IPPNW
Germany

Why nuclear energy is not an answer to global warming

Dr. Alex Rosen

Why nuclear energy is not an answer to global warming

Arugments prepared by Dr. Alex Rosen, IPPNW Germany
for the MedAct conference “”Healthy Planet – Better World”
December 9th-10th 2016 in London

Contents

Financial arguments

Nuclear energy is a bad investment

Nuclear power is a mature technology that has been around for more than 70 years. It should be able to stand on its own two feel on the free market. Originally, nuclear energy was advertised to provide mankind with „electricity too cheap to meter“. Instead, it turned out to be one of the most heavily subsidized technologies of all. Until today, it is dependent on massive direct and indirect subsidies from governments and consumers. If nuclear energy were cost competitive, the subsidies that regularly go toward nuclear technology could go to the newer technologies such as solar and wind instead so that they can become established.

While renewables are becoming cheaper and cheaper with each year, nuclear energy seems to have a negative learning curve, with the cost estimates for nuclear energy increasing in the past decade from $1.00 to $7.00 per installed Watt. Hinkley Point C, which is slated to produce around 1.600 MW will cost more than 18 billion pound – for 1.600 MegaWatt – that is more than £14.00 or $11.00 per Watt.[1]

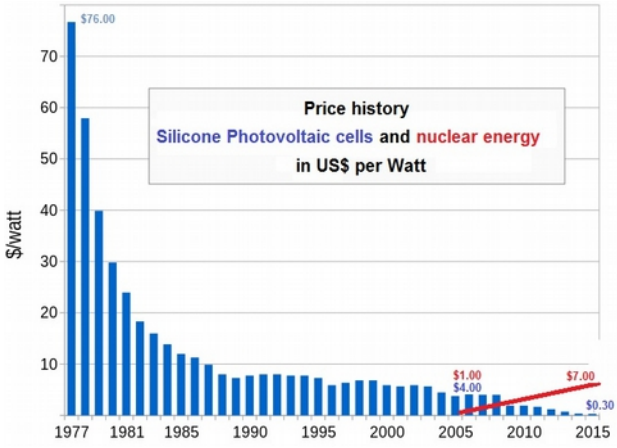


Image Sources: Bloomberg New energy Finance & pv.energytrend.com

Current nuclear projects are not reassuring

Many people in the UK seem to agree that Hinkley Point C is the worst deal that the UK could have gotten for a new nuclear power plant. But this is not true. It is the only deal that the UK could expect. Again, the project is realized only because of substantial direct and indirect state subsidies (i.e. tax payer's money). The UK is guaranteeing the French state-company EDF a price of £92.50 per MW/h for a total of 35 years. This price guarantee is already more than twice the current market value of wholesale electricity, which was on average £40-60 per MWh in the past year.[2]

Renewables also offer better price ratios: In 2015, strike-prices for solar power projects in the UK were a mere £50-79 per MWh and £79-83 per MWh for onshore wind – with much shorter contract times of around 15 years. Because electricity prices have fallen since the signing of the contract for Hinkley Point C in 2012, total energy consumer subsidies are estimated to rise from the initially proposed £6.1 billion to £29.7 billion all paid for by the consumers. In addition, there are up to £20.3 billion in construction subsidies.[3]

Previous EPR projects are not a success story: The proposed reactor in Olkiluoto, Finland is running 10 years late and costs have already tripled. The reactor in Flamanville, France is running 6 years late, while costs have also tripled. The company responsible for both endeavors, French former nuclear giant AREVA has had to declare bankruptcy over the two failed nuclear projects and had to be saved by the French state (again with tax payer's money). Another partner organization, German former nuclear giant Siemens, dropped out of the nuclear business entirely over the situation in Olkiluoto.

It is unclear whether the French state-company EDF, which is going to build Hinkley Point C can handle the expenses likely to arise from the project. After AREVA went bankrupt it had to be bought by state-owned EDF. Now EDF has a debt of €37 billion and had to be subsidized with tax money to prevent it from filing bankruptcy as well. The investment sum for Hinkley Point

1 World Nuclear Industry Report 2013

2 www.energybrokers.co.uk/electricity/historic-price-data-graph.htm

3 www.iisd.org/gsi/news/how-much-again-cost-subsidies-hinkley-point-nuclear-power

C exceeds the capacities of EDF and could lead to its financial demise, which is why its chief financial officer and a prominent board member resigned over EDF's decision to go ahead wit Hinkley Point C.[4]

Hidden costs are not taken into account

The nuclear industry argues that all of these costs are vastly exaggerated, when in truth, it is just the opposite. The costs of nuclear energy are kept artificially low.

The front-end costs for the mining and production of uranium are kept low by criminally negligent safety and health standards in uranium mines and human right abuses towards indigenous communities. Examples include the situation of the Cree and other First Nations in Canadian uranium mining regions in Ontario and Saskatchewan, the impact of uranium mining on the Aborigine populations in Kakadu National Park, Radium Hill or Olympic Dam, Australia or the health effects of chemical leeching of uranium in South Africa's Witwatersrand region around Johannesburg. These are all regions, where the UK has acquired uranium in the past.[5] Other examples include Arlit and Akokan in Niger, Mounana in Gabon, Jadugoda in India, the Wismut region in Eastern Germany, Rössing in Namibia, Church Rock or Spokane in the US and Mailuu Suu in Kyrgyzstan.[6]

The running costs of nuclear power plants are artificially decreased by freeing the nuclear industry from adequate insurance responsibilities. The amount of money in the liability pool of British Nuclear Risks Insurance Limited is wholly inadequate when it comes to the potential risks of a nuclear meltdown. For Hinkley Point C, EDF's insurance covers only €1.2 billion.[7]

The back-end costs are also not taken into consideration: decommissioning of nuclear reactors, clean-up as well as storage and security of nuclear waste cannot be calculated yet and will substantially be paid for by tax-payers for generations to come. Just recently, the government had to admit that there will be a cap for the amount of money the nuclear industry will pay for waste storage - costs which in all likelihood will spiral out of control in the coming centuries.[8]

There is still no credible solution for long term management nor a site in prospect. This imposes morally unacceptable burdens on future generations. In 2002, the cost of decommissioning the UK's nuclear facilities had been estimated at around £42 billion. This number rose to £73 billion in March 2007 and is expected to continue to rise. Around £46 billion of the £73 billion is for the decommissioning and clean-up of the Sellafield site.[9]

Costs and profits of nuclear energy

So while the vast profits of the nuclear industry are privatized (all 15 nuclear reactors in the UK are owned by the French government company EDF), risks and costs and socialized and stay in Britain.

As doctors and environmentalists, costs should not be our main arguments, however: if nuclear power would indeed help to effectively alleviate global warming, we would be willing to pay for it. But there are safer, healthier, more intelligent solutions.

