INTEGRATION OF DEMAND-SIDE-MANAGEMENT-AGREEMENTS BETWEEN DISTRIBUTORS AND CUSTOMERS IN A POWER TRADE SYSTEM UNDER LIBERALISED MARKET CONDITIONS

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SUMMARY

New relations are developed between utilities and key account customers. Utilities are turning into service businesses, key account customers have the option to cover their power demands on the free market. Utilities require supporting tools which enable the utility to guarantee power supplies over short and medium-term periods based on viable economic principles. This paper develops a method which fulfils the requirements of a situation where key account customer supply demands change within a supply area and tariff intervals. This is achieved by making load demand forecasts as accurate as possible.

1. INTRODUCTION

The supply area of a utility company is characterised by its customer structure. For the supply of normal tariff customers in communities the weather conditions have a considerable impact on the load curve at certain times of the day.

The load demands from industrial customers, in the following called key account customers, are subject to other influences, such as production and technological parameters.

Within the course of the liberalisation industrial customers are given the opportunity to choose their own power supplier.

For the utilities this means that they have to supply a changing potential of key account customers.

A utility needs to include key account customers into its supply strategies in order to make its power supplies economically viable while protecting resources and the environment. With the help of suitable tools, offers need to be made to key account customers which will lead to solid customer bonds.

This requires a flexible method for forecasting the load demand for short and medium-term periods.

2. OBJECTIVE OF DEMAND - SIDE-MANAGEMENT-AGREEMENTS BETWEEN UTILITIES AND CUSTOMERS

Demand-Side-Management- (DSM) strategies of a utility are geared towards impacting customers' requirements in order to

- achieve flexible load curves
- make use of good offers (at short notice)
- increase the use of combined generation (power generated by customers).

Under liberalised market conditions the optimised procurement of power by a regional and/or municipal utility will cover the following components

- supplier of vendor
- power generated by customers in combined heat and power generation (co-generation)
- power market and
- (key account) customers.

This means that the DSM strategies of a regional and/or municipal utility are determined by the request for optimised power procurement and by customer flexibility /4/.

3. SOLUTION METHOD

In the following, a method for solution shall be investigated and reviewed for its suitability and practicality which

1. maintains the traditional load curve in the supply region which is dependent on the weather conditions but does not include the key account customer pool,
2. comprises key account customers with Demand-Side-Management-Agreements in a key account customer pool. This pool is subject to changes caused by customers joining and leaving.

The forecasts of the load demand will be done separately for each one of the two parts, i.e. supply area and key account customer pool, and then be combined to a total demand.

They are used in the planning process as a basis for a power procurement that is economically viable to the

company (figure 1) /3/. This is when the decision is made whether DSM-Agreements with key account customers will have to come into effect for the respective period or also whether a request for supply made by a key account customer can be fulfilled.
In the following, the daily load curves of a municipal supply area and of key account customers shall be described.

3.1 Daily load curve of a supply area

A municipal energy distributor shall serve as an example for a municipal utility. Analyses of the load demand throughout different times of the day show the dependence of the load on the day temperature and the light conditions at the time of the year (figure 2).

3.2 Daily load curve of key account customers

Figure 3 shows the daily load curves of key account customers /2/.
The daily load demand of a key account customer is influenced by the following criteria:

- type of production and production technology
- shift system
- day of the week
- power purchase agreement
- (weather conditions).

To cover their power demand the key account customers inquire of the utilities, decide on the offers made by the utilities and the market and make a choice on their power purchases.
The planning horizon ranges between the following day up to one week.

3.3 Formation of a key account customer pool

Utilities may group together key account customers (KAC) with DSM-Agreements in a key account customer pool.
This pool is characterised by sudden changes in its configuration. Figure 4 shows various scenarios of the pool configuration. The objective is to provide the utility with a suitable tool which enables the company to simulate various strategies for supplying key account customers.
This is done based on short-term forecasts of the load demand. Therefore, the requirements to the accuracy of the forecasts are very strict.

