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News

Issues and Foresight

Climate, environment and circular economy | Life cycle analysis (LCA) | Metal recycling

Economics | Forecasting and scenario modeling

Publication of the GENERATE project conclusion

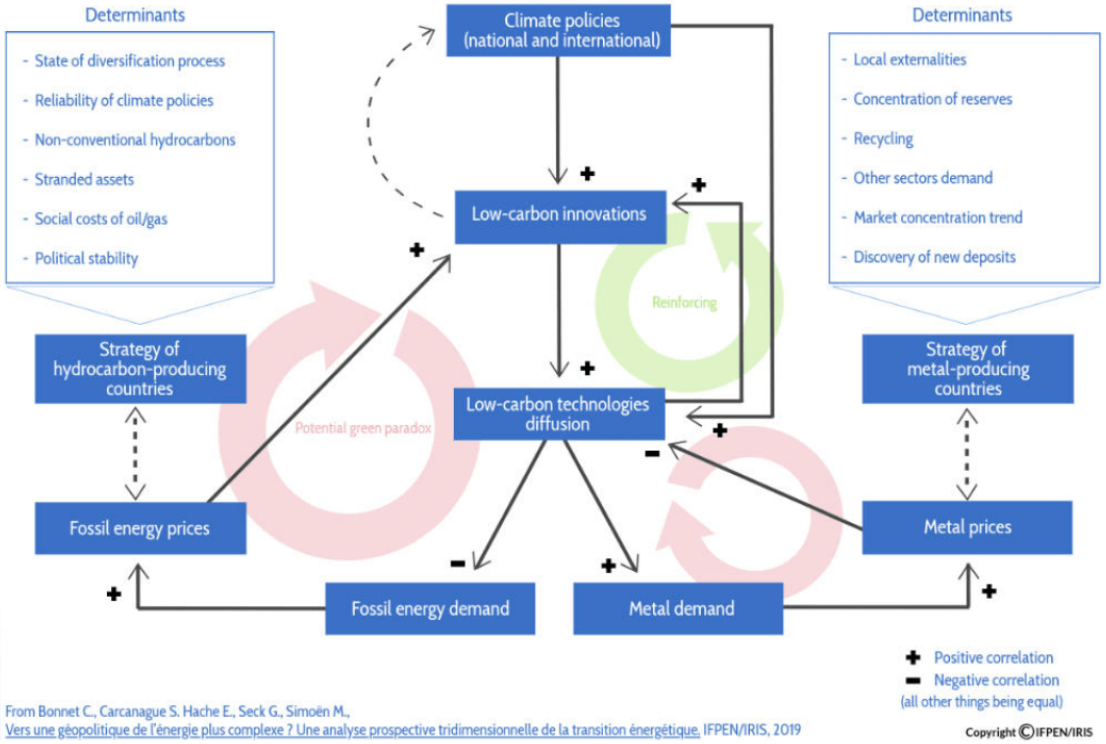
IFP Energies nouvelles (IFPEN) and the French Institute for International and Strategic Relations (IRIS) have published their report on the research conducted within the framework of the GENERATE (Geopolitics of renewable energies and prospective analysis of the energy transition) project, financed by the French National Research Agency (ANR), focusing on the evolution of energy geopolitics in the context of the low-carbon transition.

The study conclusions underline that the growth in renewable energies globally may exacerbate the reliance on some materials essential to the development of low-carbon technologies, increase competition in the field of renewable energy technologies and associated intellectual property, affect the strategies implemented by fossil fuel-producing countries and create pressure on water resources.

Over the coming decades, all these factors are likely to have an impact on energy geopolitics.