4 Financial Times, July 29th, 2016, www.ft.com/content/3209004a-54ca-11e6-befd-2fc0c26b3c60

5 Berkemeier M et al. Danish Institute for International Studies, DIIS Report 2014:02 „Governing Uranium in the United Kingdom". http://pure.diis.dk/ws/files/58173/RP2014_02_Uranium_UK_cve_mfl_web.pdf

6 Hibakusha Worldwide, www.hibakusha-worldwide.org

7 Global subsidies initiative https://www.iisd.org/gsi/news/how-much-again-cost-subsidies-hinkley-point-nuclear-power

8 The Guardian: „Secret government papers show taxpayers will pick up costs of Hinkley nuclear waste storage". https://www.theguardian.com/uk-news/2016/oct/30/hinkley-point-nuclear-waste-storage-costs

9 UK Energy Policy, Laws and Regulations Handbook, p101

Health arguments

Uranium mining harms miners and locals

The negative health impact of nuclear energy does not start with the commissioning of the reactor, but already in the so-called „front end“: uranium mining. Meta-analyses of health studies from Canada, Germany and the United States have repeatedly shown excess cases of cancer in miners, workers and their families, who often lived in irradiated regions around the mines. When uranium is extracted from the rock, huge amounts of waste rock remain, which retain roughly 85% of the original radioactivity. Through chemical leeching procedures and the refining of uranium ore to yellow cake, large amounts of liquid radioactive waste is produced – the so-called tailings, which are usually either disposed of in local rivers or lakes or collected in tailing-ponds. During wet season , these regularly flood into river systems and potable water supplies, while waste rock deposits and dried out tailing-ponds can blow radioactive dust into villages and over agricultural land during dry season.[10-17]

Nuclear power plants cause cancer

During running operations, the radioactive releases of nuclear power plants cause cancer in the surrounding population. The KiKK Study, published in the International Journal of Cancer in 2008, is the largest and most comprehensive study on childhood cancer around nuclear power plants. It analyzed data from more than 6.000 children under 5 years of age over a course of 23 years (1980-2003) in the vicinity of all 16 German nuclear power plants. The graph below, taken from the KiKK study, shows the relationship between the odds ratio of childhood cancer and the distance that a child lives from a nuclear power plant. The study showed that childhood cancer risk increased by up to 8-18% for children living within 50 km of a nuclear plant, 20-40% for children living within 10 km, and 60-75% for children living within 5 km (for childhood leukemia the risk increased by 120%). No confounders could be found – only the distance from the power plant correlated with cancer risk. In absolute numbers, that would be 1.2 additional cases of childhood cancer per year, 69% of these leukemia.[18]

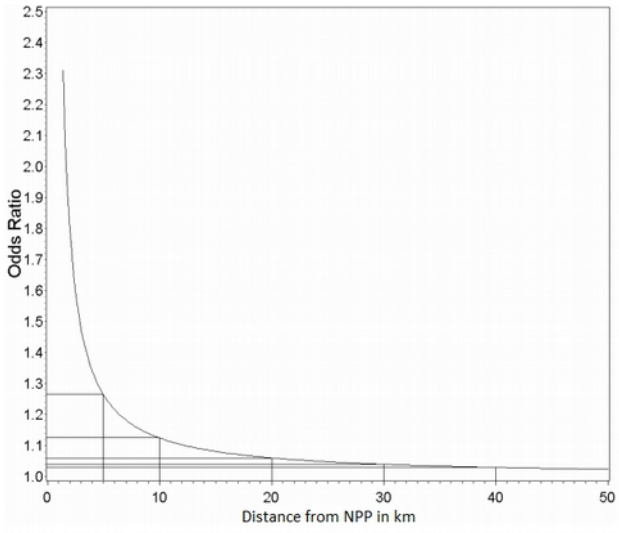


Image source: KiKK study 2008

10 Grosche B et al. „Lung cancer risk among German male uranium miners: a cohort study, 1946-1998“ Br J Cancer, 2006 Nov 6;95(9):1280-7

11 Lubin JH et al. „Lung cancer in Radon-exposed miners and estimation of risk from indoor exposure“ Journal of the National Cancer Institute 1995, 87 (11) 817-827

12 Kusiak et al. “Mortality from lung cancer in Ontario uranium miners“. Br J Ind Med 1993;50:920-928

13 Gilliland et al. “Uranium Mining and Lung Cancer Among Navajo Men in New Mexico and Arizona“. J Occup Environ Med 42(3):278-283, March 2000

14 Woodward et al. “Radon daughter exposures at the Radium Hill uranium mine and lung cancer rates among former workers, 1952-87”. Cancer Causes and Control 2:91

15 Zaire et al. “Unexpected Rates of Chromosomal Instabilities and Alterations of Hormone Levels in Namibian Uranium Miners“. Rad Res 1997 May;147(5):579-84

16 Rachel et al. “Mortality (1950–1999) and Cancer Incidence (1969–1999) in the Cohort of Eldorado Uranium Workers“. Radiation Research, December 2010, Vol. 174, No. 6A

17 Koide H. “Radioactive contamination around Jadugoda uranium mine in India“. Research Reactor Institute, Kyoto University, 8.7.02

18 Kaatsch P et al. „Leukaemia in young children living in the vicinity of German nuclear power plants.“ Int J Cancer. 2008 Feb 15;122(4):721-6. https://www.ncbi.nlm.nih.gov/pubmed/18067131)

The KiKK study has never been refuted. Other, less powerful studies from France[19], Switzerland[20] and the UK[21] have not been able to find significant increases in childhood cancers around nuclear power plants. However, this was mostly due to a lack of absolute numbers and statistical power. Taken together, these studies have actually shown to confirm the conclusions of the KiKK study.[22,23]

Data set	Occured cases	Expected cases	SIR	P-value *	RR	JP-value**
Switzerland (CH)						
0–5 km	11	7.87	1.40	0.3431	1.46	0.3334
5–15 km	54	56.40	0.96			
Great Britain (GB)						
<5 km	20	14.74	1.36	0.2216	1.41	0.1715
>5 km	1579	1640.44	0.96			
Germany (D)						
<5 km	34	24.09	1.41	0.0656	1.45	0.0549
>5 km	585	599.58	0.98			
CH + GB + D						
<5 km	65	46.70	1.39	0.0130	1.44	0.0069
>5 km	2218	2296.42	0.97			

*P-value (Poisson distribution).
**P-value (Binomial distribution).

Table Source: Körblein, 2012

A recent British study, performed by British Nuclear Fuels scientist Richard Wakeford, showed no significant rise in childhood cancer, but noted that the absence of such findings do not negate the KiKK study's results, as the design of the study was different to that of the KiKK study, with less information on actual living location of cancer patients. Also, the study only included 10 actual cancer cases in the 5 km radius around nuclear power plants, so that the power of the study and the precision of its estimates „may be inadequate to reveal an important effect“ according to the authors. The authors argue that this could be due to the fact that British nuclear power plants are located along the coastlines, far away from population centers, whereas German nuclear power plants are generally inland, with substantial populations in the surrounding area. In effect, the new British study was also not able to refute the findings of the KiKK study.[24]

Health effects can also be seen in the employees of nuclear facilities. The INWORKS study, published in Lancet Hematology in 2015 showed a direct correlation of bone marrow dose of ionizing radiation to excess leukemia rates in nuclear workers with more than 600.000 workers included in the analysis, 147.000 from the UK.[25] Other studies like the 15 country cohort study by Cardis et al[26] show similar risk factors for cancer and especially leukemia in nuclear workers across the globe.[27-31]

Health effects of low-level radiation have been shown repeatedly in major epidemiological studies in the past 15 years - from background radiation[32-35] to radiological diagnostics[36-38]. Some of these are avoidable (e.g. excessive sun, flights, unnecessary CT exams), others are not (e.g. cosmic radiation, radon). As there is no safe level of radiation and no threshold underneath which radiation is not harmful, we should strive to avoid any unnecessary source of radiation exposure. The nuclear industry is such an avoidable source.

