# Fossil Fuels DA

## 1NC Materials

### 1NC – Warming DA

#### Nuclear power is critical to stop catastrophic warming

Waldman 15 - Susanne, PhD in Risk Communication at Carleton University (“Why we Need Nuclear Power to Save the Environment” <http://energyforhumanity.org/climate-energy/need-nuclear-power-save-environment/>) RMT

The idea we might need nuclear power to save the environment may have seen farfetched thirty years ago, at the height of the anti-nuclear movement. But it’s an idea that more and more scientists of all stripes as well as energy experts and even environmentalists are coming to share.

Last month, 75 biodiversity scientists signed an open letter imploring the environmental and conservation communities to rethink “idealistic” opposition to nuclear energy, given the threats to global ecosystems set in motion by climate change. This open letter follows in the wake of another published a year ago in the New York Times by climate scientists with a similar message: “there is no credible path to climate stabilization that does not include a substantial role for nuclear power.”

These scientists who study the earth and the life on it are concerned it is too risky to rely solely on wind, solar and other so-called “green” power to replace fossil fuels, which are still the fastest growing energy sources by a long shot. As these scientists point out, renewable power sources would require enormous amounts of land, materials, and money to meet the world’s current and growing energy needs.

Wind and solar power are especially problematic because they are intermittent and can’t be dispatched to match demand. While the quest is on for grid storage options, there has not yet been a significant storage breakthrough, and any contribution it ends up making may only be modest.

In the meantime other power sources that can run full time are required to take up the slack. Options for doing so are limited to fossil fuels, biomass that is comparatively bulky and limited in scale, hydro power that is largely tapped out in some places, and nuclear power. The advantage of nuclear power is there is no shortage of suitable sites and it is the most low-footprint form of power generation, taking into account land use, materials, carbon footprint, and fuel density.

History has shown the most effective way to replace fossil fuel power over a 15-year-period is to build up nuclear. Ontarians, who rely on nuclear plants to deliver roughly three-fifths of our power every day, and have become coal-free, know this. So do people in France, where nuclear energy supplies around three quarters of power needs.

The problem is that as a complex form of technology, nuclear plants are relatively pricey to build. Few have been constructed of late in the Western world, during an era of cheap coal and gas, liberalized energy markets, cash-strapped governments, and hyped-up renewables. Experienced work forces who can put them up quickly have become hard to assemble on the fly.

These patterns can alter, though, as people come to recognize that once nuclear plants are up they can churn out steady carbon-free power for over half a century. Moreover the power they provide is typically quite cheap and not sensitive to fuel price volatility.

#### Global warming definitively causes extinction

Sharp and Kennedy 14 – (Associate Professor Robert (Bob) A. Sharp is the UAE National Defense College Associate Dean for Academic Programs and College Quality Assurance Advisor. He previously served as Assistant Professor of Strategic Security Studies at the College of International Security Affairs (CISA) in the U.S. National Defense University (NDU), Washington D.C. and then as Associate Professor at the Near East South Asia (NESA) Center for Strategic Studies, collocated with NDU. Most recently at NESA, he focused on security sector reform in Yemen and Lebanon, and also supported regional security engagement events into Afghanistan, Turkey, Egypt, Palestine and Qatar; Edward Kennedy is a renewable energy and climate change specialist who has worked for the World Bank and the Spanish Electric Utility ENDESA on carbon policy and markets; 8/22/14, “Climate Change and Implications for National Security,” *International Policy Digest*, <http://intpolicydigest.org/2014/08/22/climate-change-implications-national-security/>, Accessed 7/11/16, HWilson)

Our planet is 4.5 billion years old. If that whole time was to be reflected on a single one-year calendar then the dinosaurs died off sometime late in the afternoon of December 27th and modern humans emerged 200,000 years ago, or at around lunchtime on December 28th. Therefore, human life on earth is very recent. Sometime on December 28th humans made the first fires – wood fires – neutral in the carbon balance.

Now reflect on those most recent 200,000 years again on a single one-year calendar and you might be surprised to learn that the industrial revolution began only a few hours ago during the middle of the afternoon on December 31st, 250 years ago, coinciding with the discovery of underground carbon fuels.

Over the 250 years carbon fuels have enabled tremendous technological advances including a population growth from about 800 million then to 7.5 billion today and the consequent demand to extract even more carbon. This has occurred during a handful of generations, which is hardly noticeable on our imaginary one-year calendar. The release of this carbon – however – is changing our climate at such a rapid rate that it threatens our survival and presence on earth. It defies imagination that so much damage has been done in such a relatively short time. The implications of climate change is the single most significant threat to life on earth and, put simply, we are not doing enough to rectify the damage.

This relatively very recent ability to change our climate is an inconvenient truth; the science is sound. We know of the complex set of interrelated national and global security risks that are a result of global warming and the velocity at which climate change is occurring. We worry it may already be too late.

Climate change writ large has informed few, interested some, confused many, and polarized politics. It has already led to an increase in natural disasters including but not limited to droughts, storms, floods, fires etc. The year 2012 was among the 10 warmest years on record according to an American Meteorological Society (AMS) report. Research suggests that climate change is already affecting human displacement; reportedly 36 million people were displaced in 2008 alone because of sudden natural disasters. Figures for 2010 and 2011 paint a grimmer picture of people displaced because of rising sea levels, heat and storms.

Climate change affects all natural systems. It impacts temperature and consequently it affects water and weather patterns. It contributes to desertification, deforestation and acidification of the oceans. Changes in weather patterns may mean droughts in one area and floods in another. Counter-intuitively, perhaps, sea levels rise but perennial river water supplies are reduced because glaciers are retreating.

As glaciers and polar ice caps melt, there is an albedo effect, which is a double whammy of less temperature regulation because of less surface area of ice present. This means that less absorption occurs and also there is less reflection of the sun’s light. A potentially critical wild card could be runaway climate change due to the release of methane from melting tundra. Worldwide permafrost soils contain about 1,700 Giga Tons of carbon, which is about four times more than all the carbon released through human activity thus far.

The planet has already adapted itself to dramatic climate change including a wide range of distinct geologic periods and multiple extinctions, and at a pace that it can be managed. It is human intervention that has accelerated the pace dramatically: An increased surface temperature, coupled with more severe weather and changes in water distribution will create uneven threats to our agricultural systems and will foster and support the spread of insect borne diseases like Malaria, Dengue and the West Nile virus. Rising sea levels will increasingly threaten our coastal population and infrastructure centers and with more than 3.5 billion people – half the planet – depending on the ocean for their primary source of food, ocean acidification may dangerously undercut critical natural food systems which would result in reduced rations.

Climate change also carries significant inertia. Even if emissions were completely halted today, temperature increases would continue for some time. Thus the impact is not only to the environment, water, coastal homes, agriculture and fisheries as mentioned, but also would lead to conflict and thus impact national security. Resource wars are inevitable as countries respond, adapt and compete for the shrinking set of those available resources. These wars have arguably already started and will continue in the future because climate change will force countries to act for national survival; the so-called Climate Wars.

As early as 2003 Greenpeace alluded to a report which it claimed was commissioned by the Pentagon titled: An Abrupt Climate Change Scenario and Its Implications for U.S. National Security. It painted a picture of a world in turmoil because global warming had accelerated. The scenario outlined was both abrupt and alarming. The report offered recommendations but backed away from declaring climate change an immediate problem, concluding that it would actually be more incremental and measured; as such it would be an irritant, not a shock for national security systems.

In 2006 the Center for Naval Analyses (CNA) – Institute of Public Research – convened a board of 11 senior retired generals and admirals to assess National Security and the Threat to Climate Change. Their initial report was published in April 2007 and made no mention of the potential acceleration of climate change. The team found that climate change was a serious threat to national security and that it was: “most likely to happen in regions of the world that are already fertile ground for extremism.” The team made recommendations from their analysis of regional impacts which suggested the following. Europe would experience some fracturing because of border migration. Africa would need more stability and humanitarian operations provided by the United States. The Middle East would experience a “loss of food and water security (which) will increase pressure to emigrate across borders.” Asia would suffer from “threats to water and the spread of infectious disease. ” In 2009 the CIA opened a Center on Climate Change and National Security to coordinate across the intelligence community and to focus policy.

In May 2014, CNA again convened a Military Advisory Board but this time to assess National Security and the Accelerating Risk of Climate Change. The report concludes that climate change is no longer a future threat but occurring right now and the authors appeal to the security community, the entire government and the American people to not only build resilience against projected climate change impacts but to form agreements to stabilize climate change and also to integrate climate change across all strategy and planning. The calm of the 2007 report is replaced by a tone of anxiety concerning the future coupled with calls for public discourse and debate because “time and tide wait for no man.”

The report notes a key distinction between resilience (mitigating the impact of climate change) and agreements (ways to stabilize climate change) and states that:

Actions by the United States and the international community have been insufficient to adapt to the challenges associated with projected climate change. Strengthening resilience to climate impacts already locked into the system is critical, but this will reduce long-term risk only if improvements in resilience are accompanied by actionable agreements on ways to stabilize climate change.

The 9/11 Report framed the terrorist attacks as less of a failure of intelligence than a failure of imagination. Greenpeace’s 2003 account of the Pentagon’s alleged report describes a coming climate Armageddon which to readers was unimaginable and hence the report was not really taken seriously. It described:

A world thrown into turmoil by drought, floods, typhoons. Whole countries rendered uninhabitable. The capital of the Netherlands submerged. The borders of the U.S. and Australia patrolled by armies firing into waves of starving boat people desperate to find a new home. Fishing boats armed with cannon to drive off competitors. Demands for access to water and farmland backed up with nuclear weapons.

The CNA and Greenpeace/Pentagon reports are both mirrored by similar analysis by the World Bank which highlighted not only the physical manifestations of climate change, but also the significant human impacts that threaten to unravel decades of economic development, which will ultimately foster conflict.

Climate change is the quintessential “Tragedy of the Commons,” where the cumulative impact of many individual actions (carbon emission in this case) is not seen as linked to the marginal gains available to each individual action and not seen as cause and effect. It is simultaneously huge, yet amorphous and nearly invisible from day to day. It is occurring very fast in geologic time terms, but in human time it is (was) slow and incremental. Among environmental problems, it is uniquely global. With our planet and culture figuratively and literally honeycombed with a reliance on fossil fuels, we face systemic challenges in changing the reliance across multiple layers of consumption, investment patterns, and political decisions; it will be hard to fix!

### 1NC – Warming Real

#### There’s an unquestionable scientific consensus about warming.

Nuccitelli 16 — Dana Nuccitelli, Climate Writer for the *Guardian*, Environmental Scientist at Tetra Tech—a private environmental consulting firm, holds an M.A. in Physics from the University of California-Davis and a B.A. in Astrophysics from the University of California-Berkeley, 2016 (“It’s settled: 90–100% of climate experts agree on human-caused global warming,” *Climate Consensus – The 97%*—a *Guardian* blog about climate change, April 13th, Available Online at <https://www.theguardian.com/environment/climate-consensus-97-per-cent/2016/apr/13/its-settled-90100-of-climate-experts-agree-on-human-caused-global-warming>, Accessed 07-15-2016)

There is an overwhelming expert scientific consensus on human-caused global warming.

Authors of seven previous climate consensus studies — including Naomi Oreskes, Peter Doran, William Anderegg, Bart Verheggen, Ed Maibach, J. Stuart Carlton, John Cook, myself, and six of our colleagues — have co-authored a new paper that should settle this question once and for all. The two key conclusions from the paper are:

1) Depending on exactly how you measure the expert consensus, it’s somewhere between 90% and 100% that agree humans are responsible for climate change, with most of our studies finding 97% consensus among publishing climate scientists.

2) The greater the climate expertise among those surveyed, the higher the consensus on human-caused global warming.

[Graphic Omitted]

Expert consensus is a powerful thing. People know we don’t have the time or capacity to learn about everything, and so we frequently defer to the conclusions of experts. It’s why we visit doctors when we’re ill. The same is true of climate change: most people defer to the expert consensus of climate scientists. Crucially, as we note in our paper:

Public perception of the scientific consensus has been found to be a gateway belief, affecting other climate beliefs and attitudes including policy support.

That’s why those who oppose taking action to curb climate change have engaged in a misinformation campaign to deny the existence of the expert consensus. They’ve been largely successful, as the public badly underestimate the expert consensus, in what we call the “consensus gap.” Only 12% of Americans realize that the consensus is above 90%.

[Video Omitted]

Consensus misrepresentations

Our latest paper was written in response to a critique published by Richard Tol in Environmental Research Letters, commenting on the 2013 paper published in the same journal by John Cook, myself, and colleagues finding a 97% consensus on human-caused global warming in the peer-reviewed literature.

Tol argues that when considering results from previous consensus studies, the Cook 97% figure is an outlier, which he claims is much higher than most other climate consensus estimates. He makes this argument by looking at sub-samples from previous surveys. For example, Doran’s 2009 study broke down the survey data by profession – the consensus was 47% among economic geologists, 64% among meteorologists, 82% among all Earth scientists, and 97% among publishing climate scientists. The lower the climate expertise in each group, the lower the consensus.

[Graph Omitted]

Like several of these consensus surveys, Doran cast a wide net and included responses from many non-experts, but among the experts, the consensus is consistently between 90% and 100%. However, by including the non-expert samples, it’s possible to find low “consensus” values.

The flaw in this approach is especially clear when we consider the most ridiculous sub-sample included in Tol’s critique: Verheggen’s 2015 study included a grouping of predominantly non-experts who were “unconvinced” by human-caused global warming, among whom the consensus was 7%. The only surprising thing about this number is that more than zero of those “unconvinced” by human-caused global warming agree that humans are the main cause of global warming. In his paper, Tol included this 7% “unconvinced,” non-expert sub-sample as a data point in his argument that the 97% consensus result is unusually high.

By breaking out all of these sub-samples of non-experts, the critique thus misrepresented a number of previous consensus studies in an effort to paint our 97% result as an outlier. The authors of those misrepresented studies were not impressed with this approach, denouncing the misrepresentations of their work in no uncertain terms.

