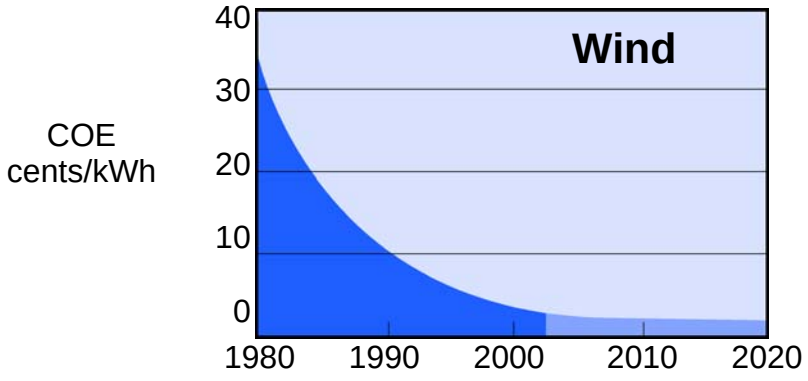
Notes for Joint Commission on Technology and Science

1. Increasing cost of oil: There is a distinction between fuels for electricity and those used in transportation. What alternative technologies address what areas of demand? Will offshore wind turbines or wave energy help alleviate the cost of gasoline?

   The offshore energy devices envisioned for the future, such as wind turbines, wave devices and current turbines, address electricity generation, and will significantly impact home heating and cooling requirements. In addition, with the advent of fuel cell dependent transportation, the ability to develop marine based Hydrogen (or ammonia) production plants could be a critical piece of the required infrastructure to support that shift to fuel cell power. The same plants can also produce desalinized water which has wide applications in some regions. Much of this technology R&D and potential future development could possibly be an export industry for Virginia.

2. a. What are the relative costs of traditional vs. alternative forms of energy?
   The traditional forms of energy production have been under development and refinement for decades. The comparison at this point on a kW-kW basis may not be accurate. Historically, cost/kWh declines after the development cycle, and levels off when production stabilizes.
   DOE envisions a 45% increase in power demand in the next 10 years. The vision is to create clean energy from sources that will help meet that need. Nuclear power is among the lowest in present cost/kWh, but was expensive to develop and is expensive to build, and much of that burden has been borne by the federal government. Currently, wind energy is the world's fastest growing electricity generating technology.

Levelized cents/kWh in constant $2000[1]



Levelized cents/kWh in constant

b. What would have to happen in the marketplace for alternative / renewable energies to be cost competitive with traditional energy sources?

As demand for electricity increases, non-renewable sources will decrease, with a corresponding increase in price. This will create additional demand for alternative sources of energy, and as demand increases, costs will decrease.

The key is to begin development of renewable offshore technologies now, so the technology is in place to meet demand at competitive prices in the future. Europe is 10 years down this path now, and the US is loosing ground in both technology and science applications in this field. Offshore renewable technologies have a potential worldwide market beyond solving US domestic energy problems. The R&D investment done in Europe to date can be leveraged to accelerate progress here in the US. This is what the Canadians are doing in Canada.

3. What are the main drawbacks of each technology?
    a. Marine Wind Turbines: There is significant engineering development required to place the devices in greater than about 30m of water, and to withstand extreme weather. The greatest limitation is possibly the integration of a modulating energy source with the present static grid design. The third is the need to carefully coordinate these facilities with other marine industries such as shipping, fishing, and military uses.
    b. Wave Energy harvesting: These include surface riding devices to harvest the wave motion. The greatest engineering challenges are reliability and maintenance issues due to the constant motion applied to the device.
    c. Tidal-in-Stream / Current Turbines: Locating turbines in a submerged environment minimizes weather impacts, but environmental and survivability issues need to be addressed, as well as long term maintenance.

4. Where are these technologies in terms of implementation across Europe, US and VA?
    a. Europe: Denmark, Germany and UK have very aggressive programs in Wind Energy. The catalyst in creating this progress was government mandates on a defined percentage of energy production being required from renewable technology. Presently 2% of Denmark's total energy consumption comes from marine wind turbines.
    b. In Scotland, the government-funded European Marine Energy Centre leads development in this technology field. The Pelamis Wave Energy Converter (OPD, Scotland) has been field-tested with promising results. The prototype system was installed off Scotland in May 2004, and a Pelamis development field is being installed off the coast of Portugal.
    c. China and India both have initiatives underway in the marine renewable market, recognizing that traditional energy sources will not be sufficient to meet their rapidly growing demand. These markets have huge potential for US energy technologies.
    d. The following is a summary of US activities:

