is booming; in 2007, global annual investment in renewables exceeded US$100 billion.[41] Decades of technological progress have seen renewable energy technologies such as wind turbines, solar photovoltaic panels, biomass power plants and solar thermal collectors move steadily into the mainstream. The same climate decision-makers who were sceptical about CCS believed far more in the ability of renewable technologies to deliver reductions in greenhouse gas emissions: 74% expressed confidence in solar hot water, 62% in offshore wind farms, and 60% in onshore wind farms.[42]

Many nations have recognised the potential of these true climate solutions and are pressing ahead with ambitious plans for energy revolutions within their borders. New Zealand plans to achieve carbon neutrality by mid-century. Renewable energy and energy efficiency, not CCS, are leading the way. New Zealand already obtains 70% of its electricity from renewable resources and aims to increase it to 90% by 2025.[43] In Germany, renewable energy use has increased 300% in the past 10 years. In the US, over 5,200 megawatts (MW) of wind energy were installed in 2007, accounting for 30% of new power installed that year; an increase of 45% in one year.[44]

The urgency of the climate crisis means solutions must be ready for large-scale deployment in the short-term. CCS simply cannot deliver in time. The technology is highly speculative, risky and unlikely to be technically feasible in the next twenty years. Letting CCS be used as a smokescreen for building new coal-fired power stations is unacceptable and irresponsible. "Capture ready" coal plants pose a significant threat to the climate.

The world can fight climate change but only if it reduces its dependence on fossil fuels, particularly coal. Renewable energy and energy efficiency are safe, cost-effective solutions that carry none of the risks of CCS, and are available today to cut emissions and save the climate.

Endnotes

[1] World Business Council for Sustainable Development (hereafter "WBSCD"), 2006

[2] Abanades, J C et al., 2005, pg 3

[3] Ragden et al., 2006, pg 24

[4] Rubin et al., 2005a, pg 40

[5] Carbon Capture Journal (hereafter "CCJ"), 2008, pg 14

[6] Greenpeace's Energy [R]evolution was produced in conjunction with the European Renewable Energy Council and the German Aerospace laboratories – it is available at www.greenpeace.org/energyrevolution

[7] United Nations Development Programme (hereafter "UNDP"), 2007 145-146

[8] Ibid

[9] Massachusetts Institute of Technology (hereafter "MIT"), 2007, pg xiii

[10] WBSCD, 2006

[11] Rubin et al., 2005a, pg 41

[12] Abanades, J C et al., 2005, pg 8

[13] International Energy Agency Greenhouse Gas R&D Programme (hereafter "IEA"), 2007 a, i

[14] MIT, 2007, pg 29

[15] CAIT institute, http://cait.wri.org/

[16] Abanades, J C et al., 2005, pg 3

[17] In other words: 20% reduced efficiency for each of these 4 power stations leads to an overall extra demand for power of 4 x 20% = 80% = 1 extra power station of the same size. The remaining 20% is needed for CCS for the fifth power plant.

[18] Shuster et al., 2007, pg 60

[19] Ragden et al., pg 24

[20] IEA, 2007a, pg 7

[21] CSIRO submission to the Australian Parliamentary House of Representatives Inquiry in Geosequestration Technology, August 2006.

[22] Azar et al., 2006

[23] Benson et al., 2005, pg 264

[24] Diesendorf, M, 2006, p. 16

[25] IEA Clean Coal Centre, http://www.iea-epl.co.uk/content/default.asp?PageId=885

[26] National Energy Technologies Laboratory (hereafter "NETL") 2007, ii

[27] Rubin et al., 2005a, pg 40

[28] Saddler, H et al., 2004, xi

[29] US DOE, FY 2009 Congressional Budget Request, February 2008

[30] Diesendorf, M, 2006, pg 13

[31] http://www.greenpeace.org/raw/content/international/press/reports/future-investment.pdf

[32] Wilson, E et al., pg 5945

[33] IEA Clean Coal Centre, http://www.iea-epl.co.uk/content/default.asp?PageId=885

[34] Levinson, Marc 2007, pg 14

[35] The Interstate Oil and gas Compact Commission 2007, pg 11

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[37] NETL, 2006

[38] Illinois Department of Commerce and Economic Opportunity, "Gov. Blagojevish Applauds the Passage of Important Legislation to Continue Illinois' Strong Bipartisan Push to Bring FutureGen to Illinois", http://www.ildceo.net/dceo/News/pr07262007-2.htm, retrieved 23.1.08.

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[43] Renewable Energy Access, New Zealand Commits to 90% Renewable Electricity by 2025, September 26 2007, http://www.renewableenergyaccess.com/rea/news/story?id=50075

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Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

Greenpeace International
Ottho Heldringstraat 5
1066 AZ Amsterdam
The Netherlands
Tel: +31 20 7182000
Fax: +31 20 5148151

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