4. FORECAST RESULTS FOR THE FOLLOWING DAY

For forecasting the load demand for the following day forecasting processes are to be applied to each part of the area.

4.1 Forecasting the following day in the supply area

The input parameters for load demand forecasts in the supply area also include weather conditions such as temperature and brightness /1,4/. Figure 2 shows the results of the forecast obtained by applying a developed neural network.

4.2 Daily load curve of the key account customer pool

In the following, two strategies for establishing the daily load demand of a pool are pursued:
a) the daily load curve is forecasted for each key account customer and then the total demand is calculated by summation.
b) based on each individual key account customer the total load demand of the pool is forecasted for the following day.
Artificial neural networks are also used for forecasting the load demand by the key account customers for the following day. The input parameters and the structure of these systems, however, need to be specified and developed for this area of application.
In scenario a) a neural network is developed for forecasting the daily load curve of each key account customer. Figure 3 shows forecast results obtained for this application.
In scenario b) a neural network forecasts the daily load demand by the key account customer pool.
The results of the forecasts made for the total key account customer demand of the following day in both scenarios are compared in Figure 4. The objective was to review the forecasting accuracy with varying configurations of the key account customer pool.
The result showing that the two scenarios contain only minor variations in their forecasting accuracy was a surprise. This statement was confirmed by the statistic analyses covering a period of 8 months (figure 5). Furthermore, the distribution functions for the total demand of the key account customer pool in figure 5 show that the forecasting accuracy of the pool demand improves with a rising number of key account customer pool members.

5. CONCLUSIONS FOR APPLICATIONS IN PRACTISE

The results obtained support the objective of forecasting the daily load demand of key account customers with DSM-Agreements separately to the forecast produced for the municipal supply area. To achieve this, it was suggested that these key account customers were grouped together in a key account customer pool. The recommended type of forecast is a forecast of the total demand in the key account customer pool. It is slightly more accurate than the single customer forecast and it also requires a method that covers the changing number of key account customer pool members.

This means that neural networks need to be configured automatically as a function of the number of key account customers so that they produce forecasts for the following day with a high accuracy. A data basis covering a period of four weeks is sufficient to train the network.
The daily load curves of the municipal supply area and of the key account customer pool are forecasted on a PC with WINDOWS NT.

LITERATURE

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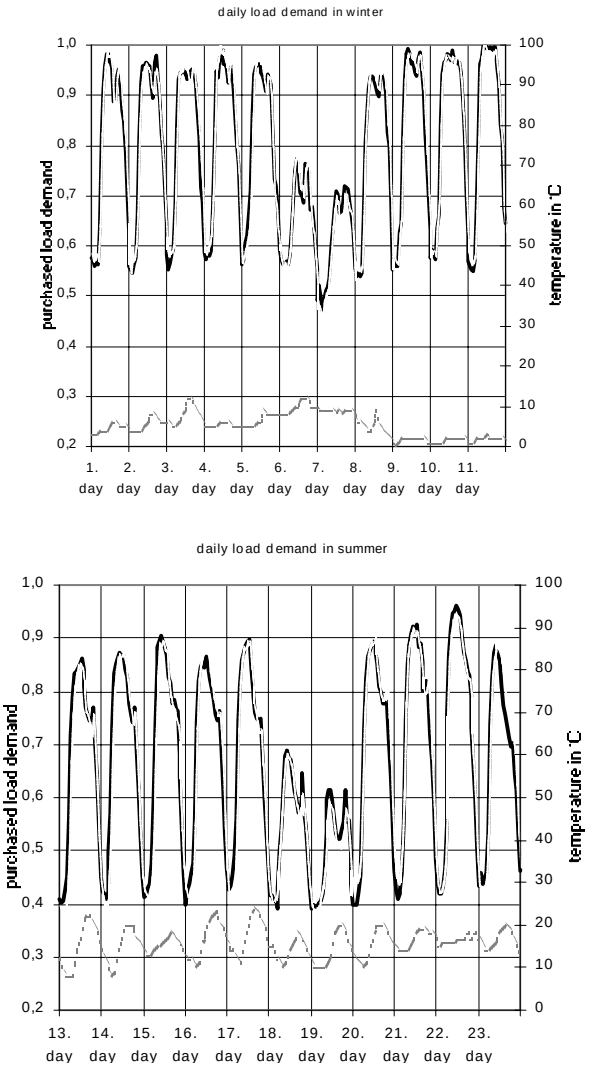