The project conducted by IFPEN and the IRIS focused on three major areas associated with the energy transition, which could have an impact on the global geopolitical landscape:

- The criticality of materials used in low-carbon technologies
- The new geography of intellectual property associated with low-carbon technologies
- The evolution of development and diversification models concerning oil and gas-producing countries



AN INCREASED RELIANCE ON COBALT, COPPER AND WATER RESOURCES

By recreating the value chains relating to the materials essential to the energy transition – cobalt, copper, lithium, nickel and rare earths – and comparing the evolution of their respective demand up to 2050 to known resources in 2010, researchers determined a criticality indicator using the TIAM-IFPEN

model.

Determined on the basis of two climate scenarios (+2°C and +4°C), the projections indicate a high level of criticality for cobalt, present in batteries, and for copper, used in electricity networks and the transport sector. Concretely, more than 90% of today's known resources for these two materials may have been depleted by 2050. In this context of significant demand, some countries that either produce or specialize in the refining of these materials, such as Chile, China, Australia and Russia, may well be playing a strategic role in global markets by 2050.

The level of criticality for lithium, for its part, is moderate since 75% of known resources are likely to still be available in 2050 in a 2°C scenario. However, the concentration of reserves and players (5 companies control 90% of the market), differing national strategies of producing countries (Argentina, Australia, Bolivia and Chile) and the low level of transparency with respect to the price formation process may undermine secure lithium supplies for numerous importing countries in the future.

Maximum ratio of cumulative material demand by 2050 to proven resources in 2010

	4°C scenario	*2°C scenario*
Cobalt	*62,2 %*	*93,6 %*
Copper	*82,7 %*	*96,1 %*
Lithium	*17,1 %*	*26 %*
Nickel	*48,5 %*	*56,6 %*
Rare earths	*1,6 %*	*3,8 %*

Source : authors
*The figures should be interpreted as follows: for cobalt, for example, in a 4°C scenario, cumulative global demand by 2050 will represent 62.2% of proven global resources in 2010, compared to 93.6% in a 2°C scenario.

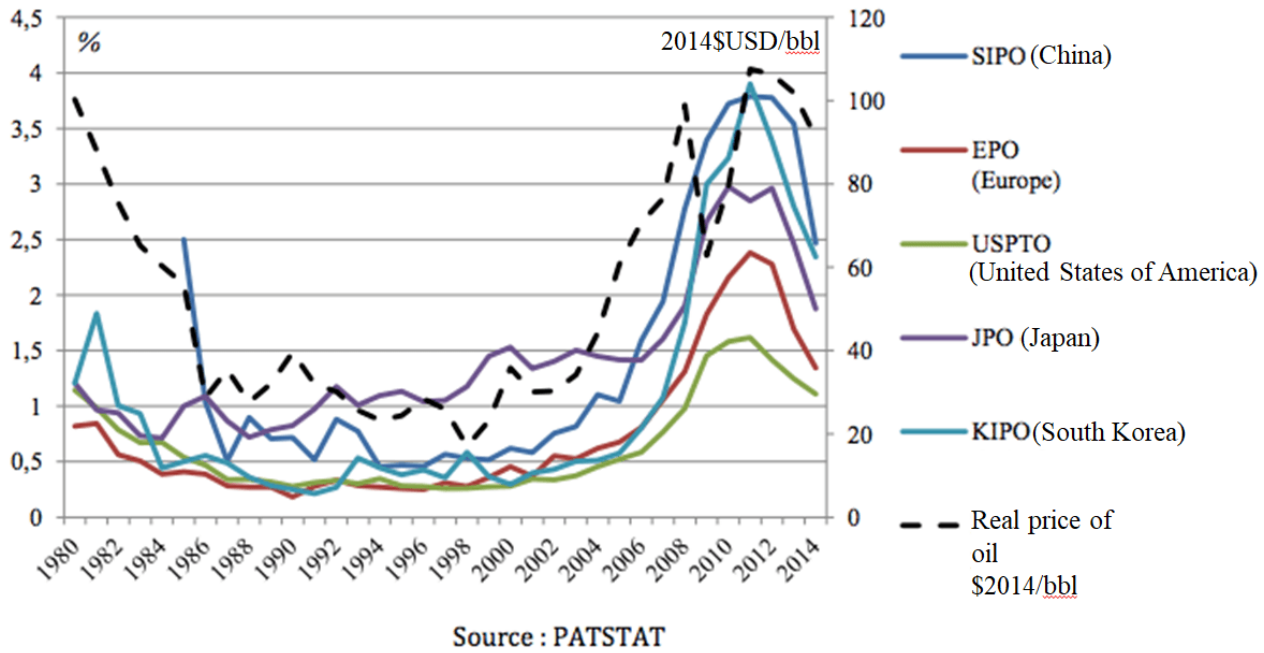
The study also focuses on the high volume of water resources required for the different production processes, irrespective of the materials studied. This environmental constraint may limit the momentum of the energy transition. This fundamental point will thus be the focus of specific attention and dedicated research in the future.

