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analyst view

Hydrogen, Fuel Cells & the Third Industrial Revolution

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Passers-by at India's 214 MW Gujarat Solar Park (Source: Ajit Solanki/AP)

At the beginning of the month I attended the 19th World Hydrogen Energy Conference in Toronto, Canada. There, world-famous American economist and EC political advisor Jeremy Rifkin gave an engaging plenary explaining how fuel cell and hydrogen technologies play a critical role in the future socio-economic paradigm, The Third Industrial Revolution as Rifkin's theory calls it. His theory states that economic transformations occur when new energy systems and communication technologies converge in industrial revolutions: the first was steam power and the print industry, the second centralised electricity and electrical communication, the third as theorised by Rifkin is the convergence of renewable energies and the internet. In his own words:

The great economic revolutions occur when new energy regimes emerge and new energy regimes make possible the bringing together of larger numbers of people so that we can integrate their skills, differentiate them, and put them into larger economic units. But new energy regimes are complex so they require new communication revolutions agile enough to manage [them]. If we look through history we see that it's when communication revolutions converge with and manage new energy revolutions – those are the pivotal points in history that change the economic paradigm, the social framework and even consciousness.

Rifkin's Third Industrial Revolution is supported by five pillars; alone they are just components but when combined their synergies provide a viable platform for the change. They are:

1. *Shifting to renewable energy*

Our entire modern civilisation is built around fossil fuels: we use them for producing energy and petrochemicals are in the majority of products we consume; thus increases in oil prices negatively impact global purchasing power and our economy suffers, as we have experienced recently. Global peak oil production was reached in 2006 and the IEA suggests that it would

cost $8 trillion over the next twenty years to extract our remaining fossil reserves; but this is not, and can never be, a long-term solution. Investing in renewables utilises inexhaustible natural resources and is the only long-term solution.

2. *Using buildings as power plants*

How do we collect energies that are distributed? Rifkin proposes that we use our expansive buildings infrastructure; the EU has 191 million buildings alone. New buildings would be zero emission, positive power. Retrofitting with ever-cheapening renewable harvesting technologies would spur millions of jobs and jumpstart the economy over the forty year period required for the conversion of all European buildings, Rifkin predicted. Cost-down is likely to follow the same twenty-five year transformation the computer industry saw: in the 1970s there were only a few mainframe computers of inordinate cost, by the turn of the millennium computers were affordable for most families and a further ten years on and computing components are relatively cheap commodities that have proliferated everywhere. This also triggers a sea-change in the way power works: consumers would produce their own power and feed excess to the grid; utilities would transform from power providers to power managers, helping consumers and SMEs manage their energy flows.

3. *Deploying storage*

The intermittency of renewables dictates a need for storage. Rifkin is not technology-biased in this arena but stated that hydrogen is an obvious choice and its modularity, scalability and movability are advantageous. Hydrogen can be distributed and transferred laterally and cross-continentally; fuel cells and electrolysers will play a huge role in balancing the intricacies of the new energy paradigm. The EU has confirmed its belief in hydrogen and fuel cells through framework funding and the creation of the FCH JU. “Unless we can bring hydrogen in to store and manage the flows across regions we can’t make this work.”

4. *Using the internet to transform power grids*

Commonly dubbed the smart grid, Rifkin prefers to think of an energy internet: a nervous system for the emerging energy–communication convergence via the conversion of our existing grid infrastructure. In his analogy Rifkin compared it to the existing internet: millions of buildings would each produce a little bit of electricity, storing it in hydrogen as we would store media in digital, selling surplus back to the grid as we would share things online.

5. *Electrifying personal transportation*

Battery electric vehicles are already here and fuel cell electric vehicles are less than three years away. Homeowners will be able to use their surplus electricity to charge their BEV or after electrolysis, use it in hydrogen form to fuel their FCEV.

Critically, Rifkin emphasises that none of these components work alone; the transition must see all of these pillars emerge together. The change will not be centralised, it will emerge laterally. Lateral thinking has risen in unison with the internet, which is inherently distributed and laterally organised; economics, media, and many other aspects of life are moving to a lateral operation and now energy must follow. The EU, Korea and others have adopted the Third Industrial Revolution model, and there is an opportunity for less developed countries where fossil culture is not so engrained to leapfrog ahead in this transition. The change is not easy, it is not instant, but it is necessary if we are to continue living in the empowering and enjoyable way we do beyond this century.

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