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Abstract

Adequacy of renewable energy mixes with concentrated solar power and photovoltaic in Morocco: Impact of thermal storage and cost

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Abstract:

We analyze the sensitivity of the optimal mixes to cost and variability associated with solar technologies and examine the role of Thermal Energy Storage (TES) combined to Concentrated Solar Power (CSP) together with time-space complementarity in reducing the adequacy risk—imposed by variable Renewable Energies (RE)—on the Moroccan electricity system. To do that, we model the optimal recommissioning of RE mixes including Photovoltaic (PV), wind energy and CSP without or with increasing levels of TES. Our objective is to maximize the RE production at a given cost, but also to limit the variance of the RE production stemming from meteorological fluctuations. This mean-variance analysis is a bi-objective optimization problem that is implemented in the E4clim modeling platform which allows us to use climate data to simulate hourly Capacity Factors (CFs) and demand profiles adjusted to observations. We adapt this software to Morocco and its four electrical zones for the year 2018, add new CSP and TES simulation modules, perform some load reduction diagnostics, and account for the different rental costs of the three RE technologies by adding a maximum-cost constraint. We find that the risk decreases with the addition of TES to CSP, the more so as storage is increased keeping the mean capacity factor fixed. On the other hand, due to the higher cost of CSP compared to PV and wind, the maximum-cost constraint prevents the increase of the RE penetration without reducing the share of CSP compared to PV and wind and letting the risk increase in return. Thus, if small level of risk and higher penetrations are targeted, investment must be increased to install more CSP with TES.

Biography:

Ayat-allah Bouramdane completed her Engineer's degree in Energy at the School of Energy Engineering of the International University of Rabat (UIR), in 2017, in

Morocco, with thesis on the implementation of different structure of hybrid systems in different regions of Morocco at the Green Energy Park platform of the Research Institute for Solar Energy and New Energies (IRESEN). In 2016, Ayat-allah had the opportunity to participate in an exchange program where she spent six months at the European School of Materials Engineering (EEIGM) and National School of Electricity and Mechanics (ENSEM) of the University of Lorraine in Nancy, France. Then, in 2018, Ayat-allah completed her master in Energy & Environment: Science Technology & Management «STEEM » at Ecole Polytechnique in Palaiseau (Paris), France, with a thesis on the operation of photovoltaic power plants: Data processing & analysis, modeling and faults diagnosis at GeePs - Group of electrical engineering – Paris of CentraleSupelec. These experiences inspired Ayat-allah to contribute to a transition towards a greener future. Ayat-allah is currently PhD student at the Laboratory of Dynamic Meteorology of Ecole Polytechnique (Palaiseau, France). Her research interests lie in the fields of renewable energies and climate change.

Publication of speakers:

1. Peji, B., Sikora, V., Mili, S., Malki, K., Koren, A., & Baji, I. (2018). Effect of drip irrigation on yield and evapotranspiration of fibre hemp (Cannabis sativa L.). Ratarstvo i povrtarstvo, 55(3), 130-134.

2. Sarkar, N., Ghosh, U., & Biswas, R. K. (2018). Effect of drip irrigation on yield and water use efficiency of summer rice cultivation in pots. Journal of Pharmacognosy and Phytochemistry, 7(1), 37-40.Webinar on Nano-Engineering and Its Applications | July 22, 2020 | London, UK

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