Figure 2: Daily load curves of a municipal supply area in winter and summer

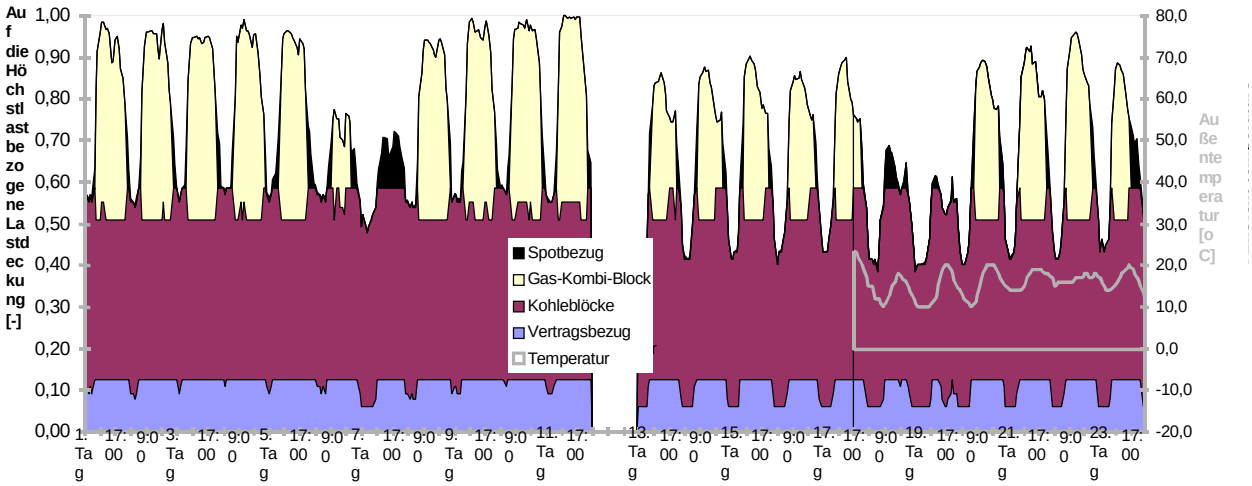

Figure 1: Planning of available resources for optimal power purchases by a utility

