

# REFlex

Analysis of the  
European energy system



Policy Brief

## Demand side management – Empirical data from the services sector

Ulrich Reiter, Martin Jakob  
TEP Energy GmbH

Katharina Wohlfarth  
Fraunhofer ISI



This project has received funding from the European Union's Horizon 2020 research and innovation programme [GA-No. 691685].

# Bibliographical data

Ulrich Reiter, Martin Jakob  
TEP Energy GmbH

Katharina Wohlfarth  
Fraunhofer Institute for Systems and Innovation Research (ISI)

Final version

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# 1 Introduction

With the increase of intermittent renewable electricity generation, the need for flexible demand side appliances and technologies able to support a reliable and stable electricity provision to final consumers is expected to grow further. Demand side management (DSM) measures are one option to deal with those challenges. DSM refers to the active modification of energy (usually electricity) demand through various methods. Traditionally, the goal of DSM was to encourage decreasing the consumption during peak hours, typically by moving energy use to off-peak times such as nighttime and weekends, possibly using storage, timers or other controls. The goal of DSM is not necessarily to decrease overall energy consumption, but to reduce the need for investments in networks and/or power plants. Currently DSM is adopted to aid grid operators in balancing intermittent generation from wind and solar. As of today, the already existing DSM measures are mainly implemented in industry processes and a broader overview of such technical DSM potentials in the industry sector is described in [1]. However, such industrial DSM potentials are limited, and further options and technologies need to be activated. In this respect, applications such as heat pumps, cooling and ventilation systems as well as large freezer units and others are seen as promising grid-connected DSM units that could cope with the above-introduced flexibility needs. The named appliances are often used in the tertiary sector and there is high interest to better understand the boundary conditions for the use of such systems.

For the services sector only a few theoretical evaluations are available and in addition the empirical data on the effective participation of companies in DSM schemes is scarce. In this note we discuss methods and results of a qualitative stakeholder survey aimed at understanding DSM barriers, thresholds, potentials and drivers, as well as designate options to implement DSM measures.

From an operator perspective, DSM can be suitable for two types of clients: on the one hand, large companies which have elevated electricity loads and consumption. Likewise, these types of establishments will have an energy management system (EnMS) as well as an energy manager at their disposal: implementing DSM can effectively contribute to lower grid connection fees and lower electricity bills. On the other hand, small companies with non-process related technologies (e.g., heat pumps) that could be aggregated by service companies, thus making available untapped demand shifting potentials in a cost-effective manner. While the cost benefit might be small for the single user, the aggregation of a large number of small units promises large contributions to stabilizing grid operations.

Importantly, the current regulatory environment for DSM widely differs across countries. Although the European Commission is striving for an integrated electricity market, more efforts are still needed to harmonize DSM regulations for new market participants. As the market design for DSM is currently undergoing rapid changes in European countries based on the implementation of [2], there are inhibitory regulatory frameworks, incomplete aggregator-models impeding pooling, etc. Also, the different markets are not accessible for flexibility providers without having to undergo complex qualification processes. Therefore, entry barriers for new market players and barriers for the development of new business models need to be removed.

To conclude this introduction, DSM technologies are currently at hand and experiences from first implementations as well as facilitating conditions do exist. Notwithstanding, due to complex regulatory frameworks there is barely space to profitably access such DSM potentials. In this context, empirical data is of high relevance to better understand the perception of services companies towards DSM options.

The policy brief is structured as follows: Section 2 describes the method and the sample of the international survey, whose results are presented in section 3. The policy brief closes with the conclusions illustrated in section 4.

## 2 Demand side management survey

In 2017, a survey was performed, targeting companies in the service sector to determine whether there is potential to improve the use of flexible loads for DSM. There are several technologies for which DSM options could prove to be effective, as these technologies consume comparatively large amounts of energy and due to the nature of their functionalities, they are meant to be used for relatively long periods of time. In the services sector, appliances of interest are mainly heating, cooling and ventilation devices, technically available in various subsectors.

Service sector companies from Switzerland, Poland, Italy and the United Kingdom were invited to participate in the survey. The focus was put on companies from branches such as wholesale and retail trade, hotels and restaurants as well as private and public office companies, because of their dominating contribution to the electricity consumption within the service sector.

