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The Efficiency of Policy Instruments for the Deployment of CCS as a Large-sized Technology

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Carbon capture and sequestration (CCS) is one of the major options for reducing carbon dioxide (CO_2) emissions, and is the most straightforward approach if it is applied to the most emitting sector: the electricity industry. Commercial-sized demo plants have not yet been developed, so public support for commercial deployment of CCS has yet to figure in the political agenda. It has been recognized that support is needed to stimulate the CCS demonstration projects developed by private firms, but for the next stage, conventional wisdom tends to consider that policies complementary to the carbon price signal that issues from taxation or a cap-and-trade system will be socially inefficient. It implicitly assumes that the roll-out of CCS technology would be led by the market's demand for low carbon technologies. The purpose of this paper is to develop a systematic view of market failures in the deployment of large sized technologies, such as the CCS system, and to identify the most adequate policies for supporting learning investment, besides the long term signal from carbon prices that will be, in fact, quite ineffective in stimulating CCS early deployment.

It is argued that pure market-pull approach cannot ignore market failures in learning investment which creates barriers for each technology. This view must be challenged for three reasons. First, benefits of cumulative learning are not captured by the investors, while the social benefits will balance the cost of learning investment. Second, uncertainty over the carbon price trend, and so over social benefits on a long-term basis, could deter investment in low carbon and capital-intensive technologies. Third, the characteristics of large-sized technology and the complexity of CCS systems magnify learning costs and risks, the chain of innovations being too long, too complex and diverse.

We analyze and compare different instruments of public policies and some of their variants: CCS mandate, investment subsidy, and

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL production subsidy (feed-in system, $C0_2$ price guarantee). The social efficiency of each policy must be assessed from three perspectives: effectiveness, static efficiency and dynamic efficiency technological variety. Static efficiency is determined by the incentive characteristics of the policy instrument to limit both the investment cost of each project and/or the operational cost during the asset life (the more or less risky character of the subsidy influences the capital cost of the project). As an element of social efficiency, we consider here that the cost of such policies, which will complement carbon pricing policies, must be paid by consumers as far as possible in order to have efficient adaptation of demand.

Concerning the three types of policy instruments, there are no clear-cut arguments to choose between different principles of support for learning investment. Experiences show that limitations and drawbacks of instruments are remediable by their adaptations, or by combination with another one, resulting in improved social performance. But four insights from the analysis help the search for effectiveness and efficiency in CCS deployment policy.

First, even with the best available technology, mandates may be less cost-efficient than market-based approaches if they are not applied in a timely way and if it is unsuitable with the maturity of the different CCS technologies. Mandate could provoke costly adaptation towards other low carbon technologies, or else underinvestment.

Second, the timing dimension is indeed essential. Investment support schemes which lower investment cost and risk are suitable mainly for the demonstration stage where the main barriers are construction costs and risks. Production support in different forms (carbon price guarantee, feed-in-subsidy, ...) is more adapted to the early-commercial stage of the technology than an investment subsidy which is not output-performance based.

Third, in terms of technological diversity prior to the commercial stage, mandate is the least adaptable solution, unless it is complemented by grants. Investment support, as well as feed-in subsidy, could be designed to differentiate between technologies.

Fourth, given the strong complementarity of transportation and storage infrastructure development with early-commercial capture project deployment, the instrument to support capture projects must reflect a determined policy because it could help the reduction of legal and political uncertainty on the development of pipes-lines and storage capacities.

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