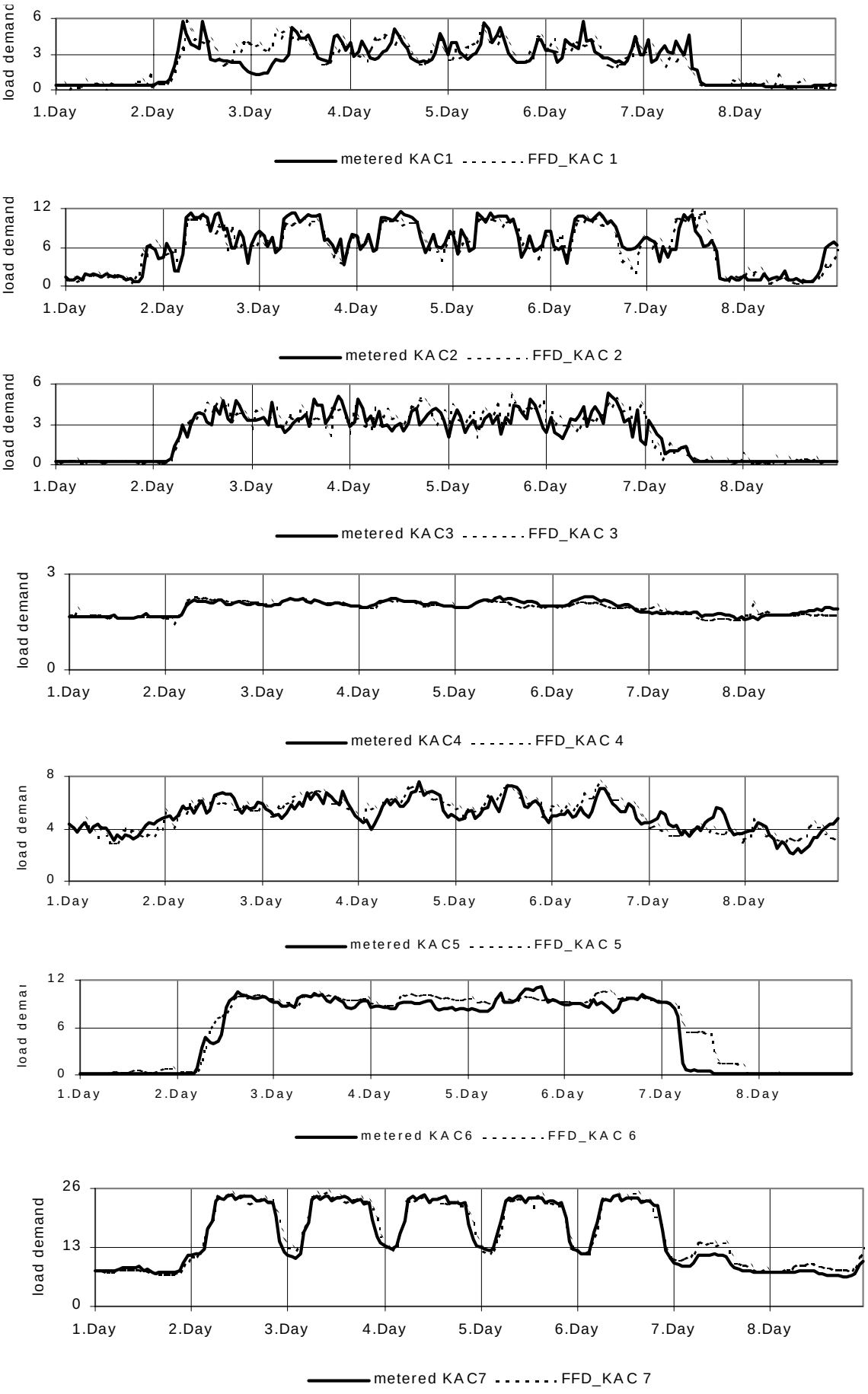

Figure 3: metered daily load curves of key account customers (KAC) with forecasts of the following day (FFD)

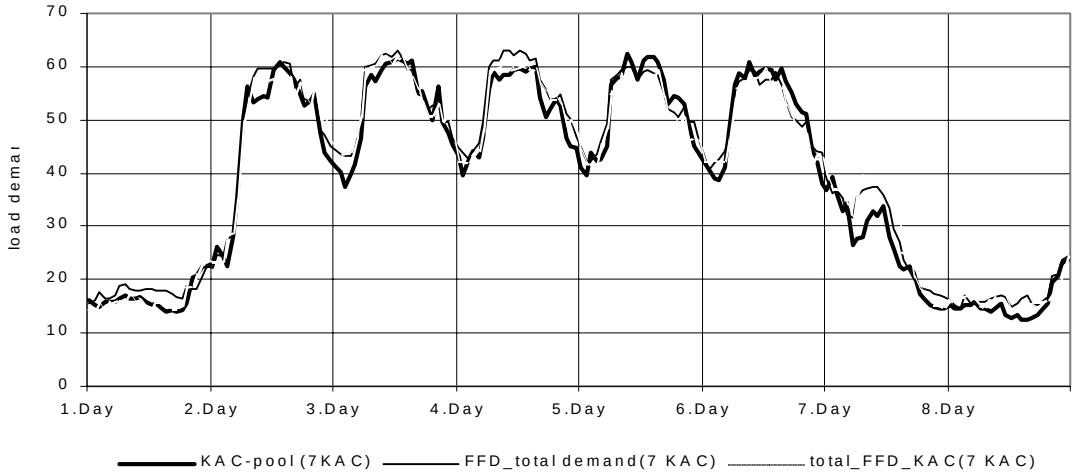

Figure 4a: key account customer pool with all key account customers and following day forecasts

