

## **Diversified Energy Portfolio & Climate Change**

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Let's take a step back and look at climate and energy generation from a rational perspective, including sustainability, reliability, economics and a comprehensive mix. Any analysis needs to be a realistic application on a global basis.

All forms of energy should be in the mix. This includes wind, solar, hydro, nuclear, gas and coal. Knee-jerk reactions by politicians to extremist groups need to be less a factor in decision making than scientific vetting. First investigate, then draw a conclusion and propose an action plan.

Wind and solar on a stand-alone basis may be fine for rural areas, but for industrialized areas, constant, reliable electricity is what is needed to drive the economy. Hydro is ideal in developing parts of the world. However, in the developed world most hydro assets have been fully developed and do not present significant potential to increase their utilization, with the one exception of upgrading turbines to more efficient models. Also, be aware that many indigenous people want rivers to run free.

Offshore wind presents its own unique set of problems. Too much wind or too little wind is problematic, limiting the operational range. Construction windows tend to be truncated, as are repair windows, due to weather conditions. Specialized ships are required to hold station during both the construction and repair phases. Offshore environments can be hostile to offshore assets. Blade delamination, structural failure of pylons and damage to transmission lines all have to be factored into the decision process.

Solar has its own unique set of issues. Solar droughts due to volcanic activity or storm systems render solar non-productive for at least one-third of the 24-hour cycle.

Nuclear, particularly with the advent of small modular reactors, is ideal for base-load capacity needs (24-hours per day, seven days per week, 365 days per year). The public outcry against nuclear is primarily based on three events: Chernobyl, Three Mile Island and Fukushima. Chernobyl was a product of Russian technology that failed to provide containment; therefore, when it had its meltdown there was no structure to contain the escaping radiation. Three Mile Island was the result of human error, which was effectively mitigated by the automated systems that shut the reactor down. Fukushima was the result of several issues including building a spent fuels pool at too low an elevation in an active seismic/tsunami area, which one can conclude was done to facilitate exporting the spent fuel rods to Europe for reprocessing and reimportation. This was compounded by the owner and government spending more time

pointing fingers than bringing more portable generators and fuel to the site or additional battery backup systems to continue cooling the pools containing the fuel rods.

Small modular reactors can be built to service current needs, and additional modules can be added as need increases. Refueling can be up to 20 years versus current large-scale reactors that have a two-year refueling cycle. And many of the spent fuels cannot be weaponized.

Whether you support or oppose coal, you need to face the cost factors that coal presents. It's plentiful and inexpensive and a major player in former Soviet satellite countries and many parts of Asia. But can we live with coal's emissions profile? Globally the U.S. has reduced coal usage, but long before the reduction in capacity the U.S. coal industry was at the forefront of reducing carbon emissions by upwards of 95% with technologies that are readily deployable to parts of the world that continue to use coal. This would help the U.S. economy by providing jobs, reviving U.S. manufacturing, assisting with trade deficits, and making the world a more climate-friendly place while supplying power to maintain our quality of life

In recent times there was a mad dash to gas-fired units, which resulted in additional harmful emissions. Gas-fired plants provide a key role in managing peak demand periods (summer heat waves, winter cold snaps). They can cycle quickly with the flick of a switch and can also be a good backup for wind and solar when the wind doesn't blow and the sun doesn't shine. Gas plants were pressed into base-load needs, resulting in dramatic increases in nitrogen oxides that caused respiratory problems and reacted with other substances in the air to produce particulates and ozone.

Energy/climate change should not be a partisan issue. Action taken should not be done to pander for votes. The Earth is too important to its inhabitants.

A suggestion I have made numerous times during the last two U.S. administrations was the following: create two task forces consisting of scientists that would: (1) study the facts and draw a reasoned conclusion as to what should be done to mitigate the effects of climate change (imperative) and (2) study the cause(s) of climate change. The panel would be primarily composed of scientists with two exceptions. One member would be an environmental expert and the other would be a conventional energy expert. The basic rule would be anyone is free to express a reasoned opinion; however, if anyone goes off on an unsubstantiated rant, that person would be eliminated and not replaced.