We subsequently collaborated with those authors in this newly-published scholarly response, bringing together an all-star lineup of climate consensus experts. The following quote from the paper sums up our feelings about the critique’s treatment of our research:

Tol’s (2016) conflation of unrepresentative non-expert sub-samples and samples of climate experts is a misrepresentation of the results of previous studies, including those published by a number of coauthors of this paper.

Consensus on consensus

In our paper, we show that including non-experts is the only way to argue for a consensus below 90–100%. The greater the climate expertise among those included in the survey sample, the higher the consensus on human-caused global warming. Similarly, if you want to know if you need open heart surgery, you’ll get much more consistent answers (higher consensus) if you only ask cardiologists than if you also survey podiatrists, neurologists, and dentists.

That’s because, as we all know, expertise matters. It’s easy to manufacture a smaller non-expert “consensus” number and argue that it contradicts the 97% figure. As our new paper shows, when you ask the climate experts, the consensus on human-caused global warming is between 90% and 100%, with several studies finding 97% consensus among publishing climate scientists.

There’s some variation in the percentage, depending on exactly how the survey is done and how the question is worded, but ultimately it’s still true that there’s a 97% consensus in the peer-reviewed scientific literature on human-caused global warming. In fact, even Richard Tol has agreed:

The consensus is of course in the high nineties.

Is the consensus 97% or 99.9%?

In fact, some believe our 97% consensus estimate was too low. These claims are usually based on an analysis done by James Powell, and the difference simply boils down to how “consensus” is defined. Powell evaluated the percentage of papers that don’t explicitly reject human-caused global warming in their abstracts. That includes 99.83% of papers published between 1991 and 2012, and 99.96% of papers published in 2013.

In short, 97% of peer-reviewed climate research that states a position on human-caused warming endorses the consensus, and about 99.9% of the total climate research doesn’t explicitly reject human-caused global warming. Our two analyses simply answer different questions. The percentage of experts and their research that endorse the theory is a better description of “consensus.” However, Powell’s analysis is useful in showing how few peer-reviewed scientific papers explicitly reject human-caused global warming.

In any case, there’s really no question that humans are the driving force causing global warming. The experts are almost universally convinced because the scientific evidence is overwhelming. Denying the consensus by misrepresenting the research won’t change that reality.

With all of the consensus authors teaming up to show the 90–100% expert consensus on human-caused global warming, and most finding 97% consensus among publishing climate scientists, this paper should be the final word on the subject.

### 1NC – China Energy

#### Chinese dependence on foreign oil collapses the global economy

Daniels and Brown 15 [Owen Daniels and Chris Brown, "China’s Energy Security Achilles Heel: Middle Eastern Oil," The Diplomat, 9/8/2015] AZ

China’s reliance on Middle Eastern oil is a very real threat to the stability of the global economic order.

While recent turbulence in the Chinese economy has caused investors and pundits much concern, observers may be missing another critical threat to both Chinese and world markets. Soaring Chinese oil consumption and turmoil in the Middle East have been central, and seemingly irrevocable, features of the global energy landscape in recent years. But China’s outsized and growing reliance on crude oil imports from this increasingly turbulent region leave the world’s largest crude importer highly exposed to the adverse effects of a major supply disruption. The Middle East’s precarious security situation and fragile political balance constitute serious threats to China’s energy security and, by extension, the stability of global markets.

China is thirsty for crude oil. The world’s most populous country consumed over 11 million barrels per day (mbd) and accounted for over one third of global oil demand growth last year. It is reliant on imports for 60 percent of its crude oil needs, and that reliance is growing as China’s demand growth has outpaced the country’s lagging domestic production growth. While the “new normal” rate of economic growth in China is expected to cut into crude oil demand growth, Chinese consumption is still projected to exceed 13 mbd by 2020. This sustained demand growth ensures that China will remain one of the largest and most sought-after crude oil markets on the planet, with suppliers from Caracas to Moscow jockeying to increase their market share in the Middle Kingdom. Despite the best efforts of producers like Russia, China will continue to be disproportionately reliant on imports from the Middle East. In 2014, Middle Eastern crude accounted for over half of total Chinese imports, a share that is unlikely to decrease in a meaningful way given current market trends.

When Saudi Arabia decided in November 2014 to protect market share rather than cut production in the face of falling prices, it effectively set into motion a supply side arms race in which Middle Eastern producers began pumping crude at breakneck rates. This summer, Iraq produced record-high volumes of crude and Gulf Arab OPEC production surged to the highest levels on record, with Saudi production peaking at roughly 10.6 mbd. Even as resilient U.S. shale production and lagging demand growth sent prices tumbling again this summer, Saudi Arabia has been steadfast in its refusal to cut production and cede market share to geopolitical rivals like Russia and Iran. Absent an unlikely Saudi production cut, other Middle Eastern suppliers like Iraq must also continue producing at breakneck rates to protect their market share.

The Chinese market’s strategic importance to competing Middle Eastern producers will incentivize them to maintain or expand current export levels to the People’s Republic. Likewise, China has a commercial interest in importing Middle Eastern oil as many of its refiners prefer Gulf producers’ medium and heavy grade crudes. In short, China will find itself locked in the embrace of Middle Eastern producers for the foreseeable future.

China’s heightened dependence on Middle Eastern crude leaves its import market vulnerable to the region’s various threats, chiefly the Islamic State (IS), factional tensions stemming from weak governance, and potential commercial fallout from ongoing political uncertainty. Unrest caused by ISIS is already impacting China’s key Iraqi and Saudi suppliers. In Iraq, ISIS set fire to wells at the Ajil oil field, held the Baiji refinery north of Tikrit, and attacked pipelines to Turkey. The group currently operates in the country’s north and west, a best-case scenario given that the Shia-dominated south comprises 90 percent of Iraq’s oil production and 85 percent of its exports. However, oil majors including BP and ExxonMobil have evacuated employees from facilities in anticipation of future threats, and a diverted security presence has seen a rise in attacks and kidnappings of southern oil workers.

In neighboring Saudi Arabia, China’s largest supplier of crude oil, ISIS aims to foment sectarian unrest in the Sunni Kingdom’s oil-rich Eastern Province. The Shia-dominated province is critical to Saudi production and has been the target of attacks in the past, including the 2006 attempted al-Qaeda bombing at the Abqaiq processing facility, through which an estimated 70 percent of Saudi crude exports pass. ISIS carried out a deadly mass shooting in the Eastern Province in November, targeted Shia mosques for suicide bombings during Ramadan, and the bombing of a Riyadh security checkpoint spurred a massive crackdown by Saudi authorities. Bombings against oil infrastructure or widespread sectarian unrest could threaten to disrupt Chinese supply.

In addition to physical threats to supply, political disputes could disrupt the delicate balance that makes Iraq an attractive commercial opportunity for international oil companies (IOCs). As ISIS has weakened Baghdad’s governance capacity, anger over violations of a shared oil export agreement between the central government and the Kurdistan Regional Government (KRG) has risen. This tension threatens to unravel the fragile oil-sales agreement, undermine reform efforts by KRG Prime Minister Haidar Abadi, deter future investment by IOCs, and potentially disrupt future Iraqi supply.

Compounding the energy security vulnerability caused by political and security instability is a crucial but largely overlooked side effect of the ongoing battle for market share: decreasing global spare capacity, the amount of production that can quickly come online in the event of a major market disruption to minimize price volatility.

Crude oil markets are most stable when spare capacity is at least 5 percent of total oil market demand, which amounts to roughly 4.7 mbd in today’s market. Traditionally, Saudi Arabia maintained sufficient spare capacity to stabilize the market in the wake of supply disruptions. As Riyadh has increased production to protect market share, however, its spare capacity has fallen significantly. Keen observers placed Saudi spare capacity it roughly 1 mbd in May before it ramped up production by roughly 300,000 barrels per day this summer. While it is difficult to pinpoint current Saudi spare capacity, it is clearly well below 5 percent of today’s market demand, and is expected to remain so at projected production levels. As a result, the safety net to ease the pain of a potential major supply disruption has vanished.

Low spare capacity has troubling implications for an import-dependent and energy-intensive country like China, whose economy has shown signs of fragility in recent months. China currently benefits from low oil prices and a market awash in excess crude; weathering a supply disruption is more manageable at $50 a barrel than $100. But given the infamous volatility of oil markets, China cannot depend on sustained low prices for its energy security.

### 1NC – Air Pollution

#### Nuclear power saves millions from pollution – even after accounting for every step of the supply chain

Schrope 13 [Mark Schrope (freelance writer and editor based in Florida), "Nuclear Power Prevents More Deaths Than It Causes," Chemical & Engineering News, 4/2/2013] AZ

Using nuclear power in place of fossil-fuel energy sources, such as coal, has prevented some 1.8 million air pollution-related deaths globally and could [save millions of more lives in coming decades](http://cgi.cen.acs.org/cgi-bin/cen/trustedproxy.cgi?redirect=http://pubs.acs.org/doi/abs/10.1021/es3051197?source=cen), concludes a study. The researchers also find that nuclear energy prevents emissions of huge quantities of greenhouse gases. These estimates help make the case that policymakers should continue to rely on and expand nuclear power in place of fossil fuels to mitigate climate change, the authors say (Environ. Sci. Technol., DOI:[10.1021/es3051197](http://cgi.cen.acs.org/cgi-bin/cen/trustedproxy.cgi?redirect=http://pubs.acs.org/doi/abs/10.1021/es3051197?source=cen)). In the wake of the 2011 Fukushima nuclear disaster in Japan, critics of nuclear power have questioned how heavily the world should rely on the energy source, due to possible risks it poses to the environment and human health. “I was very disturbed by all the negative and in many cases unfounded hysteria regarding nuclear power after the Fukushima accident,” says report coauthor [Pushker A. Kharecha](http://www.giss.nasa.gov/staff/pkharecha.html), a climate scientist at [NASA’s Goddard Institute for Space Studies](http://www.giss.nasa.gov/), in New York. Working with Goddard’s James E. Hansen, Kharecha set out to explore the benefits of nuclear power. The pair specifically wanted to look at nuclear power’s advantages over fossil fuels in terms of reducing air pollution and greenhouse gas emissions. Kharecha was surprised to find no broad studies on preventable deaths that could be attributed to nuclear power’s pollution savings. But he did find data from a 2007 study on the average number of deaths per unit of energy generated with fossil fuels and nuclear power (Lancet, DOI:[10.1016/S0140-6736(07)61253-7](http://dx.doi.org/10.1016/S0140-6736%2807%2961253-7)). These estimates include deaths related to all aspects of each energy source from mining the necessary natural resources to power generation. For example, the data took into account chronic bronchitis among coal miners and air pollution-related conditions among the public, including lung cancer. The NASA researchers combined this information with historical energy generation data to estimate how many deaths would have been caused if fossil-fuel burning was used instead of nuclear power generation from 1971 to 2009. They similarly estimated that the use of nuclear power over that time caused 5,000 or so deaths, such as cancer deaths from radiation fallout and worker accidents. Comparing those two estimates, Kharecha and Hansen came up with the 1.8 million figure. They next estimated the total number of deaths that could be prevented through nuclear power over the next four decades using available estimates of future nuclear use. Replacing all forecasted nuclear power use until 2050 with natural gas would cause an additional 420,000 deaths, whereas swapping it with coal, which produces significantly more pollution than gas, would mean about 7 million additional deaths. The study focused strictly on deaths, not long-term health issues that might shorten lives, and the authors did not attempt to estimate potential deaths tied to climate change. Finally the pair compared carbon emissions from nuclear power to fossil fuel sources. They calculated that if coal or natural gas power had replaced nuclear energy from 1971 to 2009, the equivalent of an additional 64 gigatons of carbon would have reached the atmosphere. Looking forward, switching out nuclear for coal or natural gas power would lead to the release of 80 to 240 gigatons of additional carbon by 2050. By comparison, previous climate studies suggest that the total allowable emissions between now and 2050 are about 500 gigatons of carbon. This level of emissions would keep atmospheric CO2 concentrations around 350 ppm, which would avoid detrimental warming. Because large-scale implementation of renewable energy options, such as wind or solar, faces significant challenges, the researchers say their results strongly support the case for nuclear as a critical energy source to help stabilize or reduce greenhouse gas concentrations. [Bas van Ruijven](http://www.cgd.ucar.edu/staff/vruijven/), an environmental economist at the [National Center for Atmospheric Research](http://ncar.ucar.edu/), in Boulder, Colo., says the estimates on prevented deaths seem reasonable. But he wonders if the conclusion that nuclear power saves hundreds of times more lives than it claims will convince ardent critics. The nuclear power issue is “so polarized that people who oppose nuclear power will immediately dispute the numbers,” Van Ruijven says. Nonetheless, he agrees with the pair’s conclusions on the importance of nuclear power.

#### The impact is linear – every year increased air pollution raises previous mortality rates three to six percent

Thurston et al 15 - George D. Thurston, 1 Jiyoung Ahn, 2 Kevin R. Cromar, 1 Yongzhao Shao, 2 Harmony R. Reynolds, 3 Michael Jerrett, 4 Chris C. Lim, 1 Ryan Shanley, 2 Yikyung Park, 5 and Richard B. Hayes2 1 New York University School of Medicine, Department of Environmental Medicine, Tuxedo, New York, USA; 2 New York University School of Medicine, Department of Population Health, New York, USA; 3 New York University School of Medicine, Cardiovascular Clinical Research Center, Department of Medicine, New York, USA; 4 School of Public Health, University of California, Berkeley, Berkeley, California, USA; 5 Washington University School of Medicine, Division of Public Health Sciences, Department of Surgery, St. Louis, Missouri, USA, and National Cancer Institute, Bethesda, Maryland, USA(“Ambient Particulate Matter Air Pollution Exposure and Mortality in the NIH-AARP Diet and Health Cohort” September 9 2015, DOI: 10.1289/ehp.1509676 ) RMT

In this large prospective cohort study with detailed baseline individual-level risk factor information on study participants (e.g., smoking, body mass index, alcohol use, etc.), we confirmed a monotonically increasing, and statistically significant, relationship between longterm exposure to PM2.5 air pollution and both all-cause and CVD mortality, even at the decreased PM2.5 levels experienced in the US since 2000. Comparisons by sex, age, and education for this cohort did not indicate statistically significant differences in the mortality – PM2.5 association across categories.