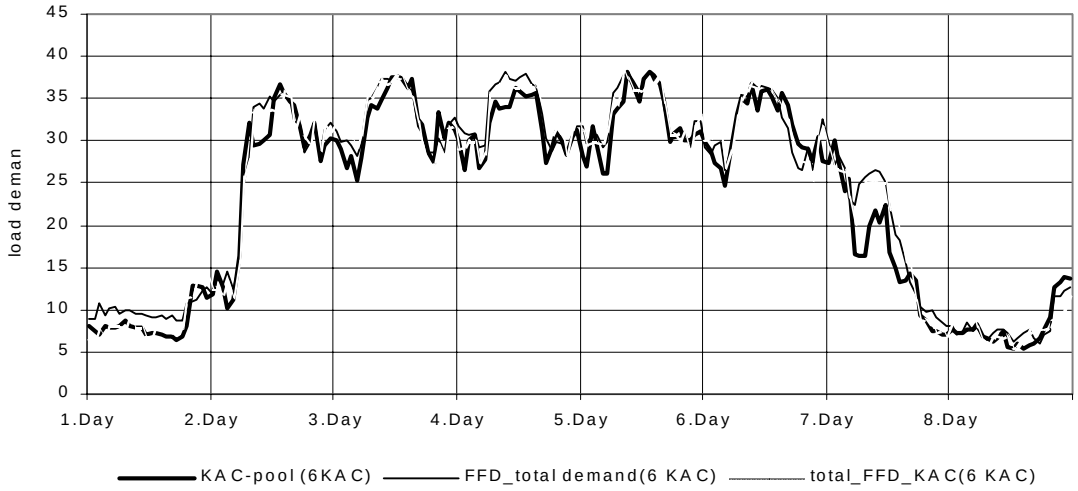

Figure 4b: key account customer pool with key account customers 1-6 and following day forecasts

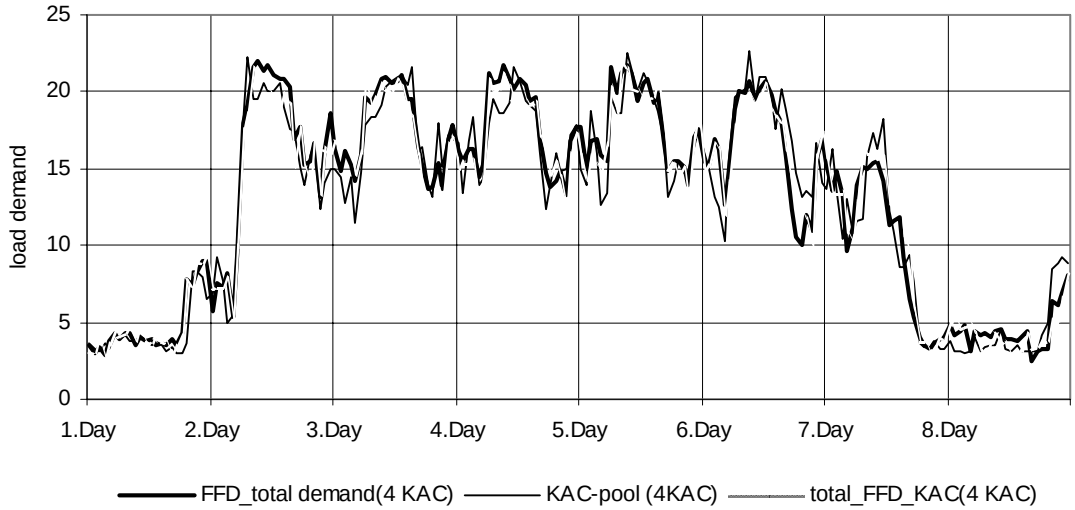

Figure 4c: key account customer pool with key account customers 1-4 and following day forecasts

