Case Study – When data speaks about DR Events

With Europe's drive for renewable integration in electricity systems, the interest arises towards a different approach on electricity Demand Response, from one in which normally the generation-follows-demand, towards one in which demand-follows-generation. Hurdles that still need to be overcome though, make this approach difficult to be implemented. A key ingredient that misses from this recipe, is the existence of the appropriate incentives that can trigger the demand side to follow the supply rules.

Holding a strong R&D activity, Intelen's research constantly deepens into the heterogeneity of behavioral patterns aiming to explore the reasons that cause individuals think, act and react differently. In the course of gaining insights about the black hole called "Demand Response", Intelen has run several DR events for residential consumers, to better understand what motives can address effective results. The analysis across these DR events intended to assess the pure interest of users in Demand Response and reveal all the attention-grabbing effects that should not be underestimated when the time for DR is coming.

A major finding was related to the potentials for savings between consumers. Energy consumption is not an absolute measure that can be explicitly defined as high or low. It is rather a relative measure determined by the total energy consumption a household needs to be operational but not inefficient. Considering this fact, there are two basic types of behaviors that need a boost to change.

The first is the irrational consumption that should be restricted. The term irrational is being used to describe the excess in energy consumption that could be avoided without having a significant impact on the consumer's perceived comfort level neither on the functionality of the house. This kind of behavior is feasible to amend without any profound cost for the consumers.

The second is the way energy is consumed. In this case, no matter what the actual level of consumption is, the challenge remains the pivot in the behavioral energy usage pattern. In other words, the interest for energy reduction is displaced by an interest for shifting the consumption to hours with lower total load. This kind of behavior is more difficult to alter since requires enough effort from the consumers to rehabilitate.

Another fundamental finding that Intelen came up with, concerned the duration of DR events. In particular, long in duration DR events (more than 2 hours) whose objective was the reduction of consumption, were not successful. The reason was that within a fast-moving daily routine, it is almost impossible to expect all users adapt their behavior and turn down their appliances for hours, only based on their intrinsic motives. Extrinsic motives should also participate. There should be provided more perceive

Results

To identify differences in the level of consumption and estimate the potentials for savings from voluntarily reduction, Intelen implemented a clustering method on collected consumption data. A low, a medium and a high energy consumption group of consumers, emerged. Then, all DR events that Intelen realized in partnership with DSO's were analysed.

With respect to the assessment of the pure interest of consumers in DR, it was found that the maximum savings achieved throughout the events are attributed to the medium energy consumption group. In particular, for the medium consumption group, the average reduction touched the percentage of 7.26%, while there wasn't marked a significant overall drop in consumption for the low and the high group.

However, there were events with observed savings for all groups. For instance, in one of the DR events, the low consumption group indicated a reduction in energy consumption equals to -4.36%, when the high consumption group had a respective 4.59% energy savings. Such savings are valuable, though they don't account for pure interest in DR events since it is the stability of savings that can reveal the existence of inner motives.

In order to draw conclusions about the consumer's possibilities in shifting their maximum electricity load to off-peak hours, Intelen again explore collected data and examined the fluctuations in consumption before, during and after the event. The results for some of the users that voluntarily managed to swift their load curve during the DR event compared to their typical consumption curve, are presented in Figure 1.

Figure 1: The graphs illustrate the users' shift in consumption to off peak hours

To study the correlation between the duration of DR events and their effectiveness, Intelen organized DR events that differ in duration so as for the comparison to be straightforward. The results were outright. None of the long in duration DR events led to significant total energy savings. Instead, the majority of the shortest DR events were linked to savings for at least one of the consumers' segments.

Conclusion

It might seem reasonable that the medium consumption group indicated the highest savings when requested, since low consumption group has by default limited potentials for savings, and respectively, the high consumption group mostly outlines consumers of a higher income that do really care about their energy bills' surplus. Though, it should not be taken for granted that these two latest, theoretically "distant from savings" groups, cannot contribute to DR events. All groups can positively affect the effectiveness of a DR event, if awareness, the appropriate training and the suitable incentives are provided.

The general sense is that not all consumers should be treated the same way when a DR is scheduled. The reason is that all consumers cannot get influenced by the same triggers, neither have the same opportunities for adding value to DR. For some consumers might be optimal to cut down the

exceeded energy consumption, while for other it is make more sense to distribute the peak of their consumption more normally within the day.

Lastly, it might be about time for energy providers to look at the exact opposite side of the coin and inspect the potentials for effective DR events by requesting customers a higher consumption at times that more renewable energy is being produced rather than looking for energy reduction when the production of energy from renewable sources is limited.