By finding significant overall associations with all-cause and cardiovascular mortality, the results presented here are consistent with many, but not all, of the prior published results examining PM2.5 and mortality. We estimated a 3% increase (95% confidence interval 0–5%) in all-cause mortality for a 10 [microgram per cubic meter] ~~µg/m3~~ annual increase in PM2.5 that, while statistically significant in this large cohort, is lower than many other past estimates. For example, a recent literature review reported a pooled effect estimate of 6% per 10 ug/m3 PM2.5 (95% confidence interval 4– 8%) for all-cause mortality (Hoek et al. 2013). Our overall estimate for CVD mortality (10 percent effect per 10 µg/m3 , 95% confidence interval 5 to15%), agrees more closely with the pooled estimate for CVD mortality reported by Hoek et al. (2013) (11% per 10 µg/m3 ; 95% CI: 6, 16%).

### Ext – Air Pollution

#### Nuclear power stops dangerous quantities of emissions

Biello 13 – David, writes for the scientific American, Internally Cites James Hansen, Professor at Columbia University (“How Nuclear Power Can Stop Global Warming” <http://www.scientificamerican.com/article/how-nuclear-power-can-stop-global-warming/>) RMT

In addition to reducing the risk of nuclear war, U.S. reactors have also been staving off another global challenge: climate change. The low-carbon electricity produced by such reactors provides 20 percent of the nation's power and, by the estimates of climate scientist James Hansen of Columbia University, avoided 64 billion metric tons of greenhouse gas pollution. They also avoided spewing soot and other air pollution like coal-fired power plants do and thus have saved some 1.8 million lives.

And that's why Hansen, among others, such as former Secretary of Energy Steven Chu, thinks that nuclear power is a key energy technology to fend off catastrophic climate change. "We can't burn all these fossil fuels," Hansen told a group of reporters on December 3, noting that as long as fossil fuels are the cheapest energy source they will continue to be burned. "Coal is almost half the [global] emissions. If you replace these power plants with modern, safe nuclear reactors you could do a lot of [pollution reduction] quickly."

Indeed, he has evidence: the speediest drop in greenhouse gas pollution on record occurred in France in the 1970s and ‘80s, when that country transitioned from burning fossil fuels to nuclear fission for electricity, lowering its greenhouse emissions by roughly 2 percent per year. The world needs to drop its global warming pollution by 6 percent annually to avoid "dangerous" climate change in the estimation of Hansen and his co-authors in a recent paper in PLoS One. "On a global scale, it's hard to see how we could conceivably accomplish this without nuclear," added economist and co-author Jeffrey Sachs, director of the Earth Institute at Columbia University, where Hansen works.

## Links

### Link – Decommissioning

#### Decommissioning releases massive amounts of emissions

Wallbridge 13 [Steve Wallbridge (Steve Wallbridge carried out doctoral and post-doctoral research in coastal engineering using laboratory, field and computational techniques (Southampton & Cambridge Universities, 1993–2001). During 7 years working in environmental consultancy he also obtained a post-graduate qualification in Science Communication and worked part-time as a freelance science writer. He joined the Nuclear Engineering Decommissioning simulation team in December 2009 to work on integrating sustainability into simulations. ), Anthony Banford, Adisa Azapagic, "Life cycle environmental impacts of decommissioning Magnox nuclear power plants in the UK," The International Journal of Life Cycle Assessment, 2013] AZ

Purpose Full life cycle assessment (LCA) impacts from decommissioning have rarely been assessed, largely because few sites have been decommissioned so that the impacts of decommissioning are currently uncertain. This paper presents the results of an LCA study of the ongoing decommissioning of the Magnox power plant at Trawsfynydd in the UK. These results have been used to estimate the potential environmental impacts for the whole UK Magnox fleet of 11 reactors that will have to be decommissioned during this century. Methods The functional unit is defined as ‘decommissioning one Magnox power plant’. The system boundary considers all stages in the life cycle of decommissioning, including site management, waste retrieval, plant deconstruction, packaging and storage of intermediate- and low-level wastes (ILW and LLW). High-level waste, i.e. waste fuel is excluded as it was being removed from the site to be reprocessed at Sellafield. The environmental impacts have been estimated using the CML 2001 methodology. Primary data have been sourced from the Trawsfynydd site and the background from Ecoinvent. Results and discussion Most impacts from decommissioning are due to the plant deconstruction (25–75 %) and ILW storage and disposal (25–70 %). For the example of global warming potential (GWP), estimated at 241 kt CO2 eq./functional unit, or 3.5 g CO2 eq./kWh of electricity generated during the lifetime of the plant, 55 % of the impact is from plant deconstruction and 30 % from ILW disposal. The results for the whole UK Magnox fleet indicate that the impacts vary greatly for different sites. For example, the GWP ranges from 0.89 to 7.14 g CO2 eq./kWh. If the impacts from storage of waste fuel at Sellafield are included in the estimates, the GWP increases on average by four times. Overall, decommissioning of the UK Magnox reactors would generate 2 Mt of CO2 eq. without and 11 Mt of CO2 eq. with the waste from Sellafield. This represents 0.4 and 2 % of the total UK annual emissions, respectively.

### Link – Belgium

#### Nuclear power key to stop emissions in Belgium

Toobin 16 [Adam Toobin, "Why Target Belgium? For Terrorists, the Answer Is Complicated and Nuclear" Inverse Magazine, 3/22/2016] AZ

Belgium remains heavily reliant on nuclear power to reach its clean energy goals under the Kyoto and Paris protocols, and support for the programs remains high. Some areas in Belgium even obtain as much as 50 percent of their energy from nuclear power. Despite the current old age of Belgian nuclear power reactors, the country has no plans for new plants once the current facilities expire.

#### Nuclear power is key to Belgian energy – makes half of its electricity and prevents carbon emissions

IEA 16 [International Energy Association, "Energy Policies of IEA Countries: 2016 Review Belgium," 2016] AZ

Nuclear power plays a key role in Belgium’s energy supply, constituting about half the electricity generation and 16.6% of total primary energy supply (TPES) in 2014. In 2015, nuclear power generation fell further, to 26 terawatt-hours (TWh), according to FPS (Federal Public Service) Economy. In recent years, electricity generated from nuclear power, and consequently the share of nuclear energy in the generation mix, has significantly decreased because of long-term outages of several nuclear units. Despite that, the share of nuclear power in Belgium remains one of the highest in the Organisation for Economic Co-operation and Development (OECD) countries. Seven units, all pressurised water reactors (PWRs), are currently operating in Belgium for a total net installed capacity of 5 913 megawatts (MW) at the end of 2015. The reactors are located at the sites of Doel, on the Scheldt estuary close to Antwerp, and of Tihange, on the river Meuse between Liège and Namur. Since the last (International Energy Agency (IEA) in-depth review in 2009, total net capacity has increased by about 100 MWe as a result of capacity upgrades at Doel 1, Doel 4 and Tihange 3. All nuclear power plants (NPPs) in Belgium are operated by Electrabel, a 100% subsidiary of Engie since 2003. Electrabel is the sole owner of Doel 1 and 2 units, and owns 50% of Tihange 1 and 89.8% of the other four units. The remaining 50% of Tihange 1 is owned by EDF which controls also the remaining 10.2% share of the other four units (see Table 10.1). Belgium has a long tradition in nuclear research and in civil nuclear power, dating from the early 1960s, and for many years the Belgian industry covered almost all activities in the nuclear fuel cycle. In 1962, the BR3 (Belgian Reactor 3) was the first pilot PWR connected to the grid in Western Europe. Belgium co-operated with France in the construction of the first full-scale PWR in Europe (Chooz A). The development of nuclear power in Belgium started at the end of the 1960s with the decision to build three nuclear units at the two sites of Doel and Tihange. Following the first oil crisis, another four units were ordered and connected to the grid by the end of 1985. The whole Belgian nuclear capacity has been commissioned in a relatively short period of about ten years, from February 1975 to October 1985; the lifetime of the nuclear fleet is therefore quite homogeneous, with an average of 35 years of operation. Over the course of operation, the Belgian nuclear fleet has generated about 1 420 TWh of baseload electricity and contributed significantly to the security of energy supply (see Figure 10.1). Nuclear power has also helped avoid emissions of large quantities of carbon dioxide2 , and had an important role in Belgium’s efforts to reduce air pollution (sulphur dioxide SO2 and oxides of nitrogen NOx).

### Link – India

#### Nuclear energy key to prevent carbon emissions

Victor 6 [David Victor (professor at the School of Global Policy and Strategy, UC San Diego and director of the School’s new Laboratory on International Law and Regulation), "Nuclear power for India is good for us all," NY Times, 3/16/2006] AZ

STANFORD, California — If the deal to supply India with nuclear technologies goes through, future generations may remember it for quite different reasons than the debate over nuclear proliferation. Nuclear power emits no carbon dioxide, the leading cause of global warming. And India, like most developing countries, has not been anxious to spend money to control its emissions of this and other so- called greenhouse gases. India is embracing nuclear power for other reasons - because it can help the country solve its chronic failure to supply the electricity needed for a burgeoning economy. But in effect, the deal would marry their interest in power with ours in protecting the planet. India is growing rapidly. In recent years its economy has swelled at more than 7 percent per year, and many analysts believe it is poised to grow even faster in the coming decade. The economic growth is feeding a voracious appetite for electricity that India's bankrupt utilities are unable to satisfy. Blackouts are commonplace. Farmers, who account for about two-fifths of all the power consumed, can barely rely on getting power for half of every day. In industrial zones, the lifeblood of India's vibrant economy, unstable power supplies are such trouble that the biggest companies usually build their own power plants. So most analysts expect that the demand for electricity will rise at about 10 percent a year. (For comparison, U.S. power demand notches up at just 2 percent annually.) Over the past decade, about one third of India's new power supplies came from natural gas and hydro electricity. Both those sources have been good news for global warming - natural gas is the least carbon- intensive of all the fossil fuels, and most of India's hydroelectric dams probably emit almost no greenhouse gases. However, the bloom is coming off those greenhouse-friendly roses. New supplies of natural gas cost about twice what Indians are used to paying, and environmental objections are likely to scupper the government's grand plans for new hydro dams. That leaves coal - the most carbon-intensive of all fossil fuels. Already more than half of India's new power supplies come from coal, and that could grow rapidly. Traditionally, the coal sector was plagued by inefficiencies. State coal mines were notoriously dangerous and inefficient.Coal-fired plants in western provinces, far from the coal fields and vulnerable to the dysfunctional rail network, often came within days of shutting operations due to lack of coal. All that is changing. Private and highly efficient coal mines are grabbing growing shares of the coal market. Upgrades to the nation's high-tension power grid is making it feasible to generate electricity with new plants installed right at the coal mines. These improvements make coal the fuel to beat. So the deal struck with President George W. Bushmatters. At the moment, India has just 3 gigawatts of nuclear plants connected to the grid. Government planners envision that nuclear supply will grow to 30 GW over the next generation, but that will remain a fantasy without access to advanced nuclear technologies and, especially, nuclear fuels - such as those offered under the deal with the Bush administration. By 2020, even after discounting for the government's normal exuberance in its forecasts, a fresh start for nuclear power could increase nuclear generating capacity nearly ten-fold. By displacing coal, that would avoid about 130 million tons of carbon dioxide per year (for comparison, the full range of emission cuts planned by the European Union under the Kyoto Protocol will total just 200 million tons per year). The effort, if successful, would eclipse the scheme under the Kyoto Protocol, known as the Clean Development Mechanism, that was designed to reward developing countries that implement projects to reduce their emissions of greenhouse gases. The largest 100 of these CDM projects, in total, won't reduce emissions as much as a successful effort to help India embrace safe nuclear power.

### Link – Japan

#### Japan needs nuclear power

WNA 16 [World Nuclear Association, "Nuclear Power in Japan," August 2016] AZ

Japan needs to import about 84% of its energy requirements. Its first commercial nuclear power reactor began operating in mid-1966, and nuclear energy has been a national strategic priority since 1973. This came under review following the 2011 Fukushima accident but has been confirmed. The country's 50+ main reactors have provided some 30% of the country's electricity and this was expected to increase to at least 40% by 2017. The prospect now is for two thirds of this, from a depleted fleet. Currently 42 reactors are operable and potentially able to restart, and 24 of these are in the process of restart approvals. The first two restarted in August and October 2015. Despite being the only country to have suffered the devastating effects of nuclear weapons in wartime, with over 100,000 deaths, Japan embraced the peaceful use of nuclear technology to provide a substantial portion of its electricity. However, following the tsunami which killed 19,000 people and which triggered the Fukushima nuclear accident (which killed no-one), public sentiment shifted markedly so that there were wide public protests calling for nuclear power to be abandoned. The balance between this populist sentiment and the continuation of reliable and affordable electricity supplies is being worked out politically.

