

# Coping with National Fuel in Regional Power Markets: Application to the Gulf Coast Council Interconnector

Abdullah Alawad, Pablo Dueñas, Ahmad Alabdulkareem,  
and Carlos Batlle

*Energy subsidies are traditionally banned by regional market regulations to ensure competition and maximize short and long-term economic efficiency. However, evidence from reviewing the different regional markets implemented worldwide does not reveal the removal of these subsidies, but quite the contrary. We explore how the efficiency of regional electricity markets can be optimized when coexisting with national fuel subsidies. We propose simple bidding conditions and market clearing methods whereby one of two prices may be attributed to each generating unit depending on domestic or export demand. The proposal is illustrated with a full-scale case study - the Gulf Cooperation Council Interconnection - where the reluctance to comply with that limitation might be underlying governments' unwillingness to commit to regional integration.*

One key aspiration for countries the world over in recent decades has been the institution of regional markets to integrate several national/state power grids. In addition to improving short-term reliability, integrating contiguous markets can lower power supply costs through coordinated operation and eventually integrated energy resource investment planning. The materialization of such benefits necessitates thoughtful market design informed by technical, economic and institutional analyses of the regional system. More specifically, market design must address not only the technical issues that condition the performance of the regional power system, but also other constraints associated with sociopolitical objectives, deemed to be a high priority by some member states.

Trading in power exchanges is thus limited not only by grid constraints and agents' operational and economic characteristics, but as well as by other conditioning factors that must be borne in mind when concluding supply agreements or participating in power auctions. So

the design of all the mechanisms in place in organized markets for electricity, from capacity markets to day-ahead, intraday and balancing markets need therefore to allow accommodating such constraints in the most efficient way possible.

One of the most prominent and widespread such factors are energy subsidies, i.e. measures aimed at keeping prices for electricity end users below market levels. Traditionally regional markets regulation has aimed at banning such subsidies, to properly ensure healthy competition and maximize short- and long-term economic efficiency. However, as we evidence by reviewing the different regional markets implemented not just in the EU and the US but worldwide, experience increasingly shows that the trend does not lead to the removal of these subsidies, but quite the contrary. As a result, it is worth looking for innovative regional market design solutions to take the best of the integration of different power system, while coping with the existence of this sort of national subsidization mechanisms.

Figure 1 shows that in spite of obvious benefits to be reaped by eliminating subsidies, no significant or even minimal medium-term drop has occurred. Over the 2008-2018 period, the overall energy-related subsidies in the EU27 MS have increased by 67%. Nor is a drop in subsidies to be reasonably expected in light of recent reactions to rising oil prices: in 2018 fossil fuel subsidies totaled values last seen in 2014. As Figure 1 shows, generation-side fuel subsidies have routinely accounted for a substantial share of that total.

In particular, we focus on one of the key pieces of regional markets design, the pricing mechanism in the day-ahead market. This design element shows how different bidding formats condition efficiency gains in the presence of uncertainty in electricity markets. In the presence of any sort of subsidization policy, designing mechanisms to optimize price calculation subject to these higher order constraints happens to be instrumental. To achieve this aim, we propose original and simple bidding conditions and market clearing methods whereby one of two prices may be attributed to each generating unit depending on whether final delivery targets domestic or export demand. The proposal, designed to favor transitioning to integrated regional markets as hopefully countries gradually eliminate subsidies, is illustrated with a full-scale case study, the Gulf Cooperation Council Interconnection, where the reluctance to comply with that limitation might be underlying governments' unwillingness to commit to regional integration.

The algorithm proposed for a bidding and clearing scheme,

tested in Gulf Cooperation Council Interconnection case study, aims to fell or lower this barrier to the establishment of transnational markets and pave the way for progress in that regard. The export bidding format we propose would enable generating units to offer their output at different prices on different regional nodes. Its underlying intention is to allow generating units to express a willingness to sell their output at one price in the local/domestic node or zone and at another for exports. As the case study shows, the proposal envisages the inclusion of generating units sited in countries where generation-side fuel subsidies are in place for domestic demand only. Under the terms of the proposal, such units would be in a position to export their output when below the auction cut-off price, while not actually needing to "export" the subsidy.

Although the regional integration of electric power systems is instrumental to maximizing power generation efficiency in both the short and long term, in a number of jurisdictions generation-side fuel subsidies constitute a formidable obstacle to successful market operation. Solutions are required to enable regional markets to adapt to the presence of subsidies. We review this issue and suggest an initial mechanism that would enhance regional economic dispatching efficiency. The market design we present can be viewed as a useful tool for eliminating or at least lowering that hurdle. By implementing the bidding format and market clearing method proposed, countries could transition to integrated regional markets while gradually paring down their subsidies.