19 Sermage-Faure C et al. „Childhood leukemia around French nuclear power plants – The geocap study, 2002-2007. Int J Cancer. 2012
20 Spycher BD, Feller M, Zwahlen M, Röösli M et al.: Childhood cancer and nuclear power plants in Switzerland: a census-based cohort study. Int J Epidemiol 2011, doi: 10.1093/ije/dyr115
21 COMARE report 14: „Further consideration of the incidence of childhood leukaemia around nuclear power plants in Great Britain“
22 Körblein A. „CANUPIS study strengthens evidence of increased leukaemia rates near nuclear power plants.“ Int J Epidemiol. 2012 Feb;41(1):318-9
23 Körblein A, Fairlie I.: French Geocap study confirms increased leukemia risks in young children near nuclear power plants. Int J Cancer 2012, 131(12), 2970-1
24 Bithell JF, Murphy MFG, Stiller CA, Toumpakari E, Vincent T, Wakeford R. „Leukaemia in young children in the vicinity of British nuclear power plants: a case-control study.“ British Journal of Cancer (2013) 109, 2880-2885.
25 Leuraud K et al. „Ionising radiation and risk of death from leukaemia and lymphoma in radiation-monitored workers (INWORKS): an international cohort study.“The Lancet Haematology , Volume 2 , Issue 7 , e276 – e281.
26 Cardis E et al. Risk of cancer after low-doses of ionising radiation: retrospective cohort study in 15 countries. BMJ 2005; 331:77
27 Zielinski JM, Shilnikova N, Krewski D: Canadian National Dose Registry of Radiation Workers: overview of research from 1951 through 2007. Int J Occup Med Environ Health 2008, 21, 269-275
28 Wiesel A, Spix C, Mergenthaler A, Queißer-Luft A: Maternal occupational exposure to ionizing radiation and birth defects. Radiat Environ Biophys 2011, 50, 325-328
29 McKinney PA, Alexander FE, Cartwright RA, Parker L: Parental occupations of children with leukaemia in west Cumbria, north Humberside, and Gateshead. BMJ 1991, 302, 6.“ 81-687
30 Dickinson HO, Parker L: Leukaemia and non-Hodgkin's lymphoma in children of male Sellafield radiation workers. Int J Cancer 2002, 99
31 Richardson DB, Wing S, Schroeder J, Schmitz-Feuerhake I et al.: Ionizing radiation and chronic lymphocytic leukemia. Environ Health Perspect 2005, 113(1), 1-5
32 Krewski D et al. „Residential radon and risk of lung cancer: a combined analysis of 7 North American case-control studies.“ Epidemiology 2005 Mar; 16(2):137-45
33 Darby S, Hill D, Auvinen A, Barros-Dios JM et al.: Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies. BMJ 2005, Jan. 29, 330 (7485)
34 Kendall G, Little MP, Wakeford R, Bunch KJ et al.: A record-based case-control study of natural background radiation and the incidence of childhood leukaemia and other cancers in Great Britain during 1980 – 2006. Leukemia 2013, 27, 3-9
35 Spycher BD et al. "Background Ionizing Radiation and the Risk of Childhood Cancer: A Census-Based Nationide Cohort Study"):
36 Pearce MS, Salotti JA, Little MP, Mc Hugh K et al.: Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumors: a retrospective cohort study. Lancet 2012, 380 (9840), 499-505
37 Miglioretti DL, Johnson E, Williams A, Greenlee RT et al.: The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. JAMA Pediatr 2013, Jun 10:1-8.
38 Mathews JD, Forsythe AV, Brady Z, Butler MW et al.: Cancer risk in 680.000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. BMJ 2013, 346:12360.

The risk of nuclear accidents is underestimated

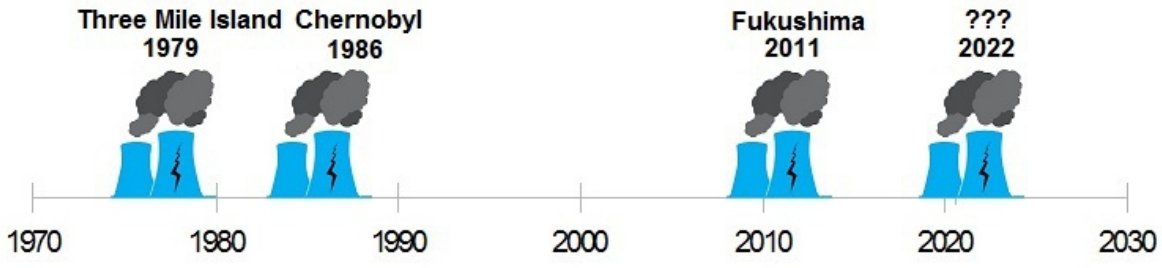
A nuclear meltdown or other serious accidents can result in the release of large amounts of radiation and lead to increased risks of cancer and other radiation-related diseases, as witnessed in Chernobyl and recently in Fukushima.[39,40] Worldwide, 12 nuclear reactors had to be shut down due to severe accidents (about 7% of all nuclear reactors that have been shut down so far). There have been three major nuclear catastrophes with melt-downs in a course of 32 years (1979-2011). That's one major nuclear catastrophe every 11 to 12 years. Statistically speaking, the next nuclear catastrophe can be expected around 2022.

Currently, roughly one third of the 58 nuclear reactors in France are offline for safety issues (carbon anomalies in the steel casings of the reactor core), just like 47 of 50 reactors in Japan. There are currently major safety issues in several nuclear reactors in Germany, Belgium, the Czech Republic, Switzerland, Sweden or Ukraine, with back-up generators failing (Forsmark, Sweden), steel containments showing unexplained cracks (Doel and Tihange, Belgium) or concrete structures too brittle to withstand an influx of cooling water at room temperature so that cooling water is regularly pre-heated.

Our nuclear legacy harms future generations

The health effects of nuclear power do not end with the decommissioning of the reactors. When a nuclear power plant is shut down, it turns into nuclear waste – not just the old fuel rods: millions of tons of concrete, steel, plastic components and other building material has to be taken apart and undergo a clearance process to assess its radioactivity. The vast majority of this material will be low level radioactive waste. Currently, many states plan to dilute this material with other industrial waste until the radioactivity lies below the state's legal limits and then release the material into the normal recycling process. This means that in a few years we could see low-level radioactively contaminated metal in skillets, spoons or braces – and would have no way of controlling or monitoring it.

In the meantime, the medium and high level radioactive waste such as old fuel rods or damaged reactor cores has to be stored in a sufficiently safe location for hundreds of thousands of years. There is still no credible solution for the long term management of this toxic nuclear waste, nor is there a site in prospect. Even in the case of subterranean long-term storage, accidents, human error, natural catastrophes, terrorist attacks or simple leaks could release radioactivity into soil and ground water, causing harm to future generations, who might not even know of the dangerous materials lurking below. Transporting this vital information to future generations in thousands of years will be a big challenge in itself. In any case, it will be our children and grandchildren who will be paying for our nuclear legacy.



39 Cardis E, Krewski D, Boniol M, Drozdovitch V et.al.: Estimates of the cancer burden in Europe from radioactive fallout from the Chernobyl accident. Int J Cancer 2006, 119, 1224–1235

40 Claussen A, Rosen A1. „IPPNW/PSR Report: 30 years living with Chernobyl, 5 years living with Fukushima – Health effects of the nuclear disasters in Chernobyl and Fukushima.“ www.ippnw.de/commonFiles/pdfs/Atomenergie/Tschernobyl/Report_TF_3005_en_17_screen.pdf

Environmental arguments

Uranium mining creates nuclear wastelands

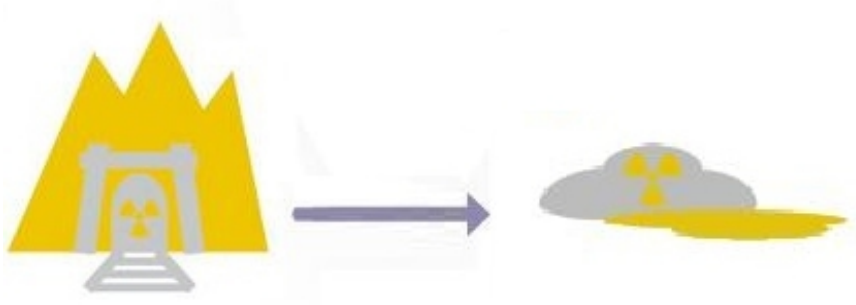
Uranium mining and conditioning devastates the affected regions and turns them into nuclear wastelands, depleting water supplies and contaminating water, soil and air with radioactive dust, tailings and waste-rock. In most countries, it is socially disadvantaged indigenous populations that are most heavily affected, such as the Cree in Canada, the Navajo in the US, the Aborigine in Australia or the Tuareg in Niger. Some examples, taken from IPPNW's Hibakusha Worldwide Exhibition[41]: The Wismut region in Eastern Germany was so heavily contaminated by uranium mining in the 1990s that it cost German tax payers more than €7 billion to stabilize and decontaminate – with continued costs over the next centuries still not calculable. In Elliot Lake, Canada, radioactive spills have killed all life in the 58 km Serpent River System. In Olympic Dam in Australia, uranium mining's excessive demand for water has caused substantial problems in the local ecosystem with the depletion of one of the country's most important aquifers, the Great Artesian Basin. In the mining towns of Arlit and Akokan in Niger, children are playing in radioactive dust and rubble while local farmers live in houses constructed largely with contaminated waste rock. Ranger Mine in Northern Australia had to be closed after numerous spills and accidents devastated large parts of the wetlands of Kakadu National Park. Every uranium mining site in the world has stories like this.