#### The plan reverses all of Japan’s past emissions reductions.

Foster 12 “As Japan shuts down nuclear power, emissions rise”, May 4, 2012 By MALCOLM FOSTER http://phys.org/news/2012-05-japan-nuclear-power-emissions.html

(AP) -- **The Fukushima crisis is eroding years of Japanese efforts to reduce greenhouse gas emissions blamed for global warming, as power plants running on oil and natural gas fill the electricity gap left by now-shuttered nuclear reactors.** Before last year's devastating tsunami triggered meltdowns at the Fukushima Dai-ichi plant, Japan had planned to meet its [carbon emissions](http://phys.org/tags/carbon%2Bemissions/) reduction targets on the assumption that it would rely on [nuclear power](http://phys.org/tags/nuclear%2Bpower/), long considered a steady, low-emissions source of energy. But now it's unclear to what extent nuclear energy will even be part of the electricity mix. Japan will be free of [atomic power](http://phys.org/tags/atomic%2Bpower/) for the first time since 1966 on Saturday, when the last of its 50 usable reactors is switched off for regular inspections. The central government would like to restart them at some point, but it is running into strong opposition from local citizens and governments.**With the loss of**[**nuclear energy**](http://phys.org/tags/nuclear%2Benergy/)**, the Ministry of Environment projects that Japan will produce about 15 percent more greenhouse gas emissions this fiscal year than it did in 1990, the baseline year for measuring progress in reducing emissions. In fiscal 2010, Japan's actual emissions were close to 1990 levels.** It also raises doubts about whether it will be able to meet a pledge made in Copenhagen in 2009 to slash emissions by 25 percent from 1990 levels by 2020.For years, nuclear power was a pillar in Japan's energy and climate policies. Until the Fukushima disaster last year, it accounted for about a third of Japan's power generation, and Tokyo had planned to expand that to half by 2030. **Now Prime Minister Yoshihiko Noda has pledged to reduce reliance on nuclear power, although his government is eager to restart some reactors to meet a looming power crunch during the hot summer months.** "The big open question is whether and when the [nuclear plants](http://phys.org/tags/nuclear%2Bplants/) will come back on line, and what that implies for Japan's long-term emissions trajectory," said Elliot Diringer, executive vice president at the Center for Climate and Energy Solutions, formerly the Pew Center on Global Climate Change, in Arlington, Virginia."If nuclear will no longer be a part of the energy mix, Japan is going to have a much tougher time reducing emissions," he said.Japan is a world leader improving energy efficiency, one important method of reining in emissions. But it has done less to expand renewable energy than several other nations, including Germany, which is phasing out nuclear power.Renewable energy accounts for about 9 percent of Japan's power generation - similar to the U.S. Most of that energy is hydroelectric power from dams; and some experts say solar and wind power are too intermittent to be a reliable source of base-load energy.As an incentive, the government will require utilities to buy power from renewable energy producers for a fixed price called "feed-in tariffs" starting in July. But the higher cost to produce renewable energy will mean higher prices for consumers.The 28-nation International Energy Agency maintains that nuclear power remains an important tool to battle global warming. "If you want to have something at a reasonable cost in terms of low carbon-emissions, then nuclear has to play a role," said Ulrich Benterbusch, director of the Paris-based group's Directorate for Global Energy Dialogue. "If you have more renewables in the mix, it's going to be more expensive." The government plans to announce a new energy strategy this summer with targets for renewables, nuclear and conventional power generation. In the meantime, Japan is spending billions importing extra oil and gas to meet demand - which is spewing more greenhouse gases into the atmosphere.**Without nuclear power, Japan is projected to produce an additional 180 million-210 million tons of emissions this fiscal year compared to the base year of 1990, when emissions totaled 1.261 billion tons. That wipes out a significant chunk of reductions Japan achieved during 2008-2010 through energy efficiency, credits for helping developing countries devise cleaner technologies and planting trees to absorb carbon dioxide.** Officials believe Japan can still barely meet its commitment under the Kyoto Protocol to reduce emissions during the five-year period through 2012 by an average of 6 percent from 1990 levels.

#### Japan is key to warming

Oike 15 [Atsuyuki Oike (director general for global issues at the Foreign Ministry of Japan), "Japan’s action plan to fight climate change," The Japan Times, 7/30/2015] AZ

Japan has now laid out its own national target for greenhouse gas emission reductions post-2020. The target, known as “Intended nationally determined contribution” (INDC) was submitted on July 17 and formalized Japan’s commitment to reduce greenhouse gas emissions by 26 percent from the 2013 level (25.4 percent from the 2005 level) by 2030. Japan’s ambitious INDC signals its determination to lead the way for the reduction of emissions globally. Japan’s INDC was crafted by summing up specific measures and advanced technologies that can be utilized. This makes it more transparent and concrete. Japan’s energy consumption per unit of GDP is currently about 30 percent lower than the average of other G-7 nations, making it one of the top performers globally. We will aim for a further 35 percent improvement in energy efficiency by 2030, by which time greenhouse gas emissions per GDP are projected to improve by around 40 percent. Japan also intends to accelerate introduction of renewable energy, with a sevenfold increase in solar power and a fourfold increase in wind and geothermal. At the 2010 Cancun Climate Conference in Mexico it was agreed that, by 2020, developed countries would jointly mobilize $100 billion per year from public and private sources to assist developing countries in tackling climate change. Japan has been providing significant support in this regard, with approximately $20 billion worth of climate finance provided for developing countries in 2013-2014. Japan also confirmed its contribution of $1.5 billion to the Green Climate Fund (GCF) in May, despite the severe fiscal constraints we face. This contribution has enabled the fund to start its preparations to support developing countries. It is essential to implement support through the GCF as soon as possible particularly to those countries most vulnerable to the effects of climate change, such as the least developed countries, small island developing states, and countries in Africa. Innovation plays a key role in tackling climate change, particularly in the development of low-carbon technology. Japan will host the 2nd Innovation for Cool Earth Forum (ICEF) in October. ICEF was launched by Abe in 2014 to provide a global platform for promoting discussion and cooperation among world leaders, industry representatives, academia and policymakers. This multi-faceted approach is necessary to help understand how innovations in energy and environmental technologies can offer climate change solutions. Japan will further promote the Joint Crediting Mechanism (JCM), which facilitates the use of advanced low-carbon technologies in developing countries. To date, 14 countries have participated in this mechanism and six projects have been registered as JCM projects in Indonesia, Palau and Mongolia (including five energy-saving projects and one renewable project). Japan will continue its contribution to the reduction of global emissions through the steady implementation of this mechanism. Japan has been able to contribute to global emission reductions in part through the diffusion of cutting-edge technology. For example, techniques that have been developed and applied in Japan’s iron and steel mills have contributed to a reduction of 50 million tons of carbon dioxide per year on a worldwide scale. It is essential to further promote such initiatives across the private sector, and to explore how official development assistance and public finances can bolster such initiatives. An international framework to be adopted at the Paris Climate Change Conference is crucial in tackling climate change effectively. Although we expect tough and difficult negotiations on the road to Paris, Japan will continue to cooperate with other countries in working toward this framework.

### Link – Taiwan

#### Nuclear power is key to Taiwan – no other type of power is feasible

Stromberg 15 [Stephen Stromberg (member of The Post’s editorial board), "The world can’t shun nuclear power," Washington Post, 5/1/2015] AZ

Tackling climate change using all the technologies we have will be hard enough. Trying to do it while swearing off nuclear power would be plainly ridiculous. That’s the lesson from Taiwan, a densely packed island state with few natural resources and a rising aversion to reactors.

Taiwan “cannot really be picky about energy,” President Ma Ying-jeou told me in an interview this week. But the Taiwanese behave as though they can. Taiwan faces many constraints, some natural, some self-imposed, explained Chien You-hsin, a former environmental minister: Most people understand that greenhouse-gas emissions warm the planet, but they fear nuclear power, refuse to live near onshore wind turbines, insist that offshore wind platforms not disturb aquatic habitats and lack wide-open spaces for solar generation. Meanwhile, the biggest share of the island’s electricity comes from burning dirty coal. In one key way, the Taiwanese attitude resembles that of people in Japan and Germany: Their advanced economies depend on abundant energy, but they recoil from the choices that reality entails, with counterproductive results.

Taiwan imports about 98 percent of its energy supplies, mostly the fossil fuels that keep its fluorescent streetscapes flashing and its many factories humming. It burns lots of coal and large amounts of natural gas, which is cleaner than coal but still produces carbon-dioxide emissions. Relying on fossil fuels also makes the island vulnerable: Its shipped-in supplies could run dangerously low in a major storm, Ma said.

The small island — it is slightly smaller than Maryland and Delaware combined — can’t produce more than a meager amount of hydropower. Solar power not only requires lots of area but also is not as much help during the rainy season. Taiwan has between 300 and 400 onshore wind turbines, but siting restrictions will make it difficult to add many more, according to Wang Ren-chain of the Industrial Technology Research Institute, a state-supported research group. His outfit is looking at installing offshore turbines, but that technology presents ecological concerns and is expensive. New technology might ease the constraints, eventually. But, for now, even if the government meets its deployment goals by 2030, renewable energy would generate only about 12 percent of the island’s electricity, the institute reckons.

That leaves nuclear power. Three nuclear plants currently provide 18 percent of Taiwan’s electricity. They don’t require large-scale fuel imports and produce virtually no carbon emissions. Unsurprisingly, the government concluded that the island needs more of them, and Taiwan began work on a fourth station that would house two reactors and supply some 9 percent of the island’s electricity. Work was nearly finished on the first reactor when the government halted the project last year in response to huge street protests. Now, with a large investment made, the reactor sits unused, waiting for the island to have the sense to insert the fuel rods.

Ma insisted that the government hasn’t scrapped the project. It can be activated in short order if future conditions demand. It’s hard to see how they wouldn’t. Yet in the same breath he declared that the government’s ultimate goal is a full transition off nuclear power. What Ma says also might not matter much; the anti-nuclear opposition party is poised to do well in presidential elections next year, and whoever’s in charge will be constrained by the public mood.

#### The plan increases emissions – they shift to coal not renewables

Chen 12 [Y.H. Henry Chen (Taiwan Business Topics magazine’s associate editor and reporter. Prior to joining Taiwan Business Topics magazine in 2014, Tim was a frequent contributor, focusing primarily on issues related to energy, economy and technology), "Non-Nuclear, Low-Carbon, or Both? The Case of Taiwan," MIT Joint Program on the Science and Policy of Global Change, December 2012] AZ

Under the non-nuclear policy scenario, fossil-based generation will replace part of the lost electricity output, and this will lead to an increase in Taiwan’s total CO2 emissions, as shown in Figure 7a. While electricity sectors, especially coal-fired power, will contribute to most of the additional emissions, a slight increase in emissions from other industrial sectors reflects that electricity input is substituted by other fossil-based energy input. Figure 7b shows that Taiwan’s total CO2 emissions may increase by more than 3.5% relative to BAU levels from 2035 onwards. The emissions increase is not trivial, which suggests that when pursuing the non-nuclear policy, it is also important to consider effective measures that could curb CO2 emissions.

### Link Ext – Taiwan

#### Taiwan shift to full-scale thermal plants are worse

Hwang 94 [Dangerous Choice or Best Option? Jim Hwang. October 1, 1994] MSG

But there is also a strong body of support for the new nuclear power plant. Those in the power generation industry believe that an additional nuclear power plant is not only necessary, but is more friendly to the environment than thermal plants. In June, as the budget vote neared, the presidents of several major industrial groups visited the Legislature to voice their support for the new plant. Later that month, about two thousand Taipower employees also held a pro-nuclear demonstration in Taipei.¶ Dangerous¶ T.R. Ho, superintendent of the Second Nuclear Power Station, says those who work in nuclear power plants experience harmless amounts of radiation—"I myself would quit immediately if it wasn't safe."¶ "We are not saying that nuclear is the only power source," says Richard Hsu (徐錦棠), a chief engineer at Taipower. "But it is an option that Taiwan can't afford not to exploit." Hsu points out that hydropower is unreliable due to Taiwan's seasonal droughts, and that all of the resources used to create thermal power—coal, oil, and natural gas—must be imported. More than half of Taiwan's electrical power now comes from oil and coal. If shipments of these were cut off because of, say, war in the Middle East, local power would be seriously affected. Thus, Hsu believes it is necessary for Taipower to develop alternative power sources, including nuclear power.¶ Besides providing a stable power supply, nuclear energy is also Taiwan's least expensive power resource. From 1982 to 1993, the average cost of producing one kWh was 3.6 cents from nuclear power, 3.9 cents from coal, and 4.7 cents from oil. (These costs include the expense of building a nuclear plant and of storing radiation waste.) The two reactors in the Second Nuclear Power Station require 60 tons of nuclear fuel every year. To generate the same amount of electricity, a thermal plant needs 4.2 million tons of coal, 2.8 million tons of oil, or 2 million tons of natural gas. Put another way, while a nuclear power plant refuels once a year, a thermal plant requires a constant supply equal to a 20-ton coal tender arriving every two minutes.

#### Energy demand increasing in Taiwan – forces a shift to coal and rapidly increases emissions

Ferry 15 [Tim Ferry, "Taiwan’s Energy Dilemma: Emission Reductions vs. Dwindling Supply," Taiwan Business Topics, 9/15/2015] AZ

More importantly, though, Taiwan’s energy demand has continued to rise alongside economic growth, but almost no new power-generating capacity has been added in recent years, bringing Taiwan’s effective reserve margin to dangerously low levels. Demand for primary energy has increased over the past decade by an average of 1.9% annually, while power demand increased 1.8% year-on-year in 2013 after a slight dip in 2012, and the release of 2014 statistics will likely show a further increase. With Taiwan’s aging fleet of nuclear reactors nearing retirement starting in 2017, and with little push for license extensions that would enable them to continue generating power for another 20 years, Taiwan stands to lose some 18% of its power generation. Only part of that shortfall can be made up by coal-fired units currently under construction or planning, and these projects are also likely to meet opposition from environmentalists.

These developments will make it harder for Taiwan to meet its commitments under its greenhouse gas (GHG) emissions-reduction strategy.

The desire to honor its role as a developed economy in the fight against global warming – while still maintaining a sufficient and affordable energy supply – is the core of Taiwan’s energy challenge. The issues involved are always highly political, and can be expected to become even more so as Taiwan nears the presidential and legislative elections next January. Both the ruling Kuomintang (KMT) and opposition Democratic Progressive Party (DPP) agree that Taiwan needs to reduce its energy demand and carbon footprint, and the stated goals of both parties with regard to promoting renewable energy are also quite similar.