In total, over 1200 datasets were collected by standardized telephone interviews. From each country at minimum 300 complete datasets were pre-set, and randomly gathered within four subgroups of the same size. From each company, its subsector affiliation, company size, and host country were collected to allow for a statistical analysis of the subgroups. The main contents of the survey included amongst others:

- structural data of the company (floor area, type of building, electricity consumption, electricity metering),
- energy efficiency issues (planned or conducted investments in energy efficiency, audits, energy management systems),
- load management (experience, measures, contracts, payback expectations, barriers),
- available technologies and decision-making.

The questionnaire was designed to capture insights in DSM perception in order to calculate potential flexibility provision of promising subsectors across the different countries and to allow analyses of important energy related factors (e.g. investments in energy efficiency, implementation of EnMS, i.a.).

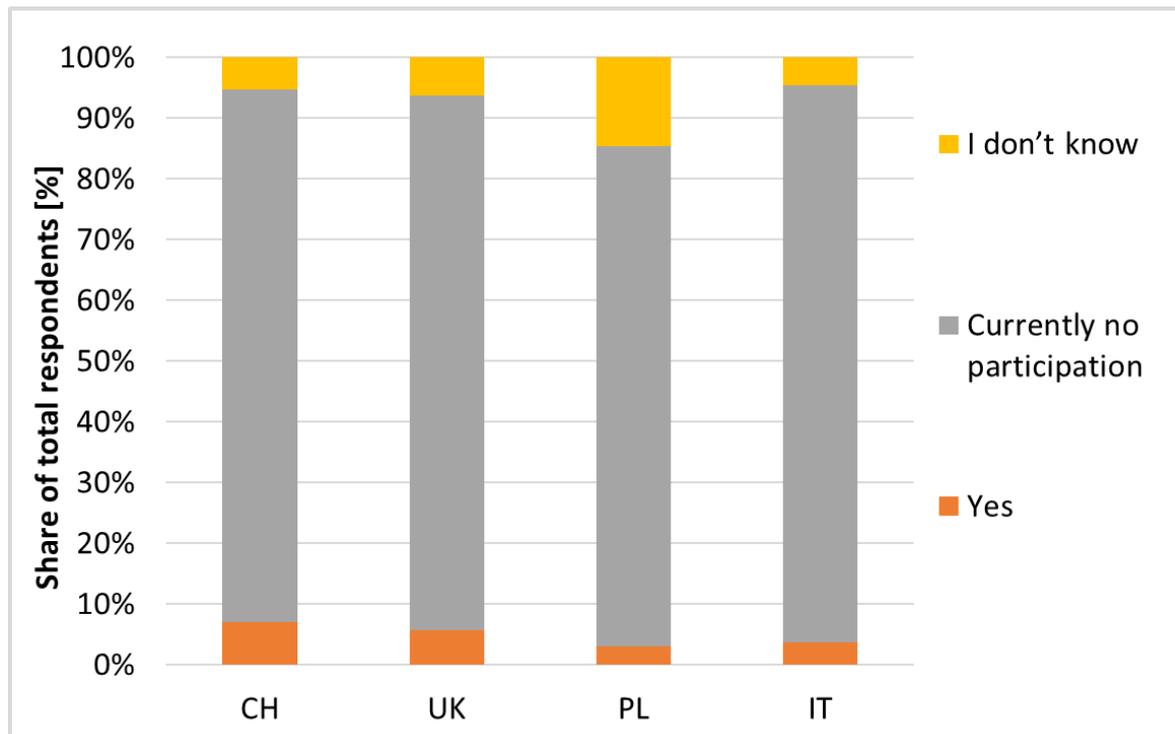
### **The DSM regulatory environment**

Based on the European Energy Efficiency Directive [2], member states are requested to implement favorable conditions for DSM. Nevertheless, the development of regulatory clarity differs between European countries. In the case of the four survey countries - Switzerland, Poland, Italy and the United Kingdom - SEDC [3] rates the demand response development of Switzerland as "commercially active with standardised arrangements", UK as "commercially active", Poland as "preliminary developed" and Italy as "closed". These different conditions have implications for the DSM potentials and company perceptions of the evaluated companies of interest.

