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On Experience of Smart Grid Projects in Europe and the Swedish Demonstration Projects

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Our project was conducted under the supervision and guidance of Professor Lina Bertling. Our work was equivalent to a 15 credit course, which we could later use as part of our education, instead of two 7,5 credit optional courses. The report of the project was published as an internal Chalmers publication.

Our findings could be used by any stakeholders around smart grid development, such as energy companies, IT companies specializing in the field, research institutions or countries, who want to assess the current technological state of smart grid projects throughout Europe. Project managers can evaluate whether their own smart grid project lacks a specific technology or whether they could implement new technologies that are used in other European projects or simply evaluate where their project stands among others in Europe in terms of technological development. It could also serve as an example for future attempts of a construction of an inventory that includes all the technologies used in smart grid projects.

Below, one can find the abstract of our report, which explains briefly what the background and scope of it are, as well as the methodology and approach that we followed. Some of our results are also presented in the last paragraph.

Renewable energy sources are expected to play a significant role into the future power system. The variable and at many cases not easily predictable production of electricity will pose a threat on the reliability and efficiency of the current electricity grid. Hence, there is great need of measures that will be able to handle these fluctuations of the production systems. Transforming the current grid to become a more intelligent system that could predict the variations as well as exploit hours with lower demand and, hence, lower electricity prices is one way to deal with the problems caused by the technology shifting. New projects that address those issues are constantly under deployment in recent years. In Sweden today there are three large demonstration projects, the Sustainable City Hyllie, Smart City Gotland and the Stockholm Royal Seaport.

Our paper investigates the technologies used in the three projects, how the goals that were set in the beginning of each project are being fulfilled, as well as the ways that the different actors are copying with the challenges and problems faced. The approach that was used includes a comparison of the projects with other successful finalized projects carried out throughout Europe. The methodology was divided in three smaller steps. The first step was the collection of data about all the technologies and all the investigated projects in Europe and Sweden. The second step was to construct a table where a significant number of technologies used by the projects were listed alongside with an indication on whether the implementation of the technologies is finished or ongoing. The results for the ongoing Swedish demonstration projects were iterated and checked by conducting interviews with key people inside the projects.

Some of our results include a comparison of the Swedish projects with a selection of similar European ones. The Swedish projects seem more extensive utilizing a broader range of technologies and are still ongoing, whereas all of the investigated European projects have been concluded. The most commonly used technologies in Europe are Information & Communication Technologies (ICT) and demand-side management. On the other side, algorithms for the optimization of the power system are only implemented by one German project. Regarding individual projects' comparison, the Hyllie project is expected to use a larger number of technologies, if by the end of the project, all the planned ones will be implemented. Smart Grid Gotland mainly focuses on wind power technology and ways to exploit larger levels of penetration into the system by using HVDC cables and storage facilities. Finally, the Royal Seaport includes less advanced technologies mainly because of the structure of the electricity mix in Stockholm. For that reason, a virtual power plant (VPP) or energy storage are not cost-effective solutions and hence not considered at all. However, it is a unique project in the sense of studying whether renewable electricity production can provide the necessary electricity in the case of instantaneous peak loads due to large cruise vessels entering the port.