#### Increases CO2 emissions

Chen 12 [Y.H. Henry Chen (Taiwan Business Topics magazine’s associate editor and reporter. Prior to joining Taiwan Business Topics magazine in 2014, Tim was a frequent contributor, focusing primarily on issues related to energy, economy and technology), "Non-Nuclear, Low-Carbon, or Both? The Case of Taiwan," MIT Joint Program on the Science and Policy of Global Change, December 2012] AZ

In this study, I provide an economy-wide analysis for Taiwan under the low-carbon growth path with or without the nuclear option, and improve the modeling for the dependency of nondispatchable generation (wind power in particular) on other dispatchable generation. Pursuing a low-carbon world without the nuclear option requires a huge change in industrial structure and a significant decrease in GDP growth, as carbon-intensive activities will be discouraged. Under this scenario, the electricity supply will also decrease significantly relative to the BAU level—an outcome reflecting that, in Taiwan, expansions of renewable generation such as hydro and wind are limited by resources and technological constraints. If the nuclear option is on the table, the negative impact on the economy is reduced, but this would require the assurance that nuclear power could avoid disasters such as the one at Fukushima, and that disposal of nuclear wastes is no longer an issue. Lastly, the analysis models Taiwan as a small open economy. One result of this is that we see large effects on trade. While this study does not explicitly model the rest of the world, the likely implication is carbon leakage. If the rest of the world were also to pursue lowcarbon policies, there would be fewer channels for Taiwan to reduce its CO2 mitigation costs through trade. While for Taiwan, carrying out the low-carbon target without the nuclear option could be expensive, the costs may be lowered through opportunities such as purchasing cheaper emissions allowances from abroad whenever possible, which could be an extension for future research. Another extension is to come up with a better representation for the production structure of industrial sectors since the one used in this research may not fully represent the technical opportunity for substituting away from fossil fuels that incur higher carbon penalties. Finally, future research could also consider the potential roles of technical innovations. For instance, recent research funded by the National Science Council argues that in Taiwan, geothermal power may have the capacity of up to 25.4 GWe—almost ten times that of Longmen Nuclear Power Station (Radio Taiwan International, 2011). Technology innovations, once viable, may significantly lower the cost of pursuing the non-nuclear and low-carbon policies.

## NP Key

### U – NP Solving Now

#### Nuclear power is resolving emissions now- models show it prevents almost half of the CO2 necessary to stop runaway warming.

Kharecha and Hansen 13, Pushker A. Kharecha\* and James E. Hansen NASA Goddard Institute for Space Studies and Columbia University Earth Institute, “Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power,” American Chemical Society, Environmental Science and Technology, 2013

We calculate that world nuclear power generation prevented an average of 64 gigatonnes of CO2- equivalent (GtCO2-eq), or 17 GtC-eq, cumulative emissions from 1971 to 2009 (Figure 3a; see full range therein), with an average of 2.6 GtCO2-eq/year prevented annual emissions from 2000 to 2009 (range 2.4−2.8 GtCO2/year). Regional results are also shown in Figure 3a. Our global results are 7−14% lower than previous estimates8,9 that, among other differences, assumed all historical nuclear power would have been replaced only by coal, and 34% higher than in another study10 in which the methodology is not explained clearly enough to infer the basis for the differences. Given that cumulative and annual global fossil fuel CO2 emissions during the above periods were 840 GtCO2 and 27 GtCO2/year, respectively,11 our mean estimate for cumulative prevented emissions may not appear substantial; however, it is instructive to look at other quantitative comparisons. For instance, 64 GtCO2-eq amounts to the cumulative CO2 emissions from coal burning over approximately the past 35 years in the United States, 17 years in China, or 7 years in the top five CO2 emitters.11 Also, since a 500 MW coal-fired power plant typically emits 3 MtCO2/year,26 64 GtCO2-eq is equivalent to the cumulative lifetime emissions from almost 430 such plants, assuming an average plant lifetime of 50 years. It is therefore evident that, without global nuclear power generation in recent decades, near-term mitigation of anthropogenic climate change would pose a much greater challenge. For the projection period 2010−2050, in the all coal case, an average of 150 and 240 GtCO2-eq cumulative global emissions are prevented by nuclear power for the low-end and high-end projections of IAEA,6 respectively. In the all gas case, an average of 80 and 130 GtCO2-eq emissions are prevented (see Figure 3b,c for full ranges). Regional results are also shown in Figure 3b,c. These results also differ substantially from previous studies,9,10 largely due to differences in nuclear power projections (see the Supporting Information). To put our calculated overall mean estimate (80−240 GtCO2-eq) of potentially prevented future emissions in perspective, note that, to achieve a 350 ppm CO2 target near the end of this century, cumulative “allowable” fossil CO2 emissions from 2012 to 2050 are at most ∼500 GtCO2 (ref 3). Thus, projected nuclear power could reduce the climate-change mitigation burden by 16−48% over the next few decades (derived by dividing 80 and 240 by 500). Uncertainties. Our results contain various uncertainties, primarily stemming from our impact factors (Table 1) and our assumed replacement scenarios for nuclear power. In reality, the impact factors are not likely to remain static, as we (implicitly) assumed; for instance, emission factors depend heavily on the particular mix of energy sources. Because our impact factors neglect ongoing or projected climate impacts as well as the significant disparity in pollution between developed and developing countries,16 our results for both avoided GHG emissions and avoided mortality could be substantial underestimates. For example, in China, where coal burning accounts for over 75% of electricity generation in recent decades (ref 14; Figure S3, Supporting Information), some coal-fired power plants that meet domestic environmental standards have a mortality factor almost 3 times higher than the mean global value (Table 1). These differences related to development status will become increasingly important as fossil fuel use and GHG emissions of developing countries continue to outpace those of developed countries.11 On the other hand, if coal would not have been as dominant a replacement for nuclear as assumed in our baseline historical scenario, then our avoided historical impacts could be overestimates, since coal causes much larger impacts than gas (Table 1). However, there are several reasons this is unlikely. Key characteristics of coal plants (e.g., plant capacity, capacity factor, and total production costs) are historically much more similar to nuclear plants than are those of natural gas plants.13 Also, the vast majority of existing nuclear plants were built before 1990, but advanced gas plants that would be suitable replacements for base-load nuclear plants (i.e., combined-cycle gas turbines) have only become available since the early 1990s.13 Furthermore, coal resources are highly abundant and widespread,24,25 and coal fuel and total production costs have long been relatively low, unlike historically available gas resources and production costs.13 Thus, it is not surprising that coal has been by far the dominant source of global electricity thus far (Figure 1). We therefore assess that our baseline historical replacement scenario is plausible and that it is not as significant an uncertainty source as the impact factors; that is, our avoided historical impacts are more likely underestimates, as discussed in the above paragraph. Implications. More broadly, our results underscore the importance of avoiding a false and counterproductive dichotomy between reducing air pollution and stabilizing the climate, as elaborated by others.27−29 If near-term air pollution abatement trumps the goal of long-term climate protection, governments might decide to carry out future electric fuel switching in even more climate-impacting ways than we have examined here. For instance, they might start large-scale production and use of gas derived from coal (“syngas”), as coal is by far the most abundant of the three conventional fossil fuels.24,25 While this could reduce the very high pollutionrelated deaths from coal power (Figure 2), the GHG emissions factor for syngas is substantially higher (between ∼5% and 90%) than for coal,30 thereby entailing even higher electricity sector GHG emissions in the long term. In conclusion, it is clear that nuclear power has provided a large contribution to the reduction of global mortality and GHG emissions due to fossil fuel use. If the role of nuclear power significantly declines in the next few decades, the International Energy Agency asserts that achieving a target atmospheric GHG level of 450 ppm CO2-eq would require “heroic achievements in the deployment of emerging lowcarbon technologies, which have yet to be proven. Countries that rely heavily on nuclear power would find it particularly challenging and significantly more costly to meet their targeted levels of emissions.” 2 Our analysis herein and a prior one7 strongly support this conclusion. Indeed, on the basis of combined evidence from paleoclimate data, observed ongoing climate impacts, and the measured planetary energy imbalance, it appears increasingly clear that the commonly discussed targets of 450 ppm and 2 °C global temperature rise (above preindustrial levels) are insufficient to avoid devastating climate impacts; we have suggested elsewhere that more appropriate targets are less than 350 ppm and 1 °C (refs 3 and 31−33). Aiming for these targets emphasizes the importance of retaining and expanding the role of nuclear power, as well as energy efficiency improvements and renewables, in the near-term global energy supply

### A2 Lifecycle Emissions

#### Even after taking account mining and construction emissions, nuclear significantly reduces emissions

Weisser 7 [Daniel Weisser, "A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies," IAEA, 2007] AZ

5.3 Nuclear Differences in the GHG emissions for nuclear energy chains, amongst others, can be attributed to the enrichment technology used, as well as the nuclear energy technology type (e.g. Pressurised Water Reactor (PWR), Boiling Water Reactor (BWR)). For example, enrichment using diffusion technology rather than centrifuge technology is more energy intensive and depending on GHG emissions relating to the electricity supply mix of the country where enrichment is taking place can significantly impact on the cumulative GHG life-cycle. A typical chain for nuclear would, for example, consist of uranium mining (open pit and underground), milling, conversion, enrichment (diffusion and centrifuge), fuel fabrication, power plant, reprocessing, conditioning of spent fuel, interim storage of radioactive waste, and final repositories [17]. The studies summarised in this section have investigated the GHG life cycle emissions only for Light Water Reactors (LWR) (i.e. PWR and BWR), which is the most widespread and commonly used reactor technology. For LWR GHG emissions during the operational stage of the reactor, relative to cumulative life-cycle emissions, are of secondary importance – ranging between 0.74 – 1.3 gCO2eq/kWhe . Unlike fossil fuel powered technologies the majority of the GHG emissions arise at the upstream stages of the fuel and technology cycle with values roughly ranging between 1.5 –20 gCO2eq/kWhe . The notable difference in the upstream emissions is mainly due to the enrichment process, with significantly higher emissions for diffusion technology and lower values for centrifuge technology if the associated electricity consumption is of fossil origin, as well as whether the fuel-cycle is ‘once-through’ or ‘recycled’. However, it is important to note that centrifuge technologies are presently the technology of choice and are believed to substitute diffusion technology in the future which currently have about 40% of the market output (i.e. enriched uranium) [33]. The GHG emissions associated with downstream activity, such as decommissioning and waste management, range between 0.46-1.4 gCO2eq/kWhe . Cumulative emissions for the studies under consideration lie between 2.8-24 g CO2eq/kWhe , as shown in Figure 5. Dones et al [17] suggest that in order to reduce emissions from nuclear technologies key areas of improvement would be to: • Reduce electricity input for the enrichment process (e.g. replacement of diffusion by centrifuges or laser technologies) • Use electricity based on low or no-carbon fuels • Extend lifetime and increase burn-up GHG avoidance at the operating stage of the nuclear power plant is minimal since its contribution to the cumulative GHG emissions is already small.

#### Nuclear life-cycles reduce emissions

Weisser 7 [Daniel Weisser, "A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies," IAEA, 2007] AZ

Increasing the use of nuclear power From a GHG emission perspective nuclear power plants (i.e. LWR) are very attractive since they have a huge GHG life-cycle reduction potential when displacing fossil fuel fired power plants, as well as the ability to provide energy services similar to most fossil fuel based energy technologies9 . Figure 5 shows that on average LWRs have the second lowest life-cycle GHG emissions of all assessed technologies

### A2 Uranium Mining

#### Mining releases minimal emissions

Parker 16 [David J. Parker, Cameron S. McNaughton, and Gordon A. Sparks, "Life Cycle Greenhouse Gas Emissions from Uranium Mining and Milling in Canada," Environ. Sci. Technol., 2016, 50 (17), pp 9746–9753 ] AZ

Life cycle greenhouse gas (GHG) emissions from the production of nuclear power (in g CO2e/kWh) are uncertain due partly to a paucity of data on emissions from individual phases of the nuclear fuel cycle. Here, we present the first comprehensive life cycle assessment of GHG emissions produced from the mining and milling of uranium in Canada. The study includes data from 2006–2013 for two uranium mine-mill operations in northern Saskatchewan (SK) and data from 1995–2010 for a third SK mine-mill operation. The mine-mill operations were determined to have GHG emissions intensities of 81, 64, and 34 kg CO2e/kg U3O8 at average ore grades of 0.74%, 1.54%, and 4.53% U3O8, respectively. The production-weighted average GHG emission intensity is 42 kg CO2e/kg U3O8 at an average ore grade of 3.81% U3O8. The production-weighted average GHG emission intensity drops to 24 kg CO2e/kg U3O8 when the local hydroelectric GHG emission factor (7.2 g CO2e/kWh) is substituted for the SK grid-average electricity GHG emission factor (768 g CO2e/kWh). This results in Canadian uranium mining-milling contributing only 1.1 g CO2e/kWh to total life cycle GHG emissions from the nuclear fuel cycle (0.7 g CO2e/kWh using the local hydroelectric emission factor).

### A2 Uranium Depletion

#### Tech solves

Kleiner 8 [Kurt Kleiner (freelance journalist, writing mostly about science and technology. I write for publications such as New Scientist, The Economist, Nature, Scientific American), "Nuclear energy: assessing the emissions," Nature Reports Climate Change , 2008] AZ

Another question has to do with the sustainability of the uranium supply itself. According to researchers in Australia at Monash University, Melbourne, and the University of New South Wales, Sydney, good-quality uranium ore is hard to come by. The deposits of rich ores with the highest uranium content are depleting leaving only lower-quality deposits to be exploited.3 As ore quality degrades, more energy is required to mine and mill it, and greenhouse gas emissions rise. "It is clear that there is a strong sensitivity of ... greenhouse gas emissions to ore grade, and that ore grades are likely to continue to decline gradually in the medium- to long-term," conclude the researchers.

But the nuclear industry points to technological advances of its own that are likely to make nuclear power less expensive and less carbon intensive. Genoa says that new methods of mining uranium and building reactors designed to run on less uranium-rich fuel could make nuclear power even more attractive. "If we're using the same reactors in two centuries, then we've missed the boat. There are going to be other technologies," Genoa says.