### 3 The role of DSM in the tertiary sector

#### Current DSM activities and potential interest

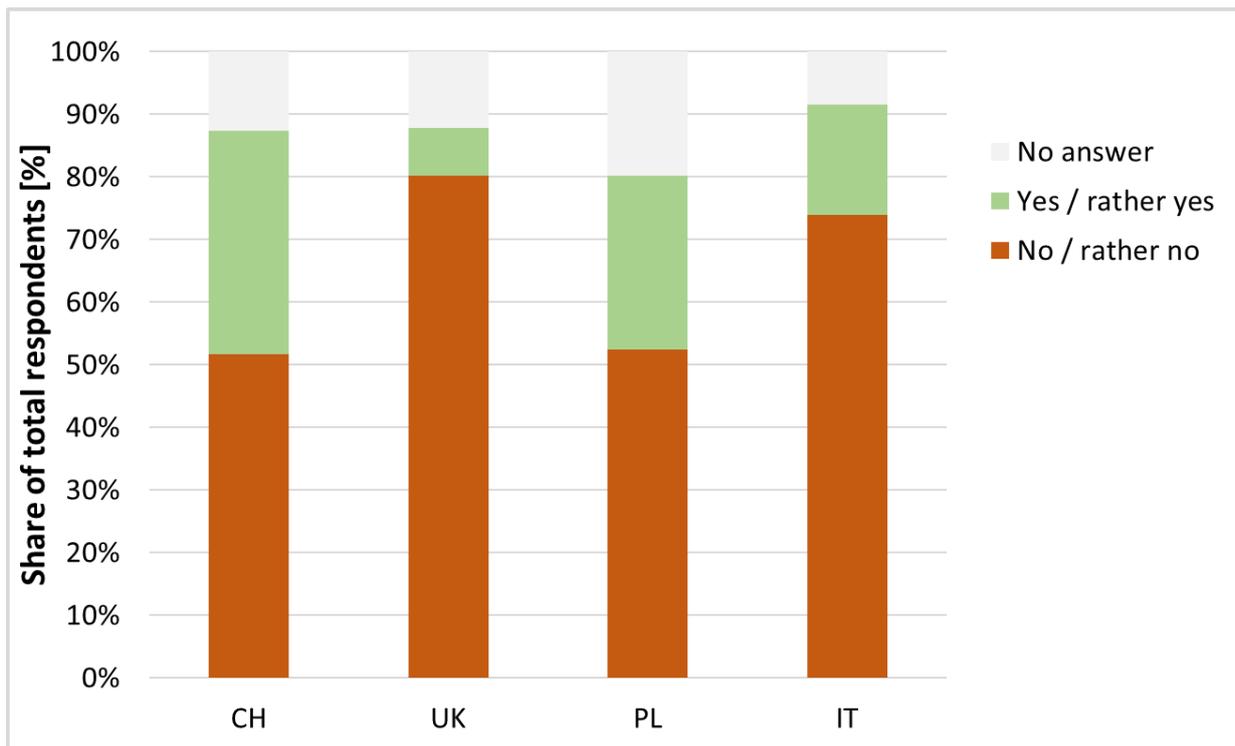
Presently DSM only plays a minor role in the tertiary sector as can be seen in Figure 1. This happens even in countries such as Switzerland (CH) or United Kingdom (UK) where the regulatory framework would allow for higher participation as the regulatory environment is favourable [3].



**Figure 1:** Share of companies which are currently participating in load management schemes. Full sample size of 300 respondents per country.

In Switzerland, which has the most favorable regulatory conditions according to [3], only 7.0 % of the respondents currently participate in load management, independent of the total annual electricity demand. This behavior is somewhat unexpected since higher electricity demand would allow for higher potential gains from participating in DSM. All other countries show lower participation rates (between 5.6 % for the UK, 3.0 % in PL and 3.6 % in IT) but with a higher share of companies with low annual electricity demand in the sample.

Companies which are currently not participating in load management were also asked if they can imagine to allowing for externally controlled appliances and therefore participate in DSM in the future (see Figure 2).