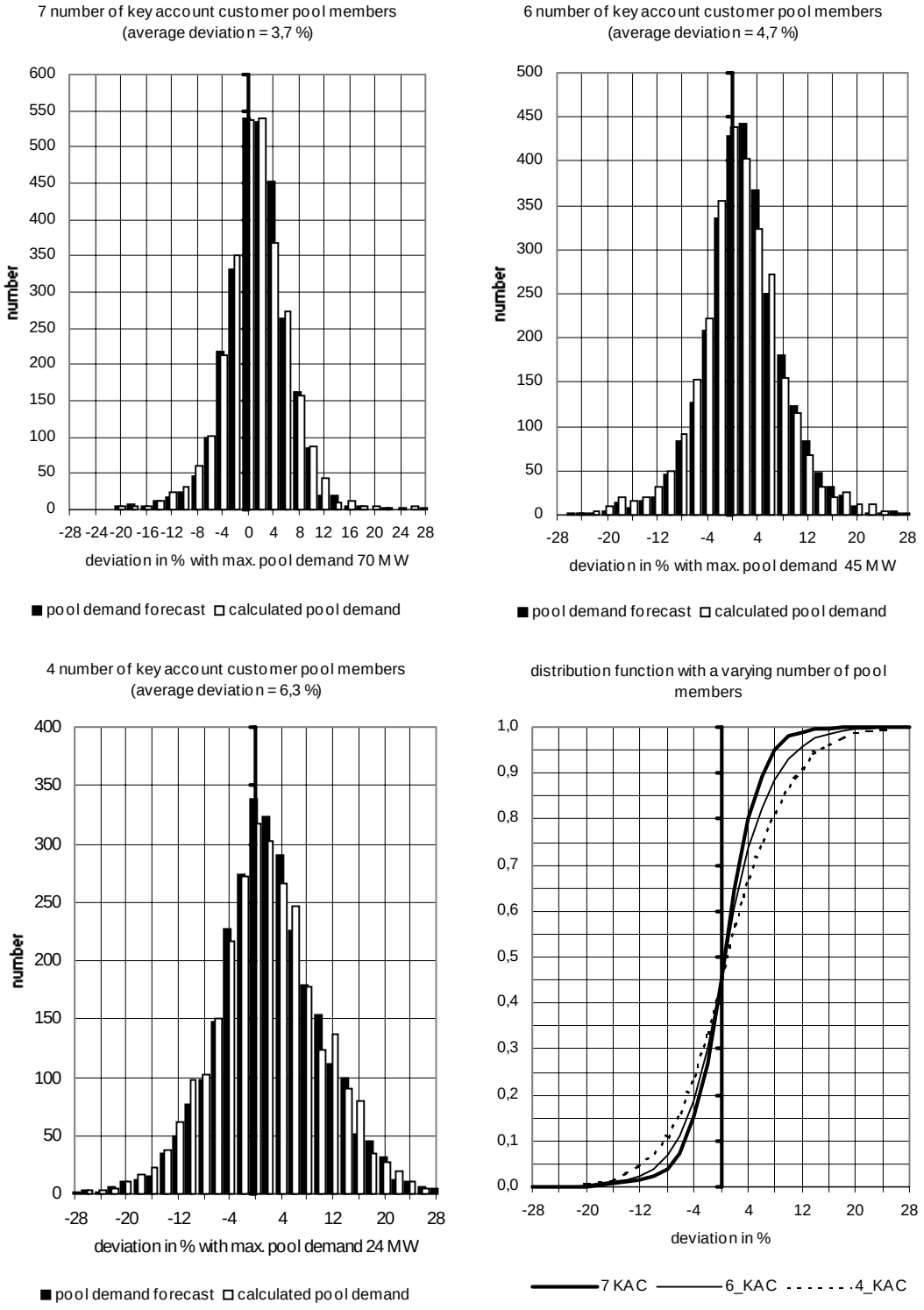

Figure 5: Comparison of the deviation between two scenarios for forecasting the total demand in the key account customer pool with a variable configuration of the key account customer pool