### A2 Not Enough NP

#### Nuclear power up

Donovan 15 [Jeffrey Donovan (IAEA Office of Public Information and Communication), "IAEA Sees Global Nuclear Power Capacity Expanding in Decades to Come," 9/8/2015] AZ

Although not a major driving force, the policies and developments in the more than 30 countries that are considering or planning their first nuclear power plant also play a role in the projections. The IAEA recently updated one of its key guidance documents, Milestones in the Development of a National Infrastructure for Nuclear Power, which forms the basis for its assistance to these “newcomer” countries. They include the United Arab Emirates, which is building its first reactors and contributing to projected growth in the Middle East and South Asia, where India is driving the expansion and constructing six new reactors. According to the 2015 projections, capacity growth in that region is projected at 25.9 GW(e) by 2030 in the low case from the current 6.9 GW(e), rising to 43.8 GW(e) in the high case. One gigawatt is equal to one billion watts of electrical power. Growth is also projected in Eastern Europe. The region includes Russia, with nine reactors under construction, as well as Belarus, which is building its first reactors. The low case estimate projects regional capacity growth to 64.1 GW(e) by 2030 from the current 49.7 GW(e), with capacity increasing to 93.5(e) in the high case. The Far East, meanwhile, will see the biggest expansion, especially in China and the Republic of Korea, which are building 24 and four reactors respectively. In the low case, capacity in that region is seen growing to 131.8 GW(e) by 2030 from the current 87.1 GW(e). In the high case, capacity is projected to expand to 219 GW(e).

## A2 Renewables

### A2 Renewables – TL

#### Even a shift to renewables means there’s still substantial fossil fuel usage since renewables aren’t consistent which is *net worse* than nuclear.

**IAEA 15** International Atomic Energy Agency “CLIMATE CHANGE AND NUCLEAR POWER 2015” Vienna Austria 2015

Renewable technologies (hydropower, wind, solar) do not face the risk of interruptions in fuel supplies, making them somewhat similar to nuclear power. The difficulty associated with their prospective major expansion in the first half of the twenty-first century forecasted by the IEA [11] is not in making reserves of energy sources but in creating storage for the produced energy. The reason is intermittency: in contrast to the dispatchable technologies powered by fuels (nuclear or fossils) with guaranteed energy output allowing long term planning, some renewables depend on unpredictable variations in natural conditions, such as windiness and insolation. Considering the fact that large scale storage of electricity is not yet affordable, this creates a significant challenge for the stable and reliable functioning of the power grid. In order to close the gap between demand and unstable supply, alternative energy sources are needed. Normally, these are thermal power plants (as the output of NPPs cannot change fast enough to balance the variations in wind or solar outputs), paradoxically increasing the importance of fossils fuels. It follows that in order to secure the dependability of electricity supply in systems using significant shares of intermittent renewables, such systems will have to include a substantial share of power plants fuelled by coal or gas. This reduces their environmental benefits significantly below the levels estimated by LCAs of various solar and wind technologies (see Section 2.3). Therefore, at the current level of development of energy storage technologies, power systems relying heavily on intermittent renewables will not only be subject to less stable supply but will also face the energy security threats associated with fossil fuels. Moreover, in terms of operational and environmental benefits, such systems are characterized by the inefficiency of fossil fuel power plant operation due to the unpredictable and abrupt changes in their required output. Though their ability to change output quickly makes them preferential options in comparison with nuclear, it leads to an inevitable trade-off in the form of significant N2O emissions that are hard to control under changing power rate regimes. The magnitude of such environmental penalties is not yet clear but, according to a study of the US National Energy Technology Laboratory (NETL), reductions in N2O emissions in energy systems with a 20% share of wind or solar PV are only 30–50% of those estimated by ignoring the fossil fuel backup. In the worst case scenarios, emissions of N2O from such systems can actually increase by 2–4 times [37].

#### Renewables aren’t good now and need time. NP in the short run is much better

**Gross 16** Daniel Gross Executive Editor at strategy+business Harvard University A.M. “Why Renewable Power Can Still Be Wasteful” The Slate JULY 29 2016 12:38 PM

And yet, given the way the U.S. has gone about adding renewables to the grid, there actually is a fair amount of inefficiency and wasted energy. On any given day, a certain amount of wind and solar power is curtailed, as the term of art goes. Wind turbines, for example, get turned off even though the blades are still turning; the production of solar plants sometimes gets dialed down. In early July in California, for about an hour one afternoon, some 292 megawatts of solar capacity was curtailed—enough to power thousands of homes. Why do we have curtailment? Blame the herky-jerky way we roll out new technologies and build infrastructure in this country. Inefficiencies in new economic infrastructure aren’t exactly new. Because the state doesn’t centrally plan and roll out new technologies in a completely rational fashion—matching demand, distribution, and supply—wrinkles and bubbles develop. Incentives may be available for one component of the technology but not for others. And so overinvestment in one stage of the process coincides with underinvestment in another stage. Which is why we have bubbles. The earliest telegraph lines from Boston to New York City stopped at the Hudson River—and messages had to be carried across the Hudson on a boat. In the 1990s, information would travel at rapid speeds across the country on fast cables but slow down in the last mile. (I wrote a book about this in 2007.) The same has happened with wind and solar. There are significant government incentives to build wind and solar farms in the plains and deserts, where land is cheap and resources are plentiful. The U.S. renewable industries have figured out how to build and finance wind and solar farms at scale. But the transmission and the distribution systems, which don’t benefit from the same incentives, haven’t kept up. Transporting electricity involves stringing high-voltage lines across hundreds of miles of open space, across property owned by thousands of owners and multiple state lines. You can put up a giant solar farm or a wind farm in a matter of months. But as the travails of transmission-builder Clean Line Energy show, building the lines that will carry electrons from the places where they are created to the places they can be used can take decades. The design of the grid also works against efficiency. Texas maintains an electricity grid that is not connected to its neighboring states. And so when the huge wind farms built in the state generate power at times when demand is low, strange things can happen—like negative prices for their energy output. And even states in which grids are interconnected, there’s often a mismatch between demand and the amount of power generated during periods of peak usage in the late afternoon, leading to price spikes. And, of course, the very nature of renewables also works against efficiency. Plants powered by coal and natural gas can guarantee steady production over the course of the day, and dial output up and down with great precision as demand changes. But wind and solar are famously intermittent sources, so the task is harder. With solar, clouds and weather patterns can affect the intensity of solar radiation. The ability of solar panels to produce electricity varies dramatically over the course of the day. Winds can gust and die down in ways that defy easy prediction. So in the middle of the day, when solar panels are producing the maximum output and demand tends to be low, there may not be users for all the electricity being produced. And at night, when the wind blows powerfully and the world is asleep, there may not be takers for the power at any price. That’s when you get curtailment, or energy waste. Curtailment is most pronounced and frequent in energy islands: geographical islands like Hawaii and electricity islands like Texas. Generally speaking, wind power is the most likely to be curtailed. In 2009, some 17 percent of the wind generation in Texas was curtailed. But as the state built new transmission lines to connect the wind farms to population centers, the rate has declined. As this exhaustive report from the Energy Department notes: Only 0.5 percent of all wind generation within the coverage area of the Electric Reliability Council of Texas was curtailed in 2014, down from the peak of 17 percent in 2009. (Here’s a chart of curtailments in Texas between 2011 and 2014.)

#### Only nuclear energy can solve – renewables cost too much

Newman 15 [Maurice Newman (Chairperson of the Australian Broadcasting Corporation, as well as former chair of the board of the Australian Stock Exchange. He was Chancellor of Macquarie University until 2008), "Sun and wind can’t match nuclear power," the Australian, 10/19/2015] AZ

These facts won’t stop the scaremongers. We will be told that we have no comprehension of the risks to human health we face. The virtues of renewable energy will be exaggerated as a viable alternative, despite its dismal economic and environmental record and growing evidence of adverse health effects from wind turbine infrasound. Last year, in the article “Sun, wind and drain”, The Economist cited work by Charles Frank of the Brookings Institution. Frank notes the limitations of “levelised costs” and uses a cost-benefit analysis to rank various forms of energy producers. “The costs include those of building and running power plants, and those associated with particular technologies, such as balancing the electricity system when wind and solar plants go offline or, disposing of spent nuclear fuel rods”. He found that nuclear-power plants that run at 90 per cent of capacity avoid almost four times as much CO2 per unit of capacity as do wind turbines and six times as much as solar arrays. He also found that seven solar plants or four wind farms would be needed to produce the same amount of electricity as a similar sized coal-fired plant. As The Economist summarises, if all the cost benefits are totted up, using Frank’s calculation, solar is by far the most expensive way of reducing CO2 emissions, followed by wind. Hydropower provides a modest net benefit but, “the most cost-effective zero-emission technology is nuclear power”. Australia’s energy day of reckoning is fast approaching. Its thermal power stations are ageing. They are forced to suffer generator intermittency and to subsidise their renewable energy competitors’ capacity. Their costs are rising and their prices falling. Legislated distortions threaten their very survival. As they cannot attract new investment, there is a growing prospect of random power outages within a decade. Something has to give. Either prices rise or, like Britain and Europe, taxpayers will have to subsidise obsolete generators to keep the lights on. This is a short-term fix only. Nuclear energy has to be on the table.

### A2 Renewables – Taiwan

#### No renewables – wind, solar, geothermal, and hydro aren't feasible

Liao & Jhou 13 [Huei-Chu Liao and Sih Ting Jhou, "Taiwan’s Severe Energy Security Challenges," Brookings Institution, 9/12/2013] AZ

2. Unlikely mission for 100 percent renewable energy

Many people in Taiwan hope that development of renewable energy will solve the island’s energy problem, and environmental groups are pushing the government to pursue the 100 percent renewable energy use in the future. In 2012, the relative share of renewable energy accounted for only 1.89 percent of Taiwan’s total energy supply; biomass and waste accounted for 1.32 percent, conventional hydro power 0.38 percent, solar photovoltaic (PV) and wind power 0.11 percent, and solar thermal 0.08 percent (see Figure 1). Among renewable sources, the Taiwan government currently prioritizes wind and solar power, but both face development obstacles.

Although the generation cost of wind power is competitive with that of traditional fossil energy, Taiwan’s terrain and small size limit suitable locations for building up onshore wind power facilities. In fact, complaints and protests from areas that already host wind power facilities are increasing. Offshore wind power also faces challenges; fishermen and coastal area environmental protection groups have raised many questions and concerns. Currently, no offshore wind power sites have been built.

The development of solar power is also problematic. The generation cost of solar PV power is two to three times that of fossil energy. People in Taiwan are unlikely to accept yet another increase in electricity prices that a shift to solar power would entail. As with wind power, land limitation is another constraint for building more solar PV.

The intermittent characteristics of both wind and solar power present yet another complication. Intermittent power supply will reduce the power supply reliability, which is particularly unacceptable for many high technology industries such as the electronic products industry which is important to Taiwan’s economy. Taiwan is an island, and the physical isolation makes intermittent power even more unfavorable. It is impossible for Taiwan to sell or buy power to balance the surplus or shortage of intermittent power supply.

Except for wind, solar, hydro-power (which accounts for a very small share), most of the other potential sources of renewable energy remain in the research or demonstration stages. Ocean energy and deep geothermal energy are two sources that could be beneficial for Taiwan, but they need to be developed.

In brief, the poor economic, environmental and geographic conditions in Taiwan limit the possibilities for renewable energy, and it will be all but impossible to reach the aim of 100 percent renewable energy use before 2050.

### A2 Battery Tech

#### No battery breakthrough – advances are all hype and aren’t scalable to the real world

Mims 14 [(Christopher Mims, ) Tech World Vexed by Slow Progress on Batteries, WSJ 10-5-2014] AT

There is no Moore’s law for batteries. That is, while the computing power of microchips doubles every 18 months, the capacity of the batteries on which ever more of our gadgets depend exhibits no such exponential growth. In a good year, the capacity of the best batteries in our mobile phones, tablets and notebook computers—and increasingly, in our cars and household gadgets—increases just a few percent. It turns out that storing energy safely and reliably is hard in a way that miniaturizing circuits is not. A pound of gasoline contains more than 20 times as much energy as a pound of lithium-ion batteries. And then there’s the expense: The battery pack in a Tesla Model S costs approximately $30,000. These problems are driving an enormous variety of research projects aimed at achieving a breakthrough in battery technology. Hardly a week goes by that we don’t hear about some magical battery, which always exists only in the lab, that doubles the capacity of current cells. But here’s a safe bet: Breakthroughs in energy storage technology aren’t coming. Not in the foreseeable future, at least. That’s because it takes years to convert “breakthroughs” in the lab into something that works at scale, under all the conditions of real life use. And the overwhelming majority of innovations don’t survive the process. This is one reason, Elon Musk said during a recent interview, that he feels safe betting $5 billion on a “gigafactory” that will produce more lithium-ion batteries, using more or less current techniques and chemistry, than all the world’s factories currently do, and it won’t be completed until 2020.

### A2 Wind

#### Wind Energy is very inefficient and takes up lots of space

**Poulter 14** SEAN POULTER FOR THE DAILY MAIL “Wind farms 'will never keep the lights on': Study claims turbines are 'expensive and deeply inefficient'” 27 October 2014

Researchers found that, on average, wind farms produce 80 per cent of their potential power output for less than one week annually – and they manage 90 per cent output for only 17 hours a year. Thousands of turbines are useless in low winds and they are turned off to prevent damage if the speeds are too high.

Families and businesses have paid billions of pounds to subsidise the building of wind farms, both on-shore and off-shore, through their energy bills, sending tariffs soaring.

The schemes are key to the Government’s promise to switch to green energy, reducing the nation’s carbon emissions in line with British and EU targets to tackle man-made global warming. The study, entitled Wind Power Reassessed: A review of the UK wind resource for electricity generation, recommends pushing ahead with nuclear power and gas-fired power stations.

Ben Southwood, Head of Policy at the Adam Smith Institute, said: ‘Wind farms are a bad way of reducing emissions and a bad way of producing power.

‘They are expensive and deeply inefficient and it seems like they reduce the value of housing enormously in nearby areas. Defending turbines, trade body RenewableUK claimed: ‘Wind power has been quietly powering millions of homes and providing a robust response to detractors.’