Nuclear energy blocks renewables

Direct and indirect state subsidies for the nuclear sector in terms of research and development, education of nuclear scientists and engineers, construction of nuclear power plants, hidden subsidies over the electricity price, reduced insurance liabilities, clean-up and decommissioning costs, waste management, etc., are drawing away money from the renewable sector.

Excess capacity from nuclear plants literally flood the electric grids so that cheaper and cleaner renewables are either not developed or are not fully used. In countries with substantial amounts of nuclear and renewable energy in the grid, wind turbines have to be turned off at regular intervals, for example, because nuclear plants are blocking the grid. Adjusting nuclear power plants to match demand is not possible, as the reactors are not as flexible cannot safely be turned on and off on short notice.

In the new Renewable Energy Country Attractiveness Index (RECAI), European countries saw their positions improve, with Germany, France, Belgium, Sweden, Ireland, Norway and Finland all climbing the ranking, while the UK fell to an all-time low in 14th position. This loss of appeal in the eyes of investors was caused to a large degree by the approval of Hinkley Point C and the negative impact this will have on investments in renewables in Britain.[42]

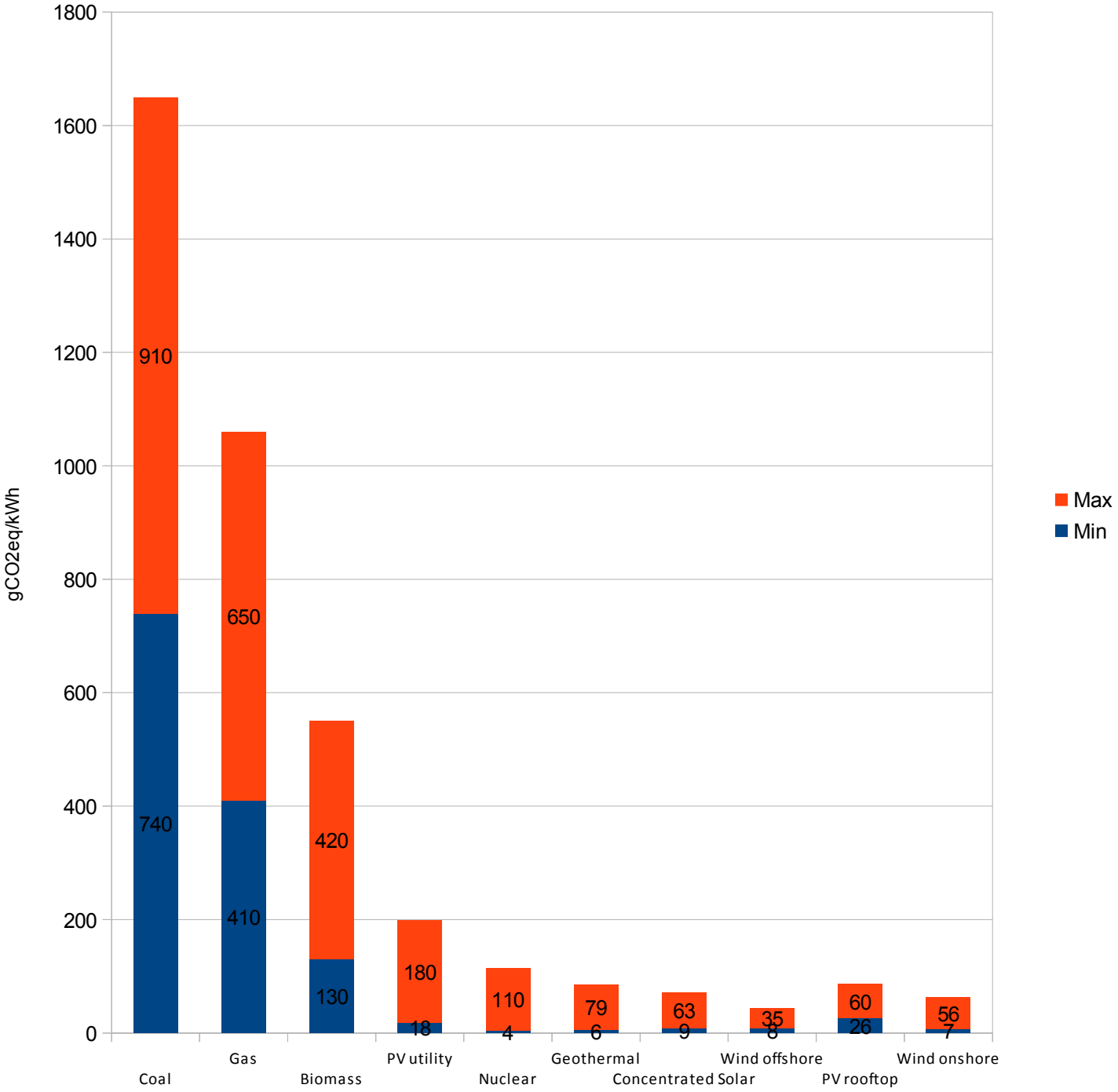


41 Hibakusha Worldwide, www.hibakusha-worldwide.org

42 www.ey.com/Publication/vwLUAssets/EY-RECAI-48-October-2016/$FILE/EY-RECAI-48-October-2016.pdf