**Figure 2:** Share of companies that could consider allowing for externally controlled appliances by service providers.

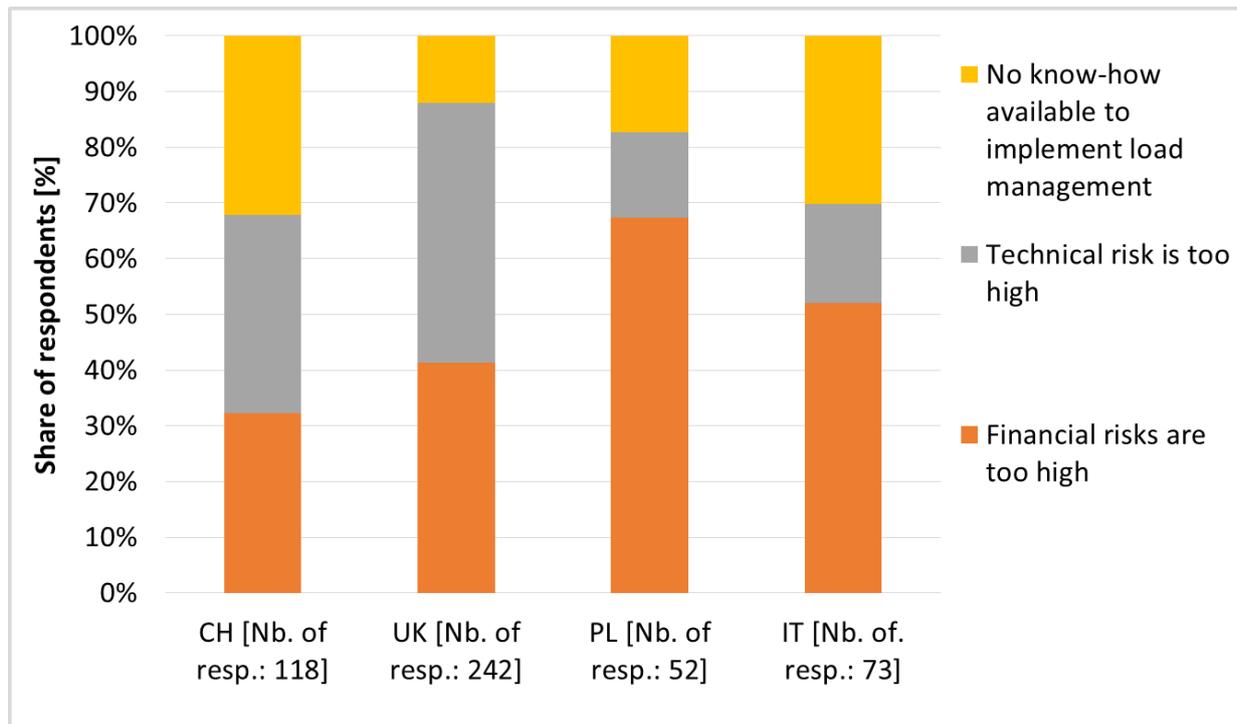
In Switzerland and Poland, the interest in DSM participation seems to be distinctly high, with 25 % (PL) to 35 % (CH) of the respondents which are rather positive (yes / rather yes) towards externally controlled demand appliances. In the other two surveyed countries, the positive response varies between 8 % (UK) and 17 % (IT). Given the country-specific regulatory environment, favorable DSM boundary conditions are not a sufficient criterion for the acceptance of such systems. Awareness raising about the possibilities of DSM is therefore needed, especially in the United Kingdom and Italy with currently low acceptance rates.

Additionally, the answers regarding the main barriers towards DSM participation (financial, technical, informational, see Figure 3) also vary across countries and did not result in a clear picture regarding correlation between regulatory and/or market environment and the acceptance of DSM solutions.

Who are the companies that seem to be more interested in and perhaps easier to incentivize to carry out DSM measures? The survey shows that the current and potential DSM adopters already have experiences with energy management systems (EnMS) or conducted energy audits significantly more often than companies without or unwilling to carry out DSM. Audits, as well as EnMS, are more common in larger enterprises which could in theory be then the companies more inclined to start DSM measures. However, from the current participation rate of load management and the related survey data, the size of the companies does not give clear insights on DSM acceptance so far. Other possible influencing factors on acceptance of DSM, i.e. building ownership (because of the possibility to make own decisions regarding the building/ facilities) and electricity costs, do not turn out to be significant.