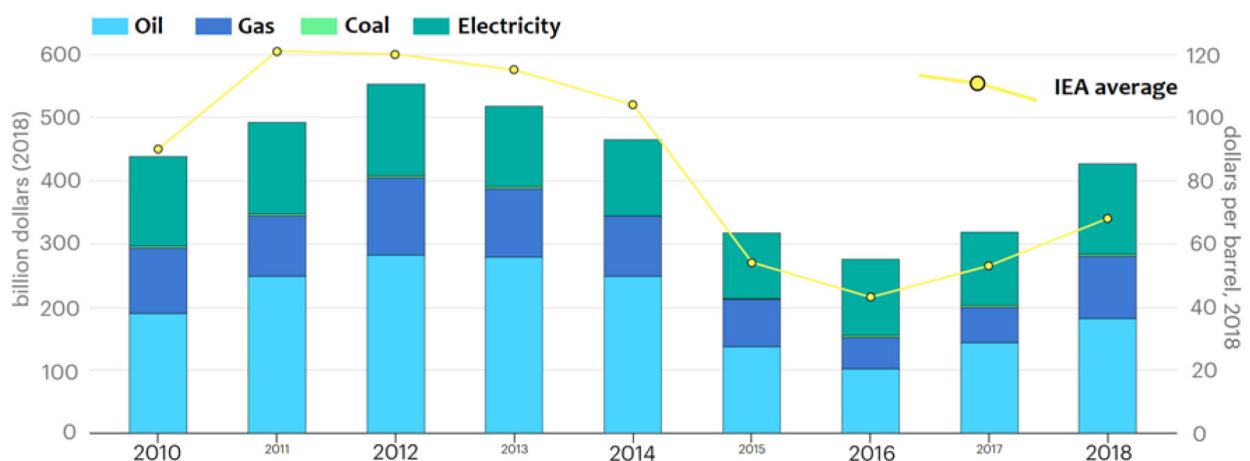


Figure 1. Subsidies for fossil fuel, 2010-18 (Matsumura and Adam, 2019)



### About the Center for Energy and Environmental Policy Research (CEEPR)

Since 1977, CEEPR has been a focal point for research on energy and environmental policy at MIT. CEEPR promotes rigorous, objective research for improved decision making in government and the private sector, and secures the relevance of its work through close cooperation with industry partners from around the globe. CEEPR is jointly sponsored at MIT by the MIT Energy Initiative (MITEI), the Department of Economics, and the Sloan School of Management.

## References

Alawad, A., P. Dueñas, and C. Batlle (2022), "Coping with National Fuel in Regional Power Markets: Application to the Gulf Coast Council Interconnector," MIT CEEPR Working Paper 2022-006, March 2022.

## About the Authors



**Abdullah Alawad** is a graduate researcher at the Center for Complex Systems (CCS) at KACST and MIT. Areas that I had focused on in my studies include optimization in electricity markets and dynamics and control of power systems. My research interests include optimization and design of energy markets, modeling of power systems and energy sources, and dynamics and control of power systems.



**Pablo Dueñas-Martinez** is a research scientist at the MIT Energy Initiative. His research focuses on the economic and regulatory modeling and analysis related to the role of traditional and new generation technologies in shaping the energy systems of the future—in developing and developed countries—within a carbon-constrained world. He has focused on topics such as liberalization and regulation of gas and electricity markets, energy security of supply and resiliency in decarbonizing economies, impact of distributed energy resources, analysis and regulation for universal energy access, and mathematical modeling of energy systems. During his career, he has worked with power and gas utilities, as well as government and regulatory agencies, on research projects and to provide advice aimed at improving operations and investments in energy systems worldwide.



**Carlos Batlle** is a Senior Associate Professor with Comillas Pontifical University's Institute for Research in Technology (IIT) in Madrid, where he teaches Energy Economics and Electric Power Systems Regulation. Since 2011 he is a Research Scholar under the Massachusetts Institute of Technology's MIT Energy Initiative, where he teaches a course entitled "Engineering, Economics and Regulation of the Electric Power Sector", headed by Prof. Pérez-Arriaga, and supervises PhD and master dissertations. He is Electricity Advisor of the Florence School of Regulation (FSR), an institution under the aegis of the European University in Florence, and Director of FSR Summer School on Regulation of Energy Utilities.



[ceep.mit.edu](http://ceep.mit.edu)

### About the Center for Energy and Environmental Policy Research (CEEPR)

Since 1977, CEEPR has been a focal point for research on energy and environmental policy at MIT. CEEPR promotes rigorous, objective research for improved decision making in government and the private sector, and secures the relevance of its work through close cooperation with industry partners from around the globe. CEEPR is jointly sponsored at MIT by the MIT Energy Initiative (MITEI), the Department of Economics, and the Sloan School of Management.