INNOVATION IN THE LOW-CARBON TECHNOLOGY SECTOR LARGELY DRIVEN BY ASIA AND OIL PRICES

Statistical studies drawing on international patent databases for the period 2002 – 2014 revealed two main trends:

- The early 2000s were marked by a significant acceleration in renewable energy technologies related to rising oil prices. In fact, price policies practiced by oil and gas-producing countries have a decisive influence on the momentum of the energy transition. It is thus vitally important to include these

countries in climate negotiations to ensure that excessively low oil prices do not undermine the decisions taken within the context of international agreements.



Source : PATSTAT

Evolution in the share of renewable energy patents in total patents granted by the five leading intellectual property offices

- Innovation in the renewable energy sector is primarily driven by Asia which currently accounts for nearly 52% of all patents, 29% of which are held by China alone. South Korea and Taiwan have specialized in photovoltaic solar technologies, while China has focused on wind technologies, biofuels, ocean energies and, to a lesser degree, photovoltaic solar energies. While the USA, Europe and Japan continue to enjoy a technological advantage, there are likely to face stiff competition over the coming decades.

THE RESILIENCE OF THE MAJOR OIL AND GAS-EXPORTING COUNTRIES

For more than 25 countries, exports of oil and gas currently account for more than 40% of their total revenues. In a context of ecological transition, the sustainability of the economic models of these countries, their vulnerability and their resilience are called into question: the demand for oil and gas is impacted by the evolution in global growth, the dynamics of the transport sector and public policies aimed at tackling climate change.

The bibliographic and statistical analysis of indicators measuring the vulnerability of oil and gas-producing countries shows that, contrary to popular belief, the major exporting countries (Gulf

countries, Russia) could take advantage of the energy transition if they adopt major strategic measures now aimed at diversifying their economies. In contrast, some exporting countries - mainly those in sub-Saharan Africa - could suffer the greatest impact from a slowdown in the demand for oil and gas.



To find out more
Decoding keys > Metals in energy transition

Read publications concerning the GENERATE project:

- *Hache, E., Bonnet, C., Seck, G.S., Simoën, M., Carcanague S., (2019), "Who's winning the low-carbon innovation race? An assessment of countries' leadership in renewable energy technologies. International Economics, vol 160, pp.31-42. https://doi.org/10.1016/j.inteco.2019.07.006*

- *Hache, E., Seck, G.S., Simoen, M., Bonnet, C., Carcanague, (2019), "Critical raw materials and transportation sector electrification: A detailed bottom-up analysis in world transport", Applied Energy, 40, pp.6-25. https://doi.org/10.1016/j.apenergy.2019.02.057*

- *Hache, E., Hacquard, P., Simoën, M., (2019), "Is the oil industry able to support a world that consumes 105 million barrels of oil per day in 2025?", Oil and Gas Science and Technology Journal, 74, 88. https://doi.org/10.2516/ogst/2019061*

- *Hache, E., Seck, G.S., Simoën, M., Bonnet, C., Carcanague S., (2020), "The impact of future power generation on cement demand: an international and regional assessment based on climate scenarios", International Economics, In Press*

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