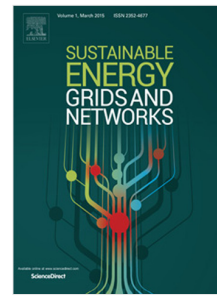


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A Novel Behavioral Real Time Pricing Scheme for the Active Energy Consumers' Participation in Emerging Flexibility Markets

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Abstract – Liberalized electricity markets, smart grids and high penetration of Renewable Energy Sources necessitate the development of novel pricing schemes able to manage energy consumption (energy efficiency services) and harmonize unpredictable/volatile production with ad-hoc consumption (flexibility services). As a result, Energy Service Providers can considerably lower the cost of energy they purchase from the wholesale market and create new revenue streams, while offering consumers lower electricity bills and digital services via online software platforms. Price-based Demand Side Management techniques can trigger the desired behavioral changes and generate novel services and business models for the Energy Service Provider's participation in congestion, balancing, and other emerging flexibility markets. The energy pricing schemes proposed so far, do not strongly motivate consumers to modify their electricity consumption habits, as they are unfair and thus unable to effectively trigger behavioral changes and offer flexibility services. Based on this observation, we develop a Behavioral Real Time Pricing scheme, which offers an easily adjustable level of financial incentives to consumers, by fairly rewarding the desirable behavioral electricity consumption changes. Performance evaluation results demonstrate that the proposed billing scheme affects the consumers' behavior much more efficiently than the traditional Real Time Pricing mechanism, outperforming the latter in all widely adopted metrics. Our billing mechanism is able to simultaneously: i) significantly reduce energy cost compared with Real Time Pricing (10%-30%), ii) slightly increase consumers' welfare (2%-4%) and iii) ensure the fair allocation of financial benefits among the consumers. All these result in significantly increased competitiveness of our billing mechanism in the flexibility markets.

Keywords: Smart grid, demand side management, dynamic pricing, flexibility markets, behavioral change, energy efficiency¹

Conflicts of interest: All authors declare no conflicts of interest.

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