The Conservative party has already pledged to end subsidies for new wind farms as Britain is set to meet EU targets.

The EU Renewable Energy Target decrees that 15 per cent of all energy in the UK - or 30 to 35 per cent of electricity - is generated by renewable sources by 2020.

The Department for Energy and Climate Change said the country needs a wide mix of energy sources. It said: ‘We're preventing a predicted energy crunch by turning round a legacy of underinvestment and neglect.

‘To deliver this, we need a diverse energy mix that includes renewable sources like wind and solar alongside nuclear and technologies like carbon capture and storage so we can continue to use fossil fuels in a cleaner way.’

## Country Specific

### Japan

#### Prior to 2011 production was 30%, they shifted to Coal and plan to increase by 21% by 2020

**WNA 16** World Nuclear Association “Nuclear Power in Japan” (Updated 21 July 2016) http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.aspx

Early in 2011, nuclear energy accounted for almost 30% of the country's total electricity production (29% in 2009), from 47.5 GWe of capacity (net) to March 2011, and 44.6 GWe (net) from then. There were plans to increase this to 41% by 2017, and 50% by 2030.Preliminary IEA figures indicate that in 2014 Japan generated 1025 TWh gross, 337 TWh from coal, 413 TWh from gas (up from 300 TWh in 2010), nothing from nuclear (cf 288 TWh in 2010), 114 TWh from oil (up from 94 TWh in 2010), and 87 TWh from hydro. The country’s nuclear capacity was progressively shut following the March 2011 Fukushima accident. Renewables contribution in 2014 was small: solar 24 TWh, wind 5 TWh, geothermal 2.6 TWh, biomass & waste 42 TWh. Final consumption in 2010 was about 1000 TWh, or about 7870 kWh per capita. This dropped to 950 TWh and 7480 kWh/capita in 2013.Capacity (IEA figures) at end of 2013 was 303 GWe, this being 44 GWe nuclear, 45 GWe hydro, 36 GWe coal, 47 GWe gas, 41 GWe oil, 18 GWe oil or coal, 51 GWe autoproducers’ ‘combustible fuels’, 13 GWe solar, 2.6 GWe wind and 0.5 GWe geothermal. In response to nuclear difficulties, coal capacity is planned to increase 21% to 47 GWe by early 2020s.In April 2015 the government announced that it wanted base-load sources to return to providing 60% of the power by 2030, with about one-third of this being nuclear. Analysis by the Research Institute of Innovative Technology for the Earth estimated that energy costs would then be reduced by JPY 2.4 trillion (USD 20.0 billion) per year compared with the present 40% base-load scenario (renewables being 30%). At the same time, it was reported that 43 coal-fired power projects were planned or under construction, totalling 21.2 GWe and expected to emit 127 million tonnes of CO2 per year. In February 2016 the BP Energy Outlook said that Japanese reactors were expected to restart over the next five years to reach 60% of their 2010 levels by 2020.

#### Japan used the most coal in nearly 40 years after phasing out some of its nuclear power plants

**Stapczynski 15** - Stephen Stapczynski is a staff writer for Bloomberg: 10 September 2015 (“Japan Utilities Burn Record Coal Amid Minister's Call for Cuts” Bloomberg, Available Online at http://www.bloomberg.com/news/articles/2015-09-11/japan-utilities-burn-record-coal-amid-minister-s-call-for-cuts, Accessed 8/9/16)IG

Japan’s regional power utilities burned the most coal on record in August, flouting calls from the nation’s environmental minister to rein in use to control greenhouse gas emissions.

The nation’s 10 power utilities used 5.82 million metric tons of coal in August, the Federation of Electric Power Cos. reported Friday. That’s the most in monthly usage since the group started compiling data in April 1972. While total power generation and purchases fell 0.9 percent, liquefied natural gas use slid to the least in August in 5 years and fuel oil to its lowest level for the month in 6 years.

Japan’s environment minister said last month that he won’t support a new coal power station planned for central Japan as part of a push by the ministry to control greenhouse gas emissions. Coal consumption increased 19 percent between 2010 and 2014, largely due to the March 2011 Fukushima disaster, which led to the shuttering of the nation’s nuclear plants for safety checks.

“Coal is still the cheapest fuel source,” Ali Izadi-Najafabadi, a Tokyo-based analyst with Bloomberg New Energy Finance, said by phone. There is more coal plant capacity available this year than last year in Japan, he said.

By year’s end it will cost on average of about 4 yen (3 cents) per kilowatt hour to operate a coal-fired plant, compared to 9.6 yen for a gas-fired facility, according to data compiled by BNEF. Thermal coal at the port of Newcastle in Australia, the fuel’s biggest export harbor, closed at $59.48 a ton Sept 4, according to prices from Globalcoal. That’s near the lowest since May 2007.

### Germany

#### Germany phase out led to significantly more coal, with ¼ of electricity being nuclear beforehand.

**WNA 16** “Nuclear Power in Germany” (Updated 6 July 2016) http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx

Germany until March 2011 obtained one-quarter of its electricity from nuclear energy, using 17 reactors. The figure is now about 16% from eight reactors. A coalition government formed after the 1998 federal elections had the phasing out of nuclear energy as a feature of its policy. With a new government in 2009, the phase-out was cancelled, but then reintroduced in 2011, with eight reactors shut down immediately. The cost of attempting to replace nuclear power with renewables is estimated by the government to amount to some €1000 billion without any assurance of a reliable outcome, and with increasing reliance on coal, especially lignite. Public opinion in Germany remains broadly opposed to nuclear power with virtually no support for building new nuclear plants. Almost half of Germany’s electricity is generated from coal, and there are no plans to phase this out. Germany has some of the lowest wholesale electricity prices in Europe and some of the highest retail prices, due to its energy policies. Taxes and surcharges account for more than half the domestic electricity price.

### Sweden

#### Attempts to phase out nuclear power increases emissions and accidents – Sweden proves

Qvist and Brook 15 - Staffan A. Qvist- Department of Physics and Astronomy, Uppsala University, Sweden; Barry W. Brook - Faculty of Science, Engineering and Technology, University of Tasmania, Australia: 4 May 2015 (“Environmental and health impacts of a policy to phase out nuclear power in Sweden” Elseiver Ltd. Journal of Energy Policy, p. 1, Available Online at http://www.karnteknik.se/upload/aktiviteter/medlemsaktiviteter/20151009\_Staffan%20Qvists%20Energy%20Policy.pdf, Accessed 8/8/16)IG

Nuclear power faces an uncertain future in Sweden. Major political parties, including the Green party of the coalition-government have recently strongly advocated for a policy to decommission the Swedish nuclear fleet prematurely. Here we examine the environmental, health and (to a lesser extent) economic impacts of implementing such a plan. The process has already been started through the early shutdown of the Barsebäck plant. We estimate that the political decision to shut down Barsebäck has resulted in 2400 avoidable energy-production-related deaths and an increase in global CO2 emissions of 95 mil- lion tonnes to date (October 2014). The Swedish reactor fleet as a whole has reached just past its halfway point of production, and has a remaining potential production of up to 2100 TWh. The reactors have the potential of preventing 1.9–2.1 gigatonnes of future CO2-emissions if allowed to operate their full life- spans. The potential for future prevention of energy-related-deaths is 50,000–60,000. We estimate an 800 billion SEK (120 billion USD) lower-bound estimate for the lost tax revenue from an early phase-out policy. In sum, the evidence shows that implementing a ‘nuclear-free’ policy for Sweden (or countries in a similar situation) would constitute a highly retrograde step for climate, health and economic protection.

## Coal Impacts

### ! – Worker Safety

#### Fossil fuels are far worse

Gordelier 10 [Stan Gordelier (head of NEA Nuclear Development Division), "Comparing Nuclear Risks with Those from Other Energy Sources," Nuclear Energy Agency – OECD, 2010] AZ

The risk associated with the operation of a nuclear plant is that radioactivity is released to the environment, resulting in exposure by and health effects to the population. Since significant releases of activity are extremely rare. reliance on statistics of events is not possible. The report uses the analytical technique of probabilistic safety assessment (PSA) by which potential accidents, their probabilities of occurrence and their consequences can be assessed. It is common to look at the outcomes in terms of the theoretical probabilities of core damage (an accident in which the fuel cladding is ruptured, for example by overheating and melting) and the more severe events in which significant radioactivity breaches the primary circuit and the secondary containment and is released to the environment. These two measures are termed the theoretical core damage frequency (C DF) and the theoretical large release frequency (LRF). While these are not actual statistics on accident rates, they serve to illustrate the trends. The report looks at the “as originally designed” CDFs and LRFs over the evolution of reactor designs from Generation 1 to Generation 11 and on to Generation III/111+. It shows that, over this evolution, there has been a very significant reduction in both CDF and LRF. While this clearly indicates that modern designs are extremely safe, it is important to recognise that earlier designs have also been back-fitted with safety improvements, oflen evaluated using the techniques of PSA. If the world turns to nuclear energy in large measure to alleviate the energy issues it confronts, it can be expected that this evolution in CDF and LRF reduction will continue and it is desirable that it does so. The report then looks at real accident data from full energy chains, using an impressive collection of data assembled by the Paul Scherrer Institute (P51) in Switzerland. Using this severe accident data (events that have resulted in 5 or more prompt fatalities that have actually occurred from 1969 onwards) it compares the outcomes with the theoretical accident outcomes from PSA analysis (since there are no real nuclear accident data from OEC D countries and only one data point from non-OEC D countries). This shows that, contrary to the expectation of many people, nuclear power generation presents a very low risk in comparison to the use of fossil fuels. The latent fatalities (i.e. deaths resulting from the exposures of radioactivity over long periods after the event) from the C hernobyl accident are also considered. These are of the same size as the prompt deaths from the world’s biggest non-OECD hydro accident. They are also considerably smaller than the latent deaths resulting from fossil fuel use, although data on these is difficult to find.

### ! – Radioactivity

#### Coal is just as radioactive if not worse due to “fly ash” concentrations

Mara **Hvistendahl 7** contributing correspondent at Science and author of Unnatural Selection: Choosing Boys over Girls, and the Consequences of a World Full of Men (PublicAffairs, 2011). She is currently writing a book on the rise of economic and cyber-spying and the global battle over technological secrets. on December 13, 2007 “Coal Ash Is More Radioactive Than Nuclear Waste” Scientific American <http://www.scientificamerican.com/article/coal-ash-is-more-radioactive-than-nuclear-waste/>

Over the past few decades, however, a series of studies has called these stereotypes into question. Among the surprising conclusions: the waste produced by coal plants is actually more radioactive than that generated by their nuclear counterparts. In fact, the fly ash emitted by a power plant—a by-product from burning coal for electricity—carries into the surrounding environment 100 times more radiation than a nuclear power plant producing the same amount of energy. \* [See Editor's Note at end of page 2] At issue is coal's content of uranium and thorium, both radioactive elements. They occur in such trace amounts in natural, or "whole," coal that they aren't a problem. But when coal is burned into fly ash, uranium and thorium are concentrated at up to 10 times their original levels. Fly ash uranium sometimes leaches into the soil and water surrounding a coal plant, affecting cropland and, in turn, food. People living within a "stack shadow"—the area within a half- to one-mile (0.8- to 1.6-kilometer) radius of a coal plant's smokestacks—might then ingest small amounts of radiation. Fly ash is also disposed of in landfills and abandoned mines and quarries, posing a potential risk to people living around those areas. In a 1978 paper for Science, J. P. McBride at Oak Ridge National Laboratory (ORNL) and his colleagues looked at the uranium and thorium content of fly ash from coal-fired power plants in Tennessee and Alabama. To answer the question of just how harmful leaching could be, the scientists estimated radiation exposure around the coal plants and compared it with exposure levels around boiling-water reactor and pressurized-water nuclear power plants. The result: estimated radiation doses ingested by people living near the coal plants were equal to or higher than doses for people living around the nuclear facilities. At one extreme, the scientists estimated fly ash radiation in individuals' bones at around 18 millirems (thousandths of a rem, a unit for measuring doses of ionizing radiation) a year. Doses for the two nuclear plants, by contrast, ranged from between three and six millirems for the same period. And when all food was grown in the area, radiation doses were 50 to 200 percent higher around the coal plants.

### ! – Race

#### Coal causes environmental racism—turns case.

GEP 15, “Environmental Racism in America: An Overview of the Environmental Justice Movement and the Role of Race in Environmental Policies”, The Goldman Environmental Press, 24 Jun 2015, BE

The problem of racial profiling in America relates to more than just police brutality and the senseless acts of violence that have recently captured the national spotlight. Race also plays a determining role in environmental policies regarding land use, zoning and regulations. As a result, African American, Latino, indigenous and low-income communities are more likely to live next to a coal-fired power plant, landfill, refinery or other highly polluting facility. These communities bear a disproportionate burden of toxic contamination as a result of pollution in and around their neighborhoods. Moreover, these communities have historically had a diminished response capacity to fight back against such policies.

A recent report from the NAACP entitled “Coal Blooded: Putting Profits Before People,” found that among the nearly six million Americans living within three miles of a coal plant, 39% are people of color – a figure that is higher than the 36% proportion of people of color in the total US population. The report also found that 78% of all African Americans live within 30 miles of a coal fired power plant.

In an interview for Yale Environment 360, Jacqueline Patterson, the Environmental and Climate Justice Director for the NAACP commented on the disproportionate burden faced by communities of color:

“An African American child is three times more likely to go into the emergency room for an asthma attack than a white child, and twice as likely to die from asthma attacks as a white child. African Americans are more likely to die from lung disease, but less likely to smoke. When we did a road tour to visit the communities that were impacted by coal pollution, we found many anecdotal stories of people saying, yes, my husband, my father, my wife died of lung cancer and never smoked a day in her life. And these are people who are living within three miles of the coal-fired power plants we visited.”

