

## The True Cost of Electricity

### Way Kuo, President of City University of Hong Kong and Member of US National Academy of Engineering

Smog is a major problem facing Beijing and many other places on earth today. It is also a reminder that environmental pollution has reached a critical point in human history.

The recent documentary *Under the Dome*, an in-depth report on environmental problems in China by Chai Jing, has triggered a heated debate over the credibility of its sources. But the debate has sidestepped one of the critical issues facing humanity: greenhouse gas (GHG) emissions and their impact on the environment and the sustainability of Earth.

Energy is a necessity in modern life. Our dependence on electricity has left noticeable carbon footprints on nature. Of the broad spectrum of energies, **Rainbow Energy** as I name it, fossil fuels (coal, natural gas and oil) are still the major energy sources for electricity generation, accounting for 67% of world electricity production as of 2012, in spite of pledges by governments around the world in exploring and increasing the use of renewable green energies. The rest comes from cleaner energies like hydroelectric (17%), nuclear (11%) and others (5%). (World Bank - World Development Indicators)

According to the Intergovernmental Panel on Climate Change, approximately 37% of total CO<sub>2</sub> emissions is from electricity production, especially from burning coal. The level of atmospheric CO<sub>2</sub> is building up and that build-up is accelerating as electricity demand is expected to increase by 43% over the next 20 years.

Nuclear energy, in comparison, ranks among the lowest of any electricity generation method in terms of GHG emissions and comparable on a lifecycle basis to wind, hydro-power and biomass. It emits 1/15<sup>th</sup> and 1/30<sup>th</sup> as much GHG as natural gas and coal, respectively.

And yet, nuclear energy has been a controversial topic ever since its adoption for commercial use. There are as many opinions about this problem as there are experts. While it is praised as one of the possible solutions to the energy shortage, it is condemned by others as “an unbearable inheritance for future generations”. The nuclear accident at Fukushima Daiichi Nuclear Plant in 2011 brought the safety concerns sharply into the public eye again.

People are haunted by the fear of nuclear disasters when in reality nuclear energy has a strong safety record. Nuclear power plants achieve a high degree of safety by using what is called the “defence-in-depth” approach with multiple physical barriers built into their operation. These physical barriers prevent operational disturbances or human failures and errors, which have been found to be the cause of 80 to 90% of mishaps and accidents. Even the recent Fukushima nuclear accident, triggered by a magnitude-9 earthquake and catastrophic 14-metre-high tsunami, has been defined as “a profoundly manmade disaster”.

According to a report published in the 2013 March issue of *Environment Science & Technology* by Kharecha and Hansen from the US National Aeronautics and Space Administration, nuclear power has made greater contributions to the welfare of human kind than all other energies in use. The report pointed out that, even taking into account the serious consequences of the three biggest nuclear disasters in history, the benefits derived from the use of nuclear power between 1971 and 2009 have helped to prevent 1.8 million deaths resulting from causes related to the use of fossil fuels, especially coal.

Also, according to a December 2013 *Lancet* article by Chen Zhu, former Minister of Health of China, and his colleagues, air pollution causes 350,000 to 500,000 premature deaths on the mainland China each year. The main polluters are industry, coal and vehicles. This is believed to be a conservative estimate, and provides further evidence that CO<sub>2</sub> reduction is a necessity.

At present, nuclear power plays a significant part in a spectrum of energies in producing base-load power, and this will continue for the foreseeable future. The other energy sources used for base-load power are fossil fuels. In the past, increased use of nuclear energy to replace fossil fuels has contributed to a reduction in CO<sub>2</sub> emissions. Therefore, it will be devastating to continue the use of fossil fuels for base-load power instead of cleaner energies..

People demand nuclear safety, and yet tend to turn a blind eye to the adverse environmental impact of fossil fuels and the millions of deaths caused by coal-mining. With modern technology and decreases in oil prices, non-traditional fossil fuels such as oil sands in Canada, pre-salt deposits in Brazil and shale oil/tight oil in the US have been discovered in abundance since the beginning of this century. Yet the development of this new generation of fossil fuels will do nothing to reduce water and air pollution but in fact will create more severe pollution than traditional oil because of the extraction method.

There is no free electricity. Given that different energies involve different levels of risk and environmental pollution, we should adopt a rational and scientific approach to policy making. The cost of using electricity must take into account the economy, the costs of electricity generation, transmission and transformation, the sustainable well-being of the environment, safety, reliability, and other social and psychological factors. Consumers could choose what combination of various sources of electricity they are willing to accept and then be charged in accordance with the declared percentage, the amount of the electricity consumed, the production cost and the cost of the risk.

We cannot afford to continue to overlook the phenomenon of global warming. The true cost of electricity should be shared by everyone.

p.s. The article is based on a talk delivered by the author at Peking University on 16 March 2015