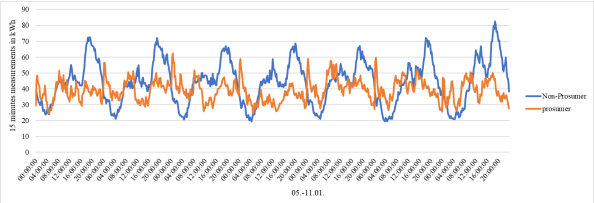
Impact of prosumers on the accuracy of load forecast with neural networks

More and more prosumers will penetrate the power grid. But how do prosumers affect the accuracy of the day-ahead load forecast? In contrast to related research on prosumers and load forecast, this paper addresses the impact of different shares of prosumers on the load forecast for areas with several households. In order to answer this research question, the load forecast accuracies for a dataset without prosumers is compared to the ones of datasets with different shares of prosumers in an experimental setup using neural networks. A sliding window approach with lagged values up to seven days is applied. Apart from electricity consumption data weather and date data are considered. The conducted tests show, that the mean absolute percentage error increases from about 8% for a dataset without prosumers up to about 39% for a dataset with a share of prosumers of 80%. It can therefore be concluded that prosumers decrease the accuracy of the day-ahead load forecast with neural networks.

Data



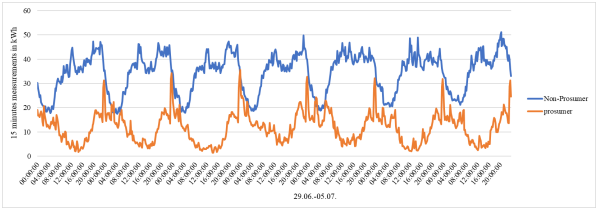
Comparison of consumption of prosumers and non-prosumers in winter

The prosumer dataset

- provided by another power utility of a city in Switzerland
- 15 minutes measurements in kWh of the net electricity consumption and production of 100 (originally 147) objects from 2017
- In sum they have a yearly electricity consumption of 712'330 kWh

The non-prosumer dataset

- provided by a power utility of a city in Switzerland
- 15 minutes measurements of 469 households from 2015.
- missing values have been completed using the average of the values of the same time the previous day and the following day respectively the previous hour and the following hour
- Overall the 469 objects have a consumption of 1'325'267 kWh



Comparison of consumption of prosumers and non-prosumers in summer

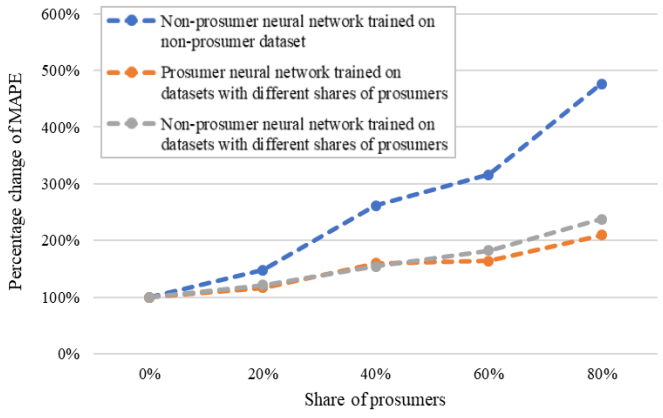
Approach

	kWh	kWh -1Δ	kWh -2Δ	kWh -3Δ	kWh -4Δ	kWh -5Δ	kWh -6Δ	kWh -7Δ	kWh -8Δ	kWh -9Δ
00:00	40.2	43.2	44.9	47.7	51.3	53.2	54.4	51.1	53.7	51.9
+1Δ	36.7	40.2	43.2	44.9	47.7	51.3	53.2	54.4	51.1	53.7
+2Δ	35.6	36.7	40.2	43.2	44.9	47.7	51.3	53.2	54.4	51.1
+3Δ	31.1	35.6	36.7	40.2	43.2	44.9	47.7	51.3	53.2	54.4

Sliding Window

	ANN trained on non-prosumer data only	*ANN trained also on prosumer data*
Optimizer	Adam	Adam
Learning rate	0.001	0.001
Loss function	MAE	MSE
Number of hidden layers	3	5
Number of neurons per hidden layer	1000	500
Activation function	ReLu	ReLu
Early stopping algorithm patience	20	20
Validation split	0.1	0.1
Combination of lagged input variables	7	4

Main Results



MAE	0%	20%	40%	60%	80%
(A)	2.1	2.9	4.9	5.6	7.2
(B)	2.1	2.5	3.6	3.6	4.5
(C)	2.1	2.6	3.4	4.1	5.3
MSE	0%	20%	40%	60%	80%
(A)	7.5	13.4	36.5	50.8	80.7
(B)	7.8	10.9	23.8	27.6	40.5
(C)	7.5	12.3	21.9	35.7	58.1
MAPE	0%	20%	40%	60%	80%
(A)	8.2	12.1	21.4	25.9	39.1
(B)	8.3	9.6	13.2	13.6	17.3
(C)	8.2	9.9	12.6	15.0	19.5