Demand Response Potentials in Industry

Christoph GUTSCHI[1], Daniel Hütter[1], Heinz STIGLER[1]

Motivation

Demand response (DR) has been applied for load shedding in many countries for the last two decades. In Europe the method was applied in many cases until the opening and coupling processes for the electricity markets and the unbundling of utilities created a situation with an excess of generation capacities, where DR was no longer necessary or profitable. In the last decade the overcapacities declined constantly due to an increase in demand as well as the deactivation of overaged generation capacities. Since this development has been leading to a coverage problem in some European countries load shedding gets interesting again.

On the other hand the development of fluctuating renewable generation like wind power leads to a rising demand for energy storage. At the moment pumped storage hydro power plants (PSPP) are the only way to store electricity in large amounts and at reasonable costs. In many cases the transmission and distribution grids are not capable of transporting large amounts of renewable energy over long distances thus there is an increasing demand for local electricity storage. The fluctuating characteristics of renewable generation and its poor predictability may require additional generation capacities for frequency control in some control areas. Demand response can offer a cheap and instantly accessible method to limit the additional demand for storage as well as control capacities and increase the technical and economic efficiency in the electricity supply system.

The benefits of DR can be optimized if a lot of power can be acquired with few contracts and only few commands can control all the required capacities. Therefore DR programs should rather focus on industry than on business or household consumers. Especially in power intensive industry branches DR measures will lead to a win-win-situation for utilities as well as consumers.

Methodical approach

In the first step the "power intensity" of various industries has been assessed by means of statistical analyses. Based on these "power intensity" ratios several branches have been identified as relevant for DR. The production chains of the relevant branches have been analysed to find out possible unit operations suitable for a fast cut-off.

In the next step telephone surveys and on-site interviews with plant operators were carried out to proof the theoretic concepts. The respondents identified many additional possibilities for DR in their plants.

Finally a concept for an optimal industrial DR was developed. In many cases DR can be carried out without any reduction of product output, especially if processes with overcapacities and available storage capacities for intermediate goods are used for DR. Thus an interruption of the limiting process of a production plant can be avoided (see figure 1). By that method the requirement for electricity storage is fulfilled by the physical storage of energy services in the form of pre-produced intermediate goods or products. Thereby the challenging electricity storage problem is converted into a product storage problem, which can be handled much easier.

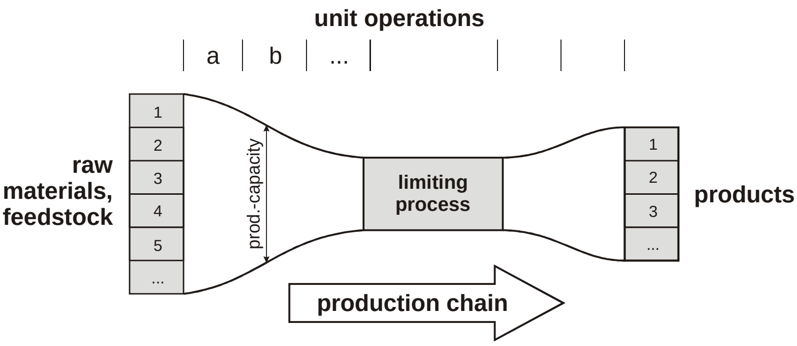

Figure 1: Schematics of a productions chain with a limiting process

[1] Institut für Elektrizitätswirtschaft und Energieinnovation, TU Graz, Inffeldgasse 18, 8010 Graz, T: +43(0)316873-7907, F: +43(0)316873-7910, christoph.gutschi@tugraz.at, www.IEE.TUGraz.at

Additionally the reaction times of different unit operations in various branches were analysed and a simple cost estimation method has been developed. Finally the markets for DR were analysed to identify fitting DR potentials in industry.

Results

Different studies [1,3] show a DR potential in the Austrian industry in the range of 300 – 400 MW. The following manufacturing industries are of major importance with respect to DR programs:
Pulp and paper, iron and steel, mining, non-metallic mineral processing, non-ferrous metals, chemicals and foundry. Further potentials can be identified in many other industries.

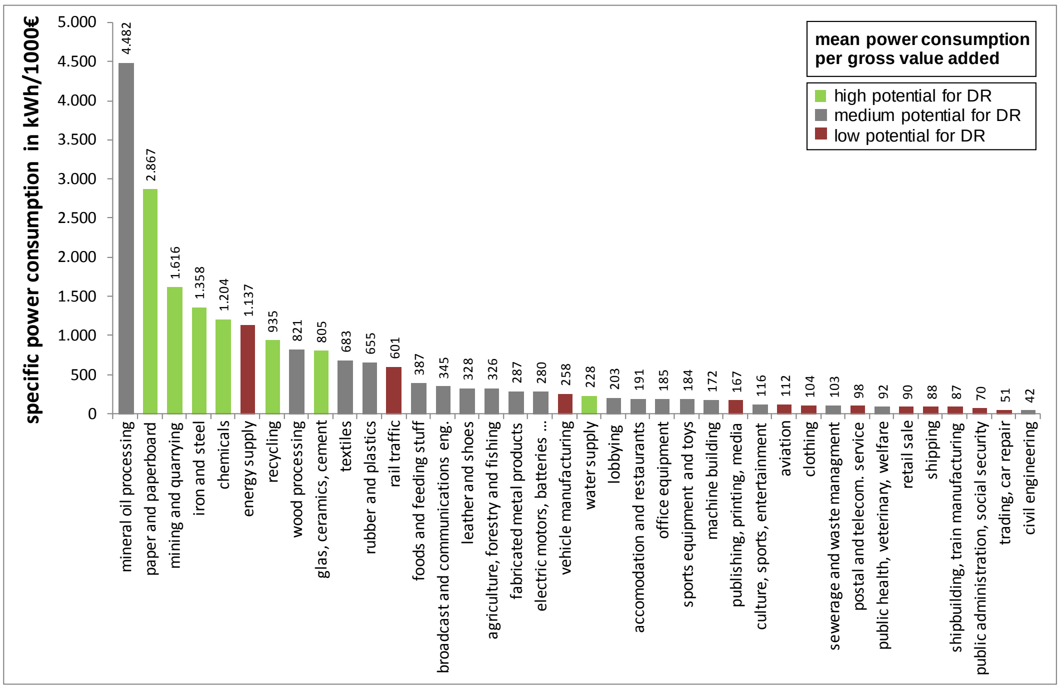

Figure 2: Mean power intensity of economic branches in Austria

Unit operations with suitable characteristics are:
Electrolysis, electric arc furnaces, electric melting furnaces, wood chippers and refiners, shredders, crushers and mills, sieves, liquefactions of gasses, chillers and cooling plants, pumping of liquids, compressors and many more.

The individual potentials may fit to different markets, e.g.

Primary Control:	industrial gas or steam turbines
Secondary Control:	chloralkali electrolysis
Tertiary control:	crushers and mills in mining, electric smelters in some chemical industries
Load shedding:	arc furnace in steel industry, technical gases, refiners in paper industry, Chillers, water supply, air conditioning, heat pumps

Many of the above mentioned processes can also be used for emergency cut-off to ensure grid stability and reliability.

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Literature

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