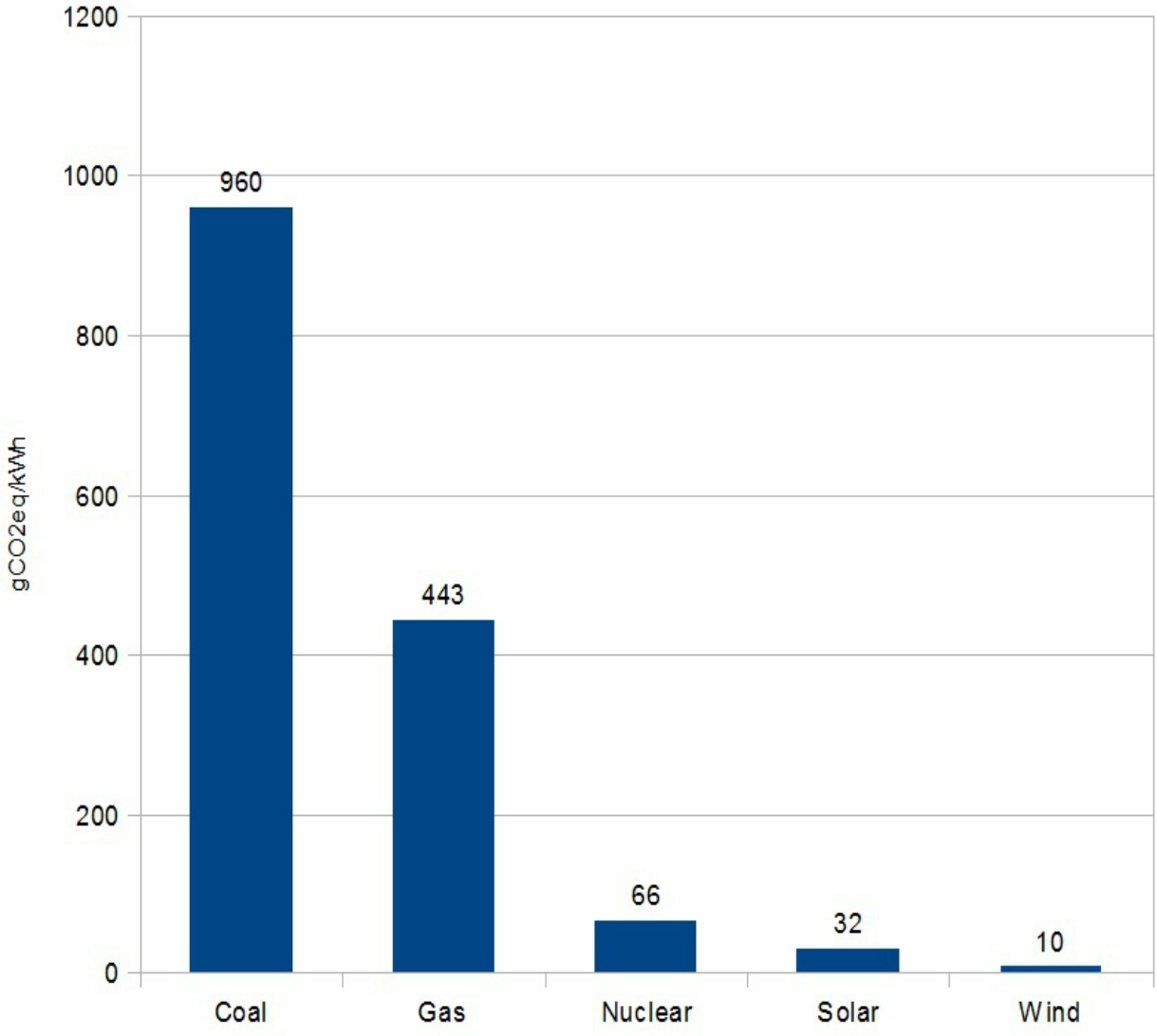
Nuclear power is not carbon-free

According to the 2014 IPCC report, nuclear energy is about on par with renewables in terms of life cycle CO_2 equivalent:[43]



43 IPCC: „Climate Change 2014 – Mitigation of Climate Change“, Annex III – Technology-specific Cost and Performance Parameters, Table A.III.2, p. 1335

Other scientists disagree with this optimistic estimate, like scientist Benjamin Sovacool from the National University of Singapore, who ran a meta-analysis of 103 life-cycle studies of the nuclear fuel cycle in 2008 and found that in fact, nuclear power generates about 6 times more CO_2 than wind energy:[44]



Not included in these estimates is the fact that, over time, life-cycle greenhouse emissions from nuclear power are likely to increase by 55-220% as high-grade uranium ores are mined out and more CO_2-intensive techniques will be required to extract it from the ground or leech it out of soil.[45]

Also not adequately represented in these estimates is the back-end of nuclear energy: the CO_2 required in treating, storing and safeguarding the enormous amounts of radioactive waste from uranium mining, chemical refinement of uranium and the nuclear power plants for hundreds of thousands of years.

44 Sovacool BK. „Valuing the greenhouse gas emissions from nuclear power: A critical survey.“ Energy Policy 36 (2008) 2940-2953

45 Warner ES, Heath GA. „Life Cycle Greenhouse Gas Emissions of Nuclear Electricity Generation.“ Journal of Industrial Ecology, Volume 16, Issue s1, April 2012, 573-592.

Nuclear power is irrelevant in terms of GHG

Nuclear power is not a solution to greenhouse gas (GHG) emissions. It is in fact irrelevant when it comes to global energy strategies. It only produces about 10% of world electricity and 5% of global energy. Electricity generation only accounts for 25% of greenhouse gas emissions.[46] That means that nuclear power currently only prevents 1.25% of global greenhouse emissions from energy production. Even the lofty goal of some nuclear lobbyists to triple nuclear power generation worldwide would only reduce greenhouse gas emissions by less than 5% - and only if the assumption is to replace coal instead of boosting exports of fossil fuels or energy sourced from fossil fuels, as happened in some countries who expanded their nuclear power generation. In 2003, MIT concluded that 1.000 to 1.500 new reactors would be needed to displace a significant amount of carbon-emitting fossil fuel generation in the coming 50 years. That would mean having to build two new reactors every month – a feat that the stagnant nuclear industry could not possibly accomplish.[47]

With very long lead times for construction of new nuclear power plants, they do not pose a useful remedy for the very acute problems of global warming. The nuclear industry does not have the capacity to rapidly expand production as a result of 20 years of stagnation. The last British nuclear reactor was commissioned more than 20 years ago.

While nuclear power has flatlined in the past two decades, global renewable power capacity more than doubled from 2004 to 2014 (and non-hydro renewables grew 8-fold) – more than 780 Gigawatt of new renewable power capacity was installed between 2005 and 2014, and costs are falling.[48] Global renewable capacity is 4.6 times greater than nuclear capacity, and the capacity for renewable electricity generation is twice as high as for nuclear generation.[49]

46 Key World Energy Statistics 2015. www.iea.org/publications/freepublications/publication/KeyWorld2016.pdf

47 The Future of Nuclear Power, MIT 2003 www.web.mit.edu/nuclearpower/pdf/nuclearpower-summary.pdf

48 Greenpeace International, September 2015, „Energy [R]evolution: A sustainable world energy outlook 2015“ www.greenpeace.org/international/en/publications/Campaign-reports/Climate-Reports/Energy-Revolution-2015

49 “Renewables 2015: Global Status Report”, REN21, www.ren21.net/status-of-renewables/global-status-report/

Nuclear power is not a global solution

Nuclear power generation is mainly restricted to countries with nuclear weapons programs and their close allies: The US produces 33% of all nuclear power worldwide with France coming in second at 17% Together, these two countries account for a total of 50% of all nuclear power generation in the world.

The other 50% of nuclear energy generation is distributed mainly over Russia, the UK and China (completing the group of 5 official nuclear weapons states), Sweden, Taiwan, Belgium Switzerland and Germany (all five of which are phasing out of nuclear energy) and Canada, South Korea, Spain and Ukraine. Japan has effectively ceased to be a major nuclear energy producer after turning off all 50 nuclear reactors after Fukushima (3 are currently back on-line).[50]

The majority of countries worldwide do not have nuclear power and lack the basic prerequisites for it, such as a stable political situation, the financial means of undertaking such expensive ventures, the scientific know-how to operate nuclear programs or the necessary safety standards to minimize the risk of another nuclear catastrophe. Renewable energy systems, on the other hand, can be implemented in pretty much any situation on earth, from mega-cities like Seoul (which decided against building a new nuclear power plant in 2011 and instead implemented energy conservation and efficiency programs that have made another large-scale power plant unnecessary) to small islands in Indonesia, where local solar power projects can bring electricity to rural villages.

Many countries have even actively decided to ban nuclear energy in their countries or have already phased out: Australia, Austria, Denmark, Greece, Ireland, Italy, Latvia, Malaysia, New Zealand, Norway, the Philippines, Portugal, Vietnam.

