AABE Hackathon HACK Problem Statements

This Technology Outlook, a global energy perspective examines key sections of the energy eco-system – from the production of natural resources- using energy in homes, workplaces, vehicles and heating. From that examination, several key themes have emerged. Some are linked to specific uses of energy, while others have impact in many areas. We set out our top ten insights and challenges for the energy world and those who have an influence on it, in government, business, academia and beyond.

10 ENERGY STATEMENTS:

1. **Meeting the Paris goals is technically and economically feasible but would require profound change.**

   Technology advancement can deliver the 70% plus emissions reductions thought necessary to keep the global temperature rise to 2*C or less, but the analysis suggests that its progress would need to be accelerated beyond currently projected trends. Many of the technologies required such as renewable power sources, hybrid and electric cards and digital innovations are growing. However, the analysis strongly suggests that such a future will not come about without significant policy intervention, for example in the form of carbon pricing. This analysis shows some of the many potential mixes of technologies available and confirms that the power sector appears to have the lowest cost options for decarbonization.

2. **Wind and solar power are set to grow rapidly and become a major source of electricity world-wide by 2050.**

   Our analysis suggests that onshore wind power could become the most economical source of electricity for many regions by 2050 as its costs continue to fall rapidly, driven by advances in turbine technology as well as economies of scale. Solar power is also increasing in efficiency and projected to become competitive in many situations.

3. **There are significant integration costs when a high proportion of grid demand is provided by wind and solar power.**

   If wind and solar power account for proportions of more than 40% of total electricity generated, considerable costs are projected to manage their intermittency. Options include storing and releasing energy, for example using batteries, managing demand or using back-up power from gas or coal – possibly with CCUS – or nuclear. Solar, which cannot be captured at all during the night incurs higher integration costs than wind.

4. **Energy Storage options are developing rapidly.**

   Technologies for storing electricity are progressing fast, particularly advanced batteries. These technologies are set to lower the costs of electric vehicles and increase the range over which they can be driven. Advanced batteries also provide new options for storing energy in electricity systems, alongside the use of pumped hydro-electric schemes. While lead-acid batteries have been most cost-effective for grid-scale storage to date, by 2050 competitive options could include compressed air energy storage and lithium-ion, metal air, solid state and flow batteries. Hydrogen could also offer an important energy storage option.

5. **Transport is set to see transformative change, led by electric vehicles.**

   Electric vehicles are projected to account for many of the 2050 fleet of cars and other light vehicles, alongside hybrids. Electric car batteries are projected to fall to a quarter of today's cost by 2050. A large proportion of vehicles is projected to become self- driving while car and ride sharing could change car purchase habits and potentially fuel consumption. Liquefied natural gas is projected to become a competitive fuel for trucks and some ships. Bio-jet remains a viable solution to help achieve the aviation industry's emissions targets, along with carbon offsets.

6. **Much of the world's heating is projected to continue to be provided by gas-fired appliances although action to reduce carbon emissions could favor electric systems and hybrid appliances using heat pumps with gas.**

   Gas-fired heaters are projected to continue to play a major role to 2050. If carbon emissions are reduced in line with the IEA's scenario for keeping the global temperature rise to two degrees, electric heat pumps are projected to become more widely deployed in China and North America, as are district heating and hybrid heat pup and gas boiler systems in Europe.

7. **Decarbonized gas technologies are important to resolving the dual challenge of reducing greenhouse gas emissions while meeting growing demand for energy.**

   The importance of decarbonizing gas using CCUS is underlined by its major presence in the modeling of the most economical energy system consistent with keeping the global temperature rise to two degrees, where it accounts for a significant share of power generation in North America and Europe. Without such deployment of gas with CCUS, such a future low-carbon system would be more expensive.

8. **Digital technology is the most significant source of system-wide efficiency improvement, although its full power is unknowable.**

   Digitization is already transforming energy through innovations such as smart grids and "connected cars". Oil and gas production are becoming much more cost-effective as result of advances in areas such as seismic and production optimization. Further changes seem assured as artificial intelligence evolves. Many developments are set to involve digital technology taking on new functions rather than simply increasing the speed and efficiency of operations.

9. **Gas and oil are set to play a continuing role.**

   Gas is projected to play a significant role in the transition to a lower-carbon economy as a source of power, heat and transport fuel, with oil continuing to be used for transport and other sectors. Investment of more than $600 billion per year is estimated to be needed to fund new projects to offset natural oil and gas field decline and meet growing demand. By 2050, technology has the potential to reduce projected average lifecycle costs for both oil and gas by around 30%.

10. **Energy efficiency offers massive potential to reduce emissions and save energy.**

    Our BP-commissioned study identified potential to save around 40% of current primary energy use and up to 13.5 billion tons of carbon dioxide emissions by making use of the best technologies, recognizing that many of these efficiency improvements require significant investment. Leading technology areas where savings can be made are in everyday uses of energy. They include improving vehicle efficiency, building design, increasing use of heat pumps and moving to LED lighting.