

# Promoting the Energy Transition Through Innovation

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With the striking exception of the USA, countries around the world are committed to the implementation of stringent targets on anthropogenic carbon emissions, as agreed in the Paris Climate Agreement. Indeed, for better or for worse, the transition towards decarbonisation is a collective endeavour, with the main challenge being a technological one. The path from a fossil-based to a sustainable and low-carbon economy needs to be paved through the development and deployment of low-carbon energy technologies which will allow to sustain economic growth while cutting carbon emissions.

Unfortunately, not all countries have access to the technologies which are necessary for this challenging transition. This in turn casts serious doubts on the possibility to achieve deep decarbonisation. Developed countries accumulated significant know-how in green technologies in the last decades, but most of developing and emerging countries do not have strong competences in this specific field. Yet, it is in these latter countries that energy demand, and hence carbon emissions, will increase dramatically in the years to come. The issue at stake is how to reconcile the need for a global commitment to the energy transition with the reality of largely unequal country-level technological competences.

Public R&D investments play an important role in the diffusion and deployment of low-carbon technologies. Public investment in research is the oldest way by which countries have supported renewable energy technologies. For instance, following the two oil crises of the 1970s, the United States invested a significant amount of public resources in research

and development on wind and solar technologies, with a subsequent increase of innovation activities in these fields. The same pattern can be observed in the last two decades in Europe, where solar, wind and other low carbon technologies have been supported by public money. But innovation policies and R&D investments are only one of the possible ways in which governments can stimulate low-carbon innovation.

**Environmental policies are another way to stimulate clean innovation, which comes as an additional pay-off of emissions reduction.** Usually, governments rely on two different types of environmental policy instruments: command-and-control policies, such as emission or efficiency standards, and market-based policies, such as carbon taxes or pollution permits. The former put a limit on the quantity of pollutant that firms and consumers can emit. The latter essentially work by putting an explicit price on pollution. Both types of instruments have the direct effect of lowering carbon emission in the short term. In the longer term, they also have the indirect effect of promoting low-carbon innovation. This is because they make it worth for firms to bring to the market new, improved technologies. Over the past decades, countries have implemented different low-carbon policy portfolios, namely a combination of different policy instruments to foster the development and deployment of low-carbon technologies. The combination of R&D, command-and-control and market-based policies varies greatly across countries.

**A crucial question often debated in the literature is : which policy instrument is more effective in promoting innovation in renewable technologies vis-à-vis innovation in efficient fossil-based technologies ?** Importantly, low-carbon innovation can refer either to renewable technologies, which effectively eliminate carbon emissions from production processes, or to more efficient fossil-based technologies, which decrease the content of carbon per unit of production. Favouring the former type of innovation over the latter is strategically important

in the long-run: renewable technologies allow to completely decouple economic growth from carbon emissions. Conversely, fossil-based technologies may give rise to rebound effects, namely increase in overall energy demand (and possibly also in overall emissions) because they make it cheaper to use fossil inputs.

A recent study by [Nesta et al. \(2018\)](#) shows that certain combinations of research and environmental policy instruments are more effective in promoting renewable energy innovation than others. More specifically, there is no 'one-fits-all' solution when it comes to choosing the optimal combination of market-based or command-and-control environmental policies. *Au contraire*, to be effective in promoting renewable innovation, policy portfolios need to be tailored to the specific capability of each country. The study relies on data on innovation in low-carbon and fossil-based technologies in OECD countries and large emerging economies (Brazil, Russia, India, China, South Africa and Indonesia, BRIICS) over the years 1990-2015. The authors apply an empirical methodology that allows to test how effective each "policy mix" is in promoting innovation, depending on the level of specialization of each country in terms of green innovation.

The analysis shows that there are three different regimes of low-carbon specialization. The first one characterizes those countries with extremely low competences in green technologies as compared to fossil-based technologies. This accounts for about half of the observations in the study, including the BRICS countries. In this case, the research suggests, the only effective way to promote the redirection of technological expertise towards green technologies is through direct investment in low carbon R&D.