Growth rates by Energy Source 2007-2012

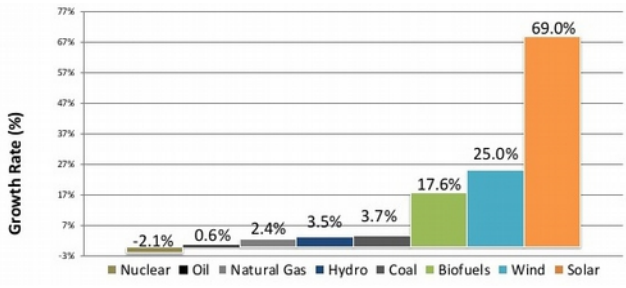


Image source: BP Statistical Review of World Energy, 2013

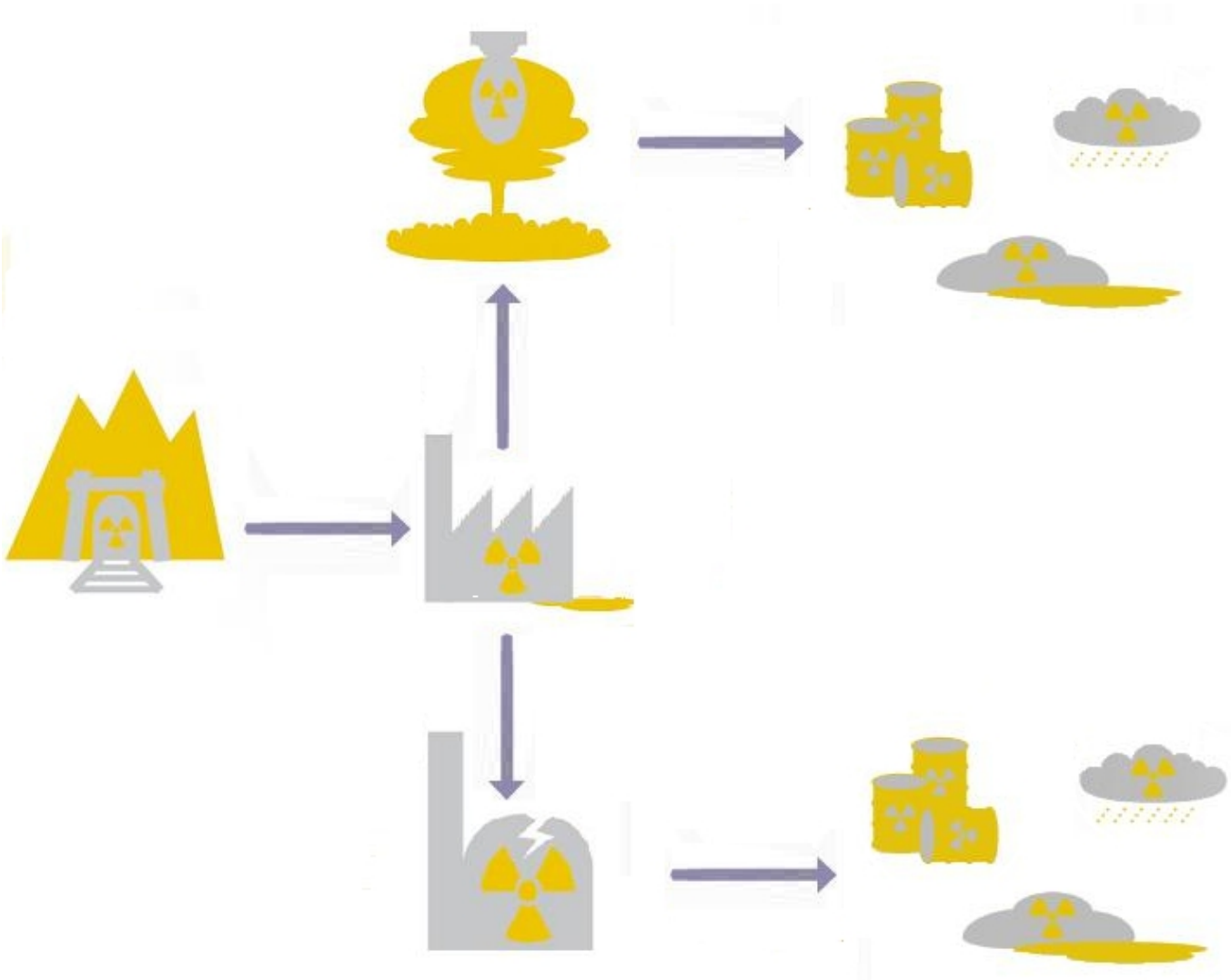
50 Nuclear Energy Institute World Statistics November 2016 www.nei.org/Knowledge-Center/Nuclear-Statistics/World-Statistics

Political arguments

Nuclear power and weapons are symbiotic

Nuclear power and nuclear weapons, or rather the civil and the industrial branches of the nuclear industry are inextricable linked. In many countries (USA, Russia, France, the UK, China, India, Pakistan, Israel, etc.), the nuclear programs were and still are under considerable influence of the military and the central government – for obvious reasons. One is the common nuclear chain – from uranium mining to conditioning, transport infrastructure, enrichment and ultimately radioactive waste management.

In addition, there has always been and still is a large overlap of investments in research and development and training of scientists and engineers. This was recently suggested as a possible argument for Hinkley Point C: a collateral benefit of the mammoth nuclear energy project would be a new generation of nuclear scientists and other hidden subsidies for the British Trident project.[51]



51 "Understanding the Intensity of UK Policy Commitments to Nuclear Power" by Emily Cox, Phil Johnstone, Andy Stirling from the Sussex University.

Waste-reducing reactors are an empty promise

The „next generation“ nuclear reactors promised by the nuclear industry, which would be able to 'burn away' nuclear waste, have been „in the making“ for more than 50 years. Arjun Makhijani from the Institute for Energy and Environment Research writes: „The idea that sodium cooled fast neutron reactors [could] be built to denaturate the plutonium reveals a technological optimism that is disconnected from the facts. (…) Roughly 100 billion USD have been spent worldwide to try and commercialize these reactors – to no avail.“[52]

Fact is, Integral Fast Reactors do not exist anywhere in the world. Early versions of fast breeder reactors were commercial failures and safety disasters. The fast breeder in Kalkar, Germany was never connected to grid for safety reasons and turned out to be a giant financial failure. The same is true for the Superphenix in France, which is also offline. The fast breeder in Monju, Japan took 9 years to built and only generated one hour of electricity before being turned off for ever. This hour cost 10.1 billion USD. Safety issues have been a constant problem for all fast breeder programs, with major reactor accidents having occurred in France, Scotland, Japan and the US. Even with the political will, it would take decades to develop these reactors - at exorbitant costs.

It is important to realize as well that 'burning' nuclear waste in such reactors does not make it disappear, but only transmutes it – i.e. the proportion of long-lived isotopes like plutonium, americium or curium is reduced, but some remain (cesium, krypton-87, stronium-90). To substantially reduce the danger of nuclear waste, it would take hundreds of years, at very high costs with marginal benefit – final storage is still needed for huge volumes of low-level and transuranic waste. At the same time, there are inherent proliferation risks, as these reactors can be reprogrammed to produce vast amounts of plutonium themselves.

Public discourse is influenced by the industry

The influence of the nuclear industry on governments and public discourse on nuclear issues cannot be overstated, for example through lobbyists that are strategically placed in public service positions. A case in point is the campaign for Hinkley Point C in UK, which runs against the financial interests of the British population, funnels money from the UK to France and China and gives these countries a greater control over the vital British energy sector.

In recent years, large companies have increasingly resorted to a new type of public relations strategy: “Astroturfing”. Like the artificial lawn “Astroturf” used in soccer stadiums, which looks like grass, but has no roots, there are more and more groups that purport to be grassroots-campaigns, but who are actually funded by the industry. George Monbiot writes about it at length, calling out the “international misinformation machine composed of thinktanks, bloggers and fake citizens' groups” and noting that “corporate funded think-tanks and fake grassroots groups are now everywhere.”[53] While he is mainly talking about climate change deniers, the same principle is true in the case of the nuclear industry. Surfing on the wave of activism and concern about climate change, the nuclear industry is trying to greenwash its business by selling it as a solution to global warming.