## Why are companies not (yet) interested?

Companies currently not interested in participating in DSM stated risks and a lack of know-how as their underlying reasons (Figure 3). Risk perceptions are very heterogeneous across the countries investigated. Overall, the financial risk perception seems to be dominating the picture, especially in Poland where more than 60 % of the respondents stated “high financial risk” as main barrier to participate in DSM. However, also more technical details and the company internal know-how play a relevant role.

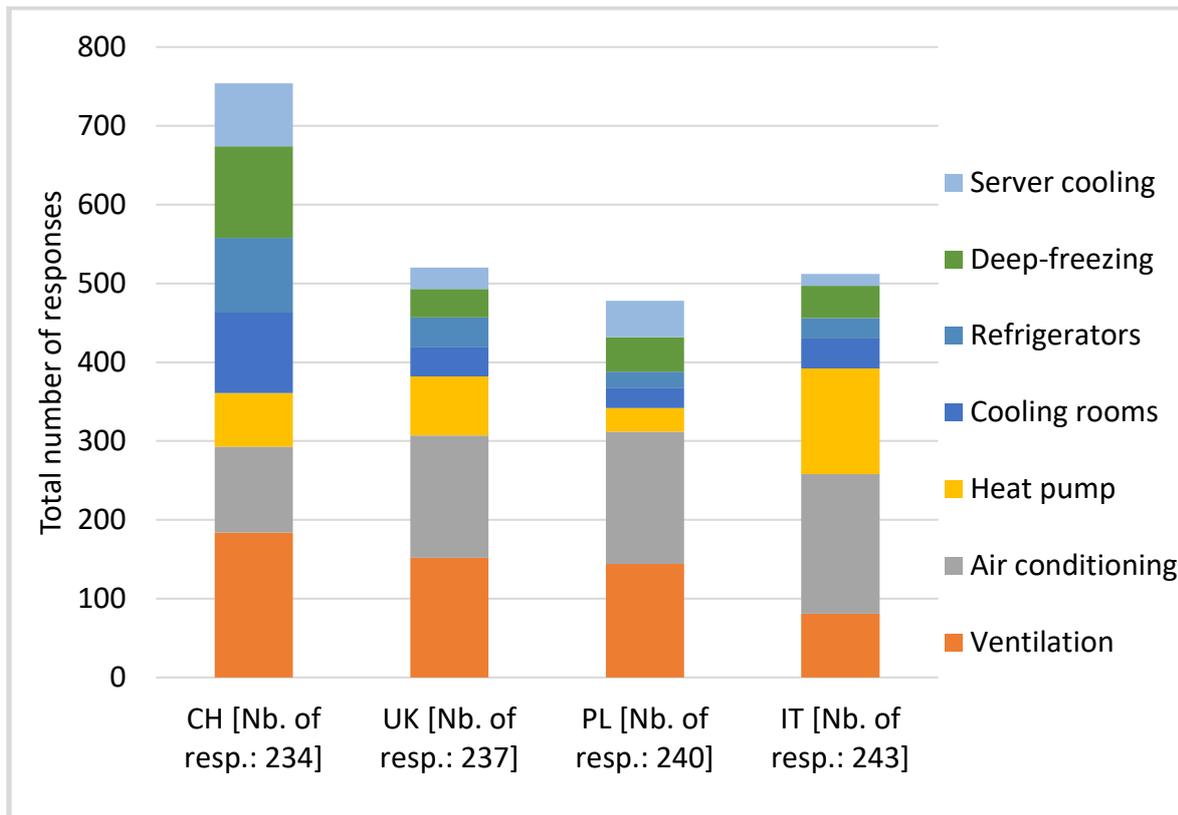


**Figure 3:** Share of respondents specifying their risks why companies are not willing to participate in DSM. Total answers per country in the legend.

To overcome such barriers regarding new DSM services and solutions, the available information and information flow needs to be improved. Independent facilitators can be crucial to prepare the floor for such additional services [4].

