



Valuing physically and financially-induced flexibility in large-scale water resources systems

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In a world characterized by rapid changes in terms of water demands and supplies, there is a growing and persistent need for institutional reforms that promote cross-sectoral, adaptive management processes and policies. Yet, in many regions throughout the world, the continued expansion of supply-side infrastructure is still perceived as the way to go despite the rising financial, social and environmental costs. This trend is further compounded by the risks posed by climate change; reservoir storage, for example, is still perceived as a key element of climate change adaptation strategies in many countries. There is a growing concern that such strategies may result in a rigidity trap whereby the physical and institutional infrastructure become inflexible and unable to adapt to changes because they are mutually reinforcing each other. However, several authors have recently advocated for adaptive, flexible, management techniques involving a more diversified portfolio of measures whose management is regularly updated as new information about supplies and demands becomes available. Despite being conceptually attractive, such a management approach presents several challenges to policy makers. One of them is the sheer amount of information that must be processed each time a management decision must be taken. To address this issue, we propose an optimization framework that can be used to determine the optimal management of a large portfolio of physical and financial assets using various hydro-climatic information. This optimization framework is illustrated with the management of a power system in Quebec involving various power stations, reservoirs, power and energy contracts as well as hydrologic and climatic data. The results can be used to assess the economic value of the flexibility induced by either the physical assets (power stations and reservoirs) or by the financial ones (contracts), an information we believe is important to highlight the benefits of adaptive management techniques.