One prominent Astroturf-NGO in the nuclear field is “Energy for Humanity”, which was founded in 2014 to help nuclear energy overcome its negative image. Energy for Humanity's team showcases a wide array of vested corporate interest: Kirsty Gogan, the NGO's Global Director was formerly head of communications of the UK's Nuclear Industry Association and spokesperson for Hinkley Point C.[54] Robert Stone is an American filmmaker who produced the nuclear PR movie “Pandora's Promise”.[55] The NGO's Chair is Daniel Aegerter, a Swiss billionaire and one of the world's 40 wealthiest people, whose company ARMADA has high-stake investments in nuclear businesses such as the Transatomic Power Corporation.[56] Its European Director is Wolfgang Denk, former head of nuclear assets at Alpiq Suisse SA, one of Switzerland's most powerful operators of nuclear power plants, member of the Board of Directors of the European Mutual Association for Nuclear Insurance, staff member of the World Nuclear University and active contributor to the World Nuclear Association.[57] More vested interest and corporate influence hardly seems possible.

52 Arjun Makhijani: A Roadmap for US Energy Policy. www.ieer.org/carbonfree

53 Monbiot G. „The Misinformation Machine“. December 1st, 2016. www.monbiot.com/2016/12/01/the-misinformation-machine/

54 Gogan K. „Only with nuclear in the mix can we quit fossil dependence", https://uknuclear.wordpress.com/2013/10/22/only-with-nuclear-in-the-mix-can-we-quit-fossil-dependence

55 Beyond Nuclear „Pandora's False Promises: Busting the pro-nuclear propaganda“. www.beyondnuclear.org/pandoras-false-promises

56 http://armada.com/Entrepeneurial_Activities/Selected_Investments

57 https://ch.linkedin.com/in/wolfgang-denk-127b12127

Can environmentalists be for nuclear energy?

Since the rise of climate change awareness, the nuclear industry has focused its public relations efforts on greenwashing its dirty business and has begun to portray itself as a solution to global warming. While this strategy has not been successful in countries with traditionally high skepticism of nuclear energy and an alert base of environmentalists, aware of the arguments listed above, the nuclear industry's attempt at reinventing itself as a "clean" source of energy has managed in causing divisions and confusions in countries like the US or the UK recently.

Beside the usual lobbying and advertisement efforts, the unusual shift of nuclear energy in public perception in the UK cannot be completely understood without the individual example of prominent environmentalist George Monbiot loudly proclaiming a radical change of mind towards a support of nuclear energy. For many people, his example is enough to cast aside doubts and criticism of nuclear energy and see it as a "green technology".

While Monbiot recently wrote in favor of nuclear energy, he opposes the UK's plans to build a new nuclear power plant at Hinkley Point C, saying that "Hinkley C could leave us with a gigantic bill and nothing to show for it. (…) It will also have stymied – through the misallocation of both financial and political resources – other contributions to the low-carbon economy, in the form of renewable power and energy-saving technologies, which could be deployed immediately with minimal risk of failure."[58] Strangely, these are the same arguments that the anti-nuclear movement has been using all along.

Regardless of the reasoning behind Monbiot's unlikely and awkward change of mind, it raises the question how a so-called „environmentalist" could ever truly support a non-sustainable source of energy that requires massive environmental degradation in form of mining and chemical leeching, turning whole regions into radioactive wastelands, draining underground water supplies, disrupting and poisoning ecosystems with radioactive waste-rock, mine tailings and chemical residue. Uranium deposits might last a few more decades, a relatively period of time, which could possibly be prolonged by employing chemical remining of waste-rock or fracking-technologies. Ultimately though, the price of extracting uranium from soil would be too high and a different technology would have to be found. This is one of the major drawbacks of nuclear technology – it can never be a lasting solution. At most, it could be a bridging technology, but at the same time it would hinder meaningful development of other, more sustainable forms of energy generation and make energy conservation and efficiency measures less attractive.

It is also questionable whether a true environmentalist could ever warm up to a technology that has been shown to releases cancer-causing radiation – both during mining and processing, transportation and everyday operations; a technology that produces large quantities of radioactive waste that poses an almost insurmountable challenge for many generations to come – our children and grandchildren, who will suffer from and have to pay for a technology that they never profited from.

Finally, it is difficult to see how a true environmentalist could support a technology that, in the unlikely but very real case of a catastrophe contaminates air, soil and sea on geographic and temporal scales unimaginable for any other type of industrial accident, rendering large areas of countryside and whole cities uninhabitable for future generations.

Radioactive uranium is usually found deep under ground, where its harmful effects usually do not pose a direct threat to mankind and the non-human biota. It is only because of mankind's decision to mine this metal, bring it to the surface, chemically alter it, place it in bomb casings or fuel rods and spread it across the globe that we now live with a nuclear legacy of radioactive contamination from mining, civil and military nuclear accidents, nuclear detonations and waste dumping.

The goal of environmentalists across the globe should be to find sustainable, clean and healthy solutions to mankind's energy needs. The energy technologies of the 19th and 20th century – fossil and nuclear fuels - are not a solution to the energy challenges of the 21st century. A real energy revolution is needed.

58 Monbiot G. „Nuclear Power – yes please. Hinkley Point – no thanks". The Guardian, September 1th, 2016.

A real energy revolution is possible

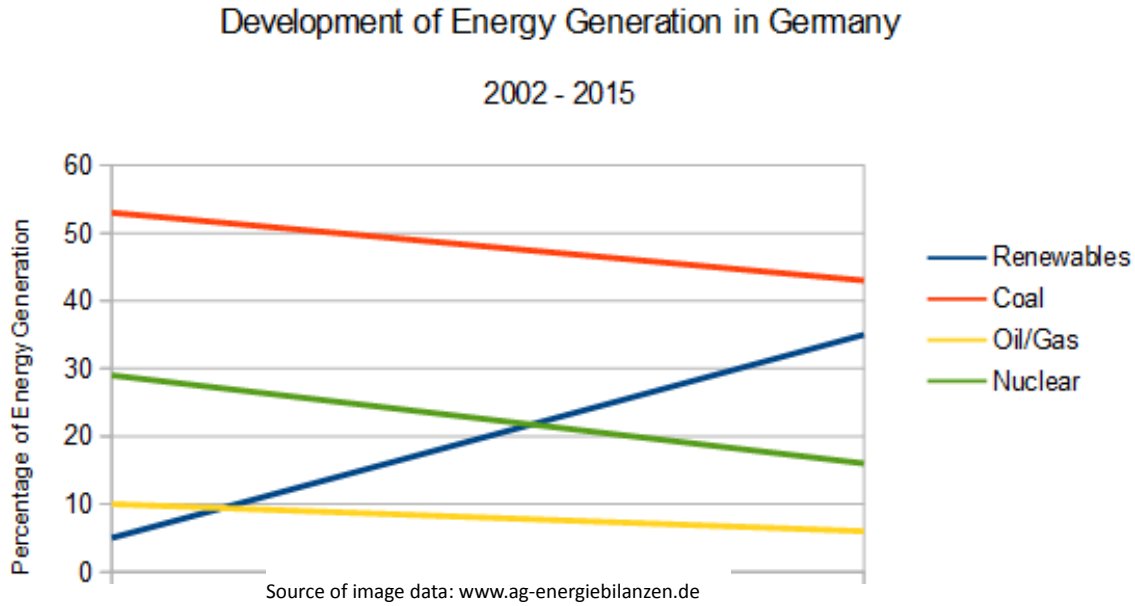
The three pillars of the real energy revolution are energy efficiency, energy conservation and renewable energy generation. A University of Cambridge study concluded that 73% of global energy use could be saved by energy efficiency and conservation measures alone.[59] All three of these measures have to build on one another and all three require a change of mind. We cannot continue business as usual and pretend that we can just switch from one mining product (coal) to another (uranium). CO_2 is a big problem for our planet, which has seen environmental degradation due to human activity on an unforeseen level. Endless growth, consumption of natural resources are not sustainable – we have to change our way of doing things.