### ! – Struc Violence

#### Fossil fuels disadvantage the poorest – reinforces poverty and causes cancer

Andrew **Breiner** **14** “How Fossil Fuels Make Inequality Worse” Sep 17, 2014 https://thinkprogress.org/how-fossil-fuels-make-inequality-worse-61acdb913aa6#.ol3pb7bfb

There’s a whole line of thinking, popular with the fossil fuel industry and its allies in politics and business, that though climate change is real, the costs of addressing it are too high, especially for the world’s poor. In June, Bill Gates, billionaire philanthropist, took to his blog to promote that argument, saying the poor “can’t afford today’s expensive clean energy solutions, and we can’t expect them [to] wait for the technology to get cheaper.” Fossil fuels aren’t actually the secret to bringing energy to the world’s poor, though. Responding to Gates’ post, Jigar Shah, the founder of SunEdison, pointed to actual energy economics in the developing world. Entrepreneurs are turning to distributed sources of clean energy to spread electricity in poor countries, he wrote, “overwhelmingly out of the desire to power the poor — not to solve climate change.” Extending the grid to connect more people to fossil fuel power has progressed slowly. Meanwhile, home solar is providing cheap, renewable, off-grid power to a growing number of the rural poor in India and across the world. And a policy like a carbon tax would actually give money to poor people to make sure they don’t have to pay the price for the switch to renewable energy. Still, as the climate impacts, pollution, and environmental devastation that stem from fossil fuel consumption became undeniable, proponents of oil, gas, and coal have sought a human face to justify their continued use. The plight of the poor provided a good opportunity. When Drilling Comes To Town A recent profile of a Texas county where drilling produces $15 million worth of oil every day tells a common story. Gardendale has been poor for decades, and has been the site of some of the nation’s most intense drilling for years. Judy Vargas raises three children there in a trailer on an unpaved road with no garbage pickup and bad-smelling tap water. Drilling didn’t bring a bigger home or more money in the family’s pocket, but it did bring a mysterious white powder in the middle of the road that Vargas drives over. “It’s sand,” the Times reports her saying, “but from where?” It was silica powder, a fracking ingredient, dumped in the middle of the road by a truck, probably to lighten its load. Silica powder is a known carcinogen. But it was likely to sit in the road until it blew away, since Gardendale has no government or police to address it. Oil companies make no secret of the fact that the people working on their rigs are highly-trained and often drawn from outside the area where they’re working. Responding to criticism that oil and gas jobs aren’t going to Ohioans, Tom Stewart, executive vice president of the Ohio Oil and Gas Association, told Ohio Public Radio, “You just don’t hire people who’ve had two weeks of training and put them on this rig. You hire people who are equipped and ready to do this kind of job and you get them from where they can be supplied to.” Stewart pointed to hotel and restaurant jobs as potential benefits for those living where drilling takes place. Those are the same jobs that Judy Vargas and her grandmother in the Texas boomtown work, providing a combined income of $1,500 a month for their family of five, while they breathe the nitrogen oxides and sands of drilling and refining. Unequal Harm The detrimental effects of fossil fuel extraction and combustion add up. Air pollution is worse where non-white and low-income people live. Living near fossil fuel operations means dealing with spills and explosions from an industry that routinely shows they have little incentive to prevent these incidents. As for the payoff, a study from Headwaters Economics found that oil and gas drilling don’t even raise incomes when they come to town — in fact, they lower them. Looking at the period from 1980 to 2011, the study found that longer periods of specialization in oil and gas meant lower per-capita incomes, more crime, and lower educational achievement. Per capita income was found to be as much as $7,000 lower in counties with a long-term focus on drilling compared to those that only experienced a year of it. Though the Headwaters study didn’t find direct evidence that drilling profits leave the areas where drilling takes place, study author Patty Gude told ThinkProgress that it made sense. “If the wages are high in mining, which they are,” she said, “it’s possible that some of that income being generated is not rewarding the local residents.” Gude emphasized that while many studies have shown positive short-term income effects of oil and gas development, the Headwaters study was significant because it showed that they don’t last long-term. Again, that points to limited job creation for high-income specialists as drilling starts, before the negative effects of extraction take over. Pollution often takes the worst toll on disadvantaged areas, but when the wealthy parts of a country get too polluted, the rich have the option to leave. That relocation is underway in China, as the country’s smog becomes more problematic. And that’s true of the impacts of climate change, as well. As carbon emissions from fossil fuels continue to accelerate climate change, poverty, hunger, instability, and conflict are exacerbated in places like Nigeria and Syria. Poor people in those countries don’t have the money, connections, or transportation to safely migrate or seek asylum, forcing many into refugee camps. A popular position for those who admit the reality of climate change but aren’t willing to advocate for swift action to address it is to insist that poor populations can’t afford the costs of cutting carbon, that what they really need is cheap fossil fuels. But as the impacts of a warming planet bear down on poor people specifically, it becomes clear that the one thing they can’t afford is more fossil fuels burned. Poorer countries are more vulnerable to the effects of climate change. A Standard & Poor’s (S&P;) assessment ranked nations on their vulnerability to things like sea level rise and agricultural shocks, finding far more in poorer countries of the world. As usual, wealthy people in those countries will be able to insulate themselves against floods and continue to buy food while most find themselves unable to cope or migrate. The S&P; analysis showed that climate vulnerabilities would make poorer nations a worse credit risk, meaning they’d have less access to loans necessary for adapting to a changing climate, and for recovering from disasters after the fact.

Outweighs:

### ! – Air Pollution

#### Fossil Fuels kill 5.5 million per year

**Amos 16** Jonathan Amos BBC Science Correspondent, Washington DC “Polluted air causes 5.5 million deaths a year new research says” 13 February 2016

More than 5.5 million people worldwide are dying prematurely every year as a result of air pollution, according to new research. Most of these deaths are occurring in the rapidly developing economies of China and India. The main culprit is the emission of small particles from power plants, factories, vehicle exhausts and from the burning of coal and wood. The data was compiled as part of the Global Burden of Disease project. Scientists involved in the initiative say the statistics illustrate how far, and how fast, some nations must travel to improve the air their citizens breathe. "In Beijing or Delhi on a bad air pollution day, the number of fine particles (known as PM2.5) can be higher than 300 micrograms per cubic metre," explained Dan Greenbaum from the Health Effects Institute, in Boston, US. "The number should be about 25 or 35 micrograms." Breathing in tiny liquid or solid particles can increase the risk of heart disease, stroke, respiratory complaints and even cancer. And while developed nations have made great strides in addressing this problem these past few decades, the number of citizens dying as a result of poor air quality in developing countries is still climbing. According to the study, air pollution causes more deaths than other risk factors like malnutrition, obesity, alcohol and drug abuse, and unsafe sex. The Global Burden of Disease project puts it as the fourth greatest risk behind high blood pressure, dietary risks and smoking.

Outweighs:

#### Coal created air pollution causes 6% of global deaths

Nuclear Engineering International 15 – Nuclear Engineering International - monthly print magazine including news, feature articles and technical articles of merit on the civil nuclear power industry; Steve Kidd is an independent nuclear consultant and economist with East Cliff Consulting followed by nearly 18 years in senior positions at the World Nuclear:9 December 2015 (“Nuclear’s environmental impact – is it trivial?” Available Online at http://www.world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx, Accessed 8/8/16)IG

External costing suggests that the public health benefits associated with reducing emissions from fossil fuel burning could still be the strongest reason for pursuing closure, in addition to climate change concerns. Thousands of deaths could be avoided in urban areas each year by reducing fossil fuel combustion in line with greenhouse gas abatement targets. The World Health Organisation (WHO) in 1997 presented estimates, of 2.7 or 3 million deaths occurring each year as a result of air pollution. In the latter estimate, 2.8 million deaths were due to indoor exposures and 200,000 to outdoor exposure. The lower estimate comprised 1.85 million deaths from rural indoor pollution, 363,000 from urban indoor pollution and 511,000 from urban ambient pollution. The WHO report points out that these totals are about 6% of all deaths. Moving to cleaner energy has huge benefits to the world.

### ! – Fish

#### **Coal plants kill millions of fish annually**

UCS 14 - UCS, Constortium of Scientists (UCS - Union of Concerned Scientists), 2014("How it Works: Water for Coal," published by Union of Concerned Scientists, Available online at http://www.ucsusa.org/clean\_energy/our-energy-choices/energy-and-water-use/water-energy-electricity-coal.html#.V9X-U2grJeU, Accessed 9/11/2016, )

Coal plants, like most other steam-producing electricity-generating plants, typically withdraw and consume water from nearby water bodies, such as lakes, rivers, or oceans, to create steam for turning their turbines.

A typical coal plant with a once-through cooling system withdraws between 70 and 180 billion gallons of water per year and consumes 0.36 to 1.1 billion gallons of that water. A typical coal plant with a wet-recirculating cooling system withdraws only a fraction as much as a once-through-cooled plant, but consumes 1.7 to 4.0 billion gallons per year, while a typical coal plant with a dry-cooled system consumes much less. (See How it Works: Water for Coal for more information.)

When water is drawn into a coal power plant, millions of fish eggs, fish larvae, and juvenile fish may also come along with it. In addition, millions of adult fish may become trapped against the intake structures. Many of these fish are injured or die in the process.

### ! – Water Security/Ecosystems

#### **Coal plants severely reduce water quality through toxic sludge and pollutants – kills ecosystems and water supplies**

UCS 14 - UCS, Constortium of Scientists (UCS - Union of Concerned Scientists), 2014("How it Works: Water for Coal," published by Union of Concerned Scientists, Available online at http://www.ucsusa.org/clean\_energy/our-energy-choices/energy-and-water-use/water-energy-electricity-coal.html#.V9X-U2grJeU, Accessed 9/11/2016, )

Coal-fired power plants, which produce almost half of the country’s electricity, have significant impacts on water quantity and quality in the United States. Water is used to extract, wash, and sometimes transport the coal; to cool the steam used to make electricity in the power plant; and to control pollution from the plant. The acts of mining and burning coal, as well as dealing with the waste, also can have major effects on water quality.

Electricity Generation

Like all thermoelectric power systems, coal plants require cooling. Three major options are available: once-through, wet-recirculating, and dry cooling. About 53 percent of coal plants in the United States use once-through cooling, about 40 percent use wet-recirculating, and less than one percent use dry-cooling.[1] Table 1 shows water requirements in gallons per megawatt-hour (MWh, or thousand kilowatt-hours) of electricity production. (Despite their name, dry-cooling systems still require water for system maintenance, cleaning, and blowdown, as explained below).[2

Table 1: Water requirements for cooling by type in gallons per megawatt-hour for conventional coal power plants[3]

The choice of cooling system used in a coal plant affects not only its water requirements but also the efficiency of the power plant as a whole. According to estimates by the U.S. Environmental Protection Agency (EPA), coal plants that use dry cooling produce about seven percent less power than those that use wet-recirculating systems.[4] Because coal power derives all of its energy from producing steam, dry cooling has a greater impact on the efficiencies of coal-fired plants than on most natural gas-fired ones. [5],[6]

Coal boilers also use small amounts of water for boiler blowdown. In this process, water is bled from the boiler to get rid of impurities that accumulate and form sludge that can impair a plant’s performance.

A more efficient coal technology, called integrated gasification combined-cycle (IGCC), is being commercialized. Along with reducing air pollutants, this process can decrease water consumption by 35-60 percent compared to conventional coal plants.[7]

Coal Mining and Transport

Coal can be mined from deep underground caverns, surface pits or from mountain tops. Mountaintop removal, the most destructive mining method, also has tremendous water impacts. In this method of extraction,

This technique can bury streams, contaminate local water sources, and increase the risk of flooding. EPA estimates that strip mining of coal by mountaintop removal has buried almost 2,000 miles of Appalachian headwater streams, some of the most biologically diverse streams in the country.[8]

Depending on its quality, coal may need to be “washed” with water and chemicals to remove sulfur and impurities before it can be burned in a power plant. According to the U.S. Department of Energy, total water used for coal mining in the United States (including water use for coal washing and cooling of drilling equipment) ranges from 70 million to 260 million gallons a day.[9] Storing coal-mining waste together with the water used to separate it from the coal can present a significant hazard if the impoundments (“slurry ponds”) fail or the slurry breaks through into nearby abandoned mines.

After extraction, coal must be transported to the power plant. While most U.S. coal travels by train, barge, or truck, some travels by the slurry pipeline method, which involves pumping water with finely ground coal over long distances. Slurry pipelines withdraw hundreds of gallons of water for every megawatt-hour of electricity produced. [10]

Post-Combustion

Waste from the Kingston Coal Ash Spill in 2008 surrounds a Tennessee home. Photo Source: J. Miles Cary/Knoxville News Sentinel

Burning coal emits large quantities of pollutants, including sulfur dioxide, carbon dioxide, nitrous oxides, and mercury. Sulfur dioxide and nitrous oxides can mix with rain or snow to form acid rain. This mixture increases the acidity of lakes and streams and can harm or kill plants and animals. Mercury is a potent neurotoxin that reduces intelligence and otherwise impairs the brain development of infants and children, and that has been linked to heart problems. According to the U.S. EPA, coal plants are the source of over half of anthropogenic (human-caused) emissions of mercury to the air in the U.S.[11] After leaving the smokestack, the mercury falls to earth and accumulates in water bodies and subsequently in the tissues of fish and of people and animals that consume those fish.

Pollution control equipment on power plants, called “scrubbers," can reduce the emissions of sulfur dioxide to the atmosphere by using a mixture of limestone and water to absorb pollutants. This process produces close to 200,000 tons of sludge waste per year for a typical power plant.[12]

Coal ash is another substance with water implications that coal power plants emit in large quantities. Sludge and coal ash wastes are often disposed of in unlined landfills and reservoirs. Heavy metals and toxic substances contained in this waste can contaminate drinking water supplies and harm local ecosystems. When the coal ash waste dike associated with the Tennessee Valley Authority’s 1,500-megawatt Kingston Fossil Plant in Tennessee gave way on December 22, 2008, for example, it dumped an estimated 1.1 billion gallons of coal ash mixed with water into the Emory River.[13]