i. Alaska: EPRI Tidal-in-stream technology demonstration site: Cook Inlet: Anchorage
ii. California: Wave pump buoy technology: Eureka
iii. Connecticut: Eergetech, Ct Clean fund- poor resources but wants to position as industry leader
iv. Hawaii: Wave energy technology- Kaneohe Bay, Oahu
v. Maryland: Current Turbines- Annapolis
vi. Massachusetts: River current turbines, Wind power- Cape Cod
vii. Maine: Tidal-in-stream technology (EPRI assessment) – Passamaquoddy Bay
viii. New Jersey: Buoy power conversion-Tuckerton
ix. New York: Axial flow turbine- East River / Wind off long Island
x. Oregon: Wave conversion using permanent magnets- Gardiner
xi. Rhode Island: Current Turbine- Pr Judith
xii. Washington: Aqua buoy demonstration- Makah Bay

e. Virginia: Verdant Power (Arlington), is involved in several projects in other states. All the conditions are favorable for Virginia to take a leading role in both development and production in the future.

5. What is the largest barrier to implementation in the US and Virginia in particular. As noted in the Ocean Commission report: An Ocean Blueprint for the 21st Century, Ch 24: "In other words it (Section 10) lacks the management comprehensiveness that is needed to take into account a broad range of issues, including other ocean uses in the proposed area and the consolidation of a coherent policy and process to guide off shore energy development." There is no substantial element of regulation or management that gives guidance. VA, as one of the leading maritime states in the country and with a large maritime industry base; needs to play a role in shaping how this is to be accomplished in the future.

6. In regards to offshore wind energy, how important and what is the distinction between projects located in state waters (< 3 miles off shore) and those located in federal waters?
   a. Jurisdiction changes with near-shore (State) and farther offshore (Federal) locations. Jurisdictions and their associated issues are still being determined, and various overlaps and vagaries exist.
   b. Near shore applications present less of an engineering challenge with installation and maintenance, with present technology supporting installation in 30 meters of water.
   c. Studies indicate better energy density exists farther off shore, and gas and oil platform technology can be applied to this industry, in support of deeper water development. In addition, the further off shore the site, the less interference likely encountered by other marine industries. On populated coastlines, the farther the site is from land, the less impact it will have on land-based industries such as tourism. However, studies show

that offshore structures create effective marine habitats that can serve to stimulate such industries as fishing and sport diving.

7. Some previous investments by VA have resulted in little or no return on investment due to failure to mature. Would this happen again if the General Assembly supported a marine renewable initiative? Why not?
    a. The issue of funding direct technologies may be premature. A better approach may be to direct funding to Academic-Industry partnerships to address general questions of engineering development, environmental assessment, etc., which will help answer basic science and economics questions in preparation for direct investment.
    b. The approach will prevent return on investment risk and put directed funding into state institutions that can assist in developing a reasonable investment strategy for the state. Additionally, this approach develops the human capital required to staff and lead the technology diffusion.

8. What could the General Assembly do to bring any of these technologies to Virginia, what would be the most effective? Tax Breaks, Direct Funding? Other Legislations?
    a. A concept to consider would be to form a coalition of State Gov, Academia, and Industry to influence policy, formulate an engagement and investment strategy.
    b. Provide initial investigative funding to VIMS, ODU, NSU, and VATECH for evaluation of environmental issues, placement and engineering prototypes for an initial test bed of technology options for off shore renewable energies.
    c. Support an Ocean Observatory Regional System for the Chesapeake Bay and Mid-Atlantic off shore region to ensure understanding of the Marine Environment and a means to baseline and measure any impacts that prototype installations may have.

9. What kinds of companies provide these technologies? Large or small? How many are there? What is SAIC doing right now and what are the plans for the future?
    a. Most of the companies involved with renewable technologies are small companies supported by grant monies or speculative investment. These companies range in size from $1m to about $20m in size. Several exceptions are General Electric, Eltra, and Vestas which are very large corporations. Depending on the qualifications used to define these companies an estimate of companies is probably in the range of 100.

    b. SAIC is presently involved to varying degrees in the following projects:
        i. Developing telecom cable applications for remote data collection and control in the Ocean Environment. (multiple programs for government customers)

ii. Developing Ocean Observing technologies and concepts (joint concept with ODU)
iii. Buoy based sensor systems for coastal and open ocean application (Internal SAIC IRAD in partnership with VIMS)
iv. Oregon Energy Coalition (OSU, OIW)
v. Discussing energy harvesting devices for Ocean Observatory with VATech
vi. Evaluating European Partners with mature technology and in discussion with several European companies.