In Germany, a loose network of city councils, individual entrepreneurs and energy start-ups, local energy cooperatives and progressive utilities have ushered in an energy revolution („Energiewende“) - against the attempts of central government to subdue it or slow it down and against the powerful four companies holding the monopoly in Germany over fossil and nuclear energy. Over the course of the last 15 years, renewable energy has risen from a mere 5% of total energy production to 35% - against all odds and against all predictions.[60]

These are average numbers. On some days, renewables already account for more than 80% of total energy production in Germany.[61] At the same time, the share of fossil fuels has been reduced from 63% to 49% and that of nuclear energy from 29% to 16%:[49,62]

Several cities and regions in Germany in have already become 100% self-reliant in terms of electricity generation or on their best way of becoming so in the coming decade. The Energiewende has become a motor for research and development, entrepreneurship and jobs. Already, more than 380,000 people in Germany are employed in the renewable energy sector, as opposed to the 30,000 in the nuclear sector.

If this is possible in a large country with a highly industrialized, diverse economy like Germany, it is possible anywhere. In fact, many countries have surpassed Germany in terms of revolutionary energy policies. Sweden is on target to run entirely on renewable energy within the next 25 years. In 2015, the country already produced 57% of its energy through renewables, the remainder coming from nuclear power, which Sweden is planning to phase out.



Source of image data: www.ag-energiebilanzen.de

59 Cullen JM et al. „Reducing Energy Demand: What Are the Practical Limits? Environ. Sci. Technol., 2011, 45 (4), pp 1711–1718

60 Burger B. „Stromerzeugung aus Solar- und Windenergie im Jahr 2015.“ Fraunhofer Institut für Solare Energiesysteme ISE www.ise.fraunhofer.de/de/downloads/pdf-files/aktuelles/folien-stromerzeugung-aus-solar-und-windenergie-im-jahr-2015.pdf

61 „2015 Rekordjahr für Erneuerbare Energien in Deutschland.“ European Climate Foundation, 07.01.16. https://europeanclimate.org/de/2015-record-year-for-renewable-energies-in-germany

62 Arbeitsgemeinschaft Energiebilanzen e.V. http://www.ag-energiebilanzen.de/7-0-Bilanzen-1990-2014.html

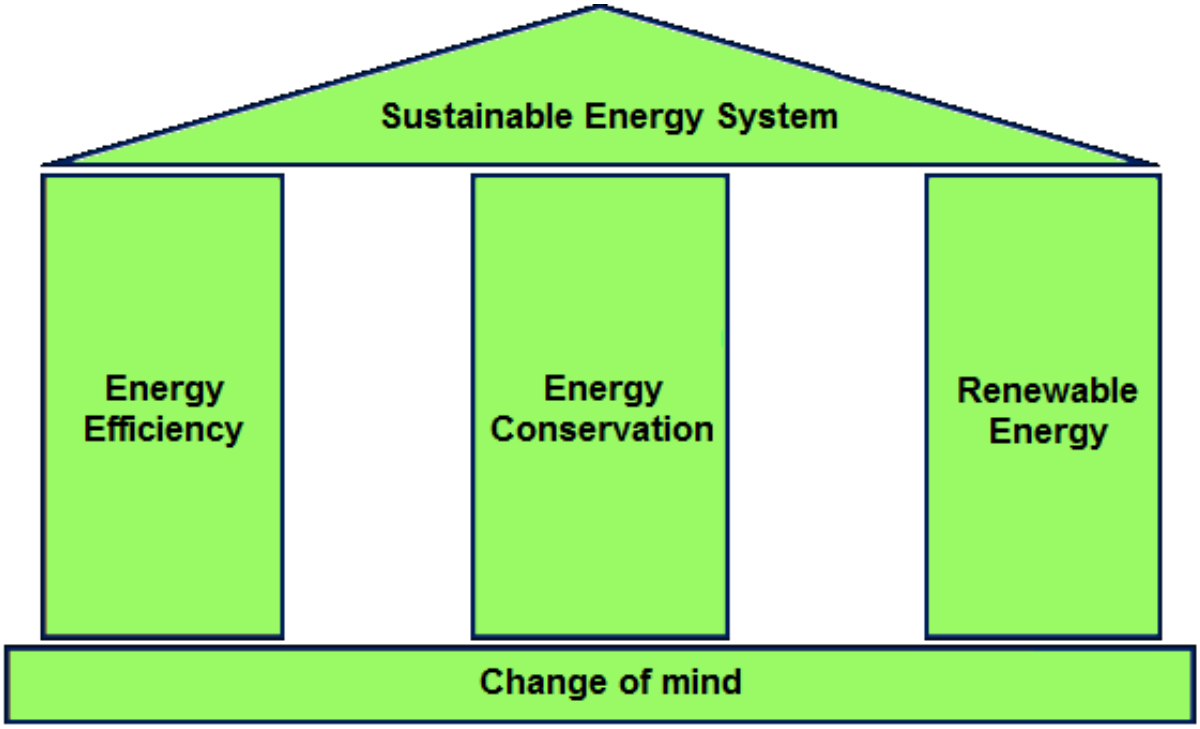
Norway and Iceland are producing 100% of their electricity from renewables. Denmark produced 140% of its electricity needs through wind power alone in 2015, exporting the rest of the energy to its neighbors, Germany, Sweden and Norway. The US state of California is aiming to produce 50% of its energy from renewables and even developing countries like China are investing heavily in renewables.

For developing countries like India, a energy revolution with distributed renewable power generation offers much more chances for development than large nuclear reactors. 70% of the population lives in rural areas and grid penetration is currently at 65%.[63] These are great prerequisites for small-scale community based distributed energy systems, but not for old-school centralized nuclear or fossil power generation. For developed countries like the UK, the positive effects beside clean, healthy energy generation are energy autonomy and independence from foreign energy imports. At the same time, money that was sent abroad before would instead be used to build up a sustainable integrated energy infrastructure on a local level, provide much-needed economic incentives, encourage entrepreneurs and start-ups and create stable, well-paying jobs in rural areas - technicians, engineers, steelworkers, architects, project developers and service personnel.

The Future lies in small-scale, community-based distributed renewable energy systems, run by communities or local energy cooperatives, using advanced batteries that store and release excess renewable power, power-to-heat cogeneration, geo-thermal heat pumps, smart grids, smart meters, and other modern solutions. Geothermal and offshore wind energy are capable of delivering reliable base load power.

This system can create energy autonomy and independence from foreign energy imports, create well-paid and stable jobs in the region, break the monopoly of large power companies by replacing their business model with decentralized alternatives and make the energy market more transparent, more flexible, more inclusive, more resilient and more democratic. Ultimately, such a system of energy generation is safer from threats like natural catastrophes (Fukushima), human error (Chernobyl) and armed conflicts (Ukraine, Iraq) and can even help promote peace by making wars over resources irrelevant.

This would truly be an energy revolution.



63 Impact analysis of distributed and RE based distributed generation on Indian economy and economy of BoP. Institute of Technology Kharagpur, India, 2010
www.wipro.org/earthian/documents/1000925_IITKGP_RE_Paper.pdf

IPPNW Germany
German Affiliate of the International Physicians for the Prevention of Nuclear War
Körtestr. 10
10967 Berlin

Phone: +49/ (0) 30 - 68 80 74 - 0
Fax: +49/ (0) 30 - 683 81 66
ippnw@ippnw.de
www.ippnw.de

Author: Dr. med. Alex Rosen
Contact: rosen@ippnw.de

Account for Donations:
IPPNW e.V.
IBAN DE39100205000002222210
BIC BFSWDE33BER
Bank für Sozialwirtschaft

Image on front page:
Ruin of unfinished fast breeder reactor in Kalkar, Germany, now used as an amusement park. Source: Koetjuh, Wikipedia


IPPNW
Germany