The second regime does come into play until a country shows enough specialization in green technologies. In this regime, environmental policies start to become effective in further consolidating the green technological specialization. The

successful innovation strategy in this case is that which combines command-and-control policy instruments – which lower the incentives associated with fossil innovation – with market-based policies – which increase the incentives associated with green innovation.

**The third regime is characterized by a substantial specialization in green know-how.** This regime includes only 12 percent of the observations in the study. In this last case, market-based instruments alone are effective in sustaining green innovation vis-à-vis innovation in fossil technologies.

**Countries which tailor their policy portfolio based on their level of competencies will be more successful in promoting renewable innovation.** A clear example of the dynamics behind this finding is illustrated by Denmark. In the pre-Kyoto period, Denmark had not yet reached the required level of expertise in renewable energy. The country continued to invest heavily in building such expertise through significant investments in renewable research and innovation. As a result, Denmark moved to the second regime. At that point, the country strengthened both command and control and market-based policy instruments, further promoting renewable innovation vis-à-vis innovation in fossil-based technologies. This resulted in an even higher level of competencies in renewables, bringing Denmark to the third regime. The country was then in a position to switch away from command-and-control instruments and simply rely on market-based instruments to promote renewable innovation.

**Countries which fail to tailor their policy portfolio are not successful in promoting renewable energy innovation.** For instance, France represents a case of failure, as illustrated by our results. The lack of an adequate market-based support for renewables in the nineties led to the full dissipation of the French early advantage in these technologies. Indeed, France was the only country that is in the third regime in the first period and was then in an ideal position to implement

ambitious policies before other countries, thus keeping its relative technological advantage. Instead, the country chose to fully specialize in nuclear energy. This eroded France's capability in renewable energy innovation. This implies that France cannot simply rely on market-based instruments to successfully promote renewable innovation nowadays.

**These results are of interest for emerging economies, and suggest that countries like Brazil, Russia, India, Indonesia, China and South Africa should be less timid in strengthening the stringency of both types of policy instruments, because they are well positioned to fully benefit from the innovation incentives.** Fast-developing countries desperately need to build innovative capacity in renewable energy technologies and promote their diffusion. Apart from India and, to a lesser extent, Indonesia, all countries have built a satisfactory level of expertise in renewables. This calls for the implementation of both market-based and command-and-control policy instruments as means to embark on a virtuous renewable innovation circle. China stands out due to a high level of expertise in green technologies. Overall, their level of expertise in renewables is such that they would be in the position to fully benefit from the innovation incentives associated with more stringent mitigation policies in support of the energy transition.

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# **Notre maison brûle, et nous ne regardons que Paris**

par Paul Malliet

Alors que la 21<sup>e</sup> Conférence des Parties, la COP 21, a débuté la semaine dernière, tous les regards sont braqués sur Paris dans l'attente d'un accord global ambitieux qui permettrait de limiter la hausse de la température moyenne mondiale à 2°C et de mener les Etats à s'orienter très rapidement sur le chemin d'une décarbonisation rapide de leurs économies. Toutefois il est une autre bataille qui se mène actuellement et qui est passée sous silence alors que ses conséquences sont d'une ampleur catastrophique.

Les forêts primaires et les tourbières d'Indonésie, principalement localisées sur les îles de Sumatra et de Kalimantan (et considérées comme l'un des trois poumons verts de la planète) ont été ravagées par le feu pendant plusieurs mois, conséquence d'une saison sèche plus longue que prévue, elle-même alimentée par le phénomène *El Niño* d'une ampleur rarement observée[1], mais également et surtout par la poursuite des pratiques de culture sur brûlis, pourtant illégales, afin de déboiser des terres nécessaires à l'extension de la culture de l'huile de palme.

Ce sont ainsi 1,62 Gigatonnes de CO<sub>2</sub> qui ont été relâchées dans l'atmosphère en l'espace de quelques semaines, triplant les émissions annuelles de l'Indonésie et faisant passer ce pays du 6<sup>e</sup> au 4<sup>e</sup> plus gros émetteur mondial derrière la Chine, les Etats-Unis, l'Inde et devant la Russie[2]. A titre de comparaison, cela représente près de 5 % des émissions mondiales pour l'année 2015.