## Potential DSM technologies

The installation figures of energy demand technologies which are potentially available for DSM are presented in Figure 4. The total number of installations differs between countries and subsectors, but mainly process-independent appliances such as ventilation, air conditioning and heating devices reach high shares, independent of the size of the company. In average across all countries, 47 % of the companies have installed a ventilation system and 50 % an air conditioning system. The installation rates of process specific technologies differ between Switzerland (in average 33 %) and the other countries (in average 10-16 %) and cannot be explained by the sample structure (i.e. size of company or sub-sector). The highest average equipment rate was found in Switzerland with approx. 3.2 of said systems installed per company. The other countries follow with approx. 2.1 - 2.2 units per company (IT and UK, resp.) and with 2 units installed (PL).



**Figure 4:** Number of installed appliances per country (multiple answers allowed), potentially available for DSM. Total number of respondents per country given in the legend.

All of the stated appliances and building technologies are grid connected and therefore potential candidates for DSM operations in general terms. Depending on the specific conditions on site, these appliances offer flexible load shifting potentials for upward and downward flexibility [5]. However, as the hourly and seasonal load profile differs between the named technologies, not all systems can equally contribute to reduce electricity generation constraints based on high shares of intermittent renewable capacity.

Looking at the country specific data on appliance related information from the survey, some additional indications relevant to accurately derive the DSM potential can be given:

- In Italy (Figure 4), the high share of heat pumps is likely to consist of (reversible) air-air heat pumps [6]. Due to the the limited shifting potential of air heating and cooling, the DSM potential is expected to be relatively small as compared to other countries with high shares of air/water and ground/water heat pumps (e.g. Switzerland).
- In Poland, 65-70 % of the installed equipment is in average less than seven years old and therefore, replacement or updating with DSM ready control systems will be unlikely in the near future (add-on controls would only be expected with large installations or in case of overhaul/replacement).
- In Italy, UK and Switzerland, the lifetime of the equipment is in average higher (in IT 41 % of the equipment older than seven years, in UK 48 % older than seven years and CH 59 % older than seven years) and therefore, an earlier exchange and upgrading of such systems can be expected, offering an installation of a DSM option.

## 4 Conclusions and policy recommendations

With the survey-based analysis of service sector companies in four European countries, we cover a wide range of different DSM regulations and are able to depict the most relevant reactions of the potential flexibility providers. The survey results show that favourable regulatory conditions, such as in Switzerland and UK, are not sufficient to establish functioning DSM markets and attract companies' interest. As of today, particularly small demand units from services sector companies are hardly participating in DSM, although on aggregate level their DSM potential would be high. Lack of (reliable) information and of financial benefits as well as perceived risks seem to be relevant barriers against the adoption of more DSM option in the tertiary sector.

By showcasing existing examples of how flexibility providers can benefit from participating in DSM markets, we expect that risk perception of services companies can be altered. As the risk perception differs very much between countries (cp. Fig. 2 and Fig. 3), specific approaches (e.g. from aggregators) are needed to highlight potential gains. These gains can range between fixed recompenses up to variable, risk sharing, flexible payments. Besides such market-based transaction schemes, information regarding technical implementation, financial benefits as well as the functionality of DSM have to be provided to small and mid-sized companies as they lack relevant know-how. Specific information can be best provided by independent stakeholders such as governmental energy agencies or independent energy advisors. For small companies, such independent information is of high relevance to further promote DSM participation. Larger companies with more standardized procedures regarding energy efficiency and energy demand (e.g. by implementing EnMS) might adopt DSM models faster. Therefore, integrating DSM into EnMS could support the further roll-out of flexibility options on the demand side. Energy advisors and auditors can help to spread the word of advantages and disadvantages of DSM systems.

Given the technical specifications of demand technologies, a large potential for DSM in Europe exists in services companies. As approx. 80 % of the companies investigated have at least one of the suitable DSM technologies installed or in use, aggregating such installations to reasonable DSM bids on the market seems to be achievable from a technical point of view. However, given the current status of regulations across Europe regarding aggregators and bid sizes, more efforts from policy makers are needed to reduce market barriers. Additionally, by integrating several technologies into one bid, transaction costs, as well as performance risks, can be mitigated.

By aggregating different demand technologies into bids, one has to keep in mind the actual need of grid operators to manage demand by reducing or increasing load for specific time instances. As the described survey has only addressed demand in general terms, further information on the appliance specific hourly and seasonal load curves and their correlation with the expected generation load profile is needed to derive the full potential of the services sector DSM potential.

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