Pourtant la question de la déforestation était centrale dans la contribution de l'Indonésie à l'effort global de réduction des émissions de gaz à effet de serre, puisque elle représente plus de 80 % de l'effort consenti[3] jusqu'à présent. De surcroît, dans le cadre du mécanisme onusien REDD+ (*Reduction Emissions from Deforestation and Forest Degradation*) lancé en 2008, l'Indonésie bénéficiait d'un financement international depuis 2011 de 1 milliard de dollars pour lutter justement

contre la déforestation et pour promouvoir une gestion durable des forêts.

Or, faute d'une réponse rapide et significative qui aurait sans doute pu limiter les incendies, c'est cet effort qui est littéralement parti en fumée ces derniers mois. Trois éléments d'explication peuvent être avancés à ce stade. Le premier relève des capacités matérielles propres à l'Indonésie lui permettant de répondre à une telle catastrophe. Les autorités ne disposaient à titre d'exemple que de 14 avions, et s'appuyaient principalement sur les populations locales pour lutter contre l'extension des feux de forêts en construisant des bassins de rétention. Le deuxième élément relève de questions géopolitiques régionales. Plusieurs tensions diplomatiques émaillent les relations que l'Indonésie entretient avec ses voisins et il a fallu plusieurs semaines d'incendies avant que le gouvernement ne consente à accepter l'aide internationale. Enfin, une culture de la corruption telle qu'elle existe à plusieurs échelons de l'administration a favorisé des années de déforestation, fragilisant encore plus les écosystèmes au risque d'incendie.

Pourtant, il est désormais indéniable que les débats autour des réponses et des moyens à apporter aux situations de catastrophes climatiques sont à l'heure actuelle totalement absents des discussions dans le cadre de la COP 21. Il est aujourd'hui plus qu'urgent que la communauté internationale soit en mesure de fournir un cadre et des moyens d'intervention en réponse à ce type d'événement, qui malheureusement devrait être de plus en plus fréquent, et dont les conséquences seraient sources de profonds déséquilibres régionaux. Le renforcement des financements destinés à la lutte contre la déforestation est évidemment primordiale, surtout que le coût de la tonne de CO<sub>2</sub> évité est dans ce cas très faible ; mais c'est principalement au niveau des pratiques que de nombreux progrès restent à faire, que ce soit par l'introduction de plus de transparence dans la

gestion des fonds ou une intégration plus forte des populations locales et des ONG dans la mise en œuvre de nouvelles pratiques.

François Hollande déclarait lors de son discours d'ouverture de la COP 21 que « ce qui est en cause avec cette conférence sur le climat, c'est la paix ». Effectivement, les conditions de la paix risquent de plus en plus de dépendre des capacités d'adaptation des sociétés face au risque climatique. Le désastre de la Seconde Guerre mondiale a conduit la communauté internationale à créer le corps des casques bleus dont le mandat est « le maintien ou le rétablissement de la paix et de la sécurité internationale ». Combien de désastres écologiques seront-ils nécessaires pour voir apparaître des casques verts ?

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[\[1\]](#) D'après l'OMM (Organisation météorologique mondiale), le phénomène *El Niño* 2015-2016 s'inscrit comme étant l'un des trois plus puissants jamais enregistrés depuis que les données sont répertoriées, en 1950, et les prochaines décennies sont susceptibles de voir une accélération d'épisodes extrêmes sous l'effet du changement climatique.

[\[2\]](#) World Resources Institute, *With Latest Fires Crisis, Indonesia Surpasses Russia as World's Fourth-Largest Emitter*, 29 octobre 2015.

[\[3\]](#) L'Indonésie s'était engagée en 2009 à réduire de 29 %, voire 41% (avec un support international), ses émissions de gaz à effet de serre (GES) par rapport à un scénario de référence (Source : National Action Plan for Greenhouse Gas Emissions Reduction (RAN-GRK)).