A sample survey of meters demonstrating energetic efficiency application

The authors names shall be revealed in time

1. Introduction

2. Load forecast for 70 meters cluster based on bootstrap and ANN

Bagging represents the approach where each segment of time-series is approximated by another decision tree – a not so accurate regression by itself. ANN represents approximation of the time series using a deterministic function. Bagging approach is usually herein better than ANN. Especially for two-months history bagging is significantly better than ANN. This implies that ANN requires at least one year historic load profile. LSTM being 512 layers require further additional data. That is why data-augmentation is insert. The concept of accurate 1) multi-step, 2) some due to being multivariate should not be underestimated. There are plenty of open source code that turned out inaccurate. A large segment of consumers 30 days look-ahead after two month is reasonable (80%) accuracy.

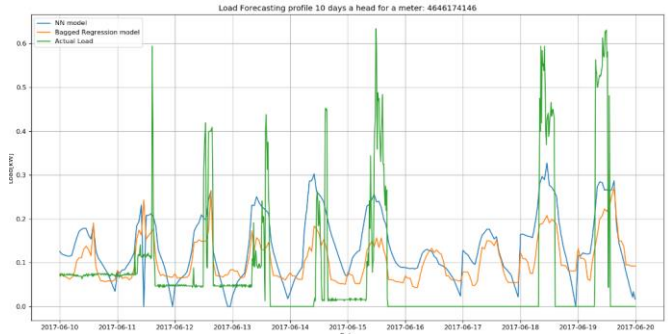

Fig 1.1: 10 days look-ahead, with 2 months history of load profile. Consumer type:

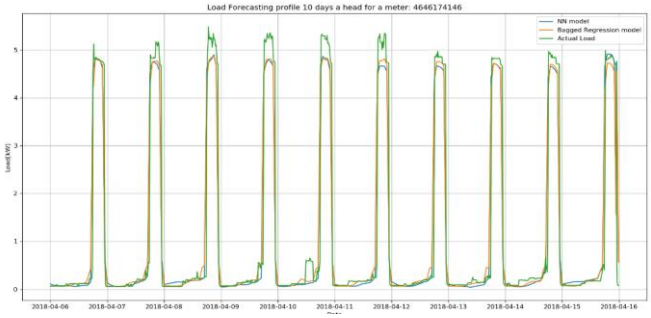

Fig 1.2: 10 days look-ahead, with 1 year history of load forecast. Consumer type:

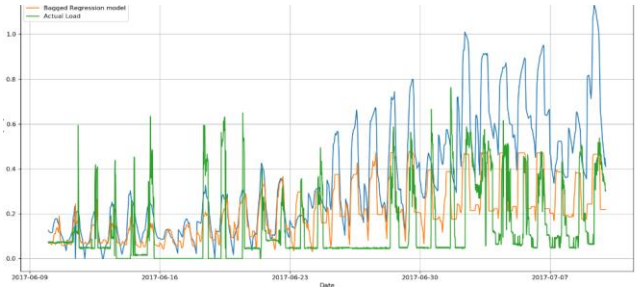

Fig. 1.3: 30 days look-ahead, with two months history of load forecast. Consumer type:

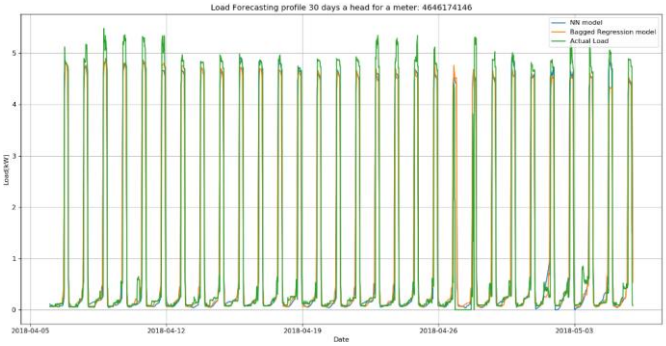

Fig 1.4: 30 days look-ahead, with 1 year history of load forecast. Consumer type:

2.2. **meter #2**

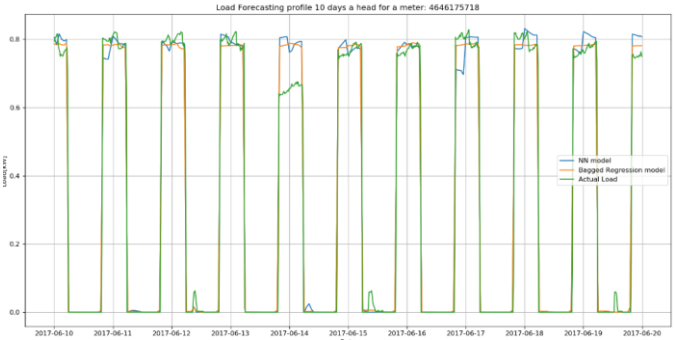

Fig 2.1: 10 days look-ahead, with 2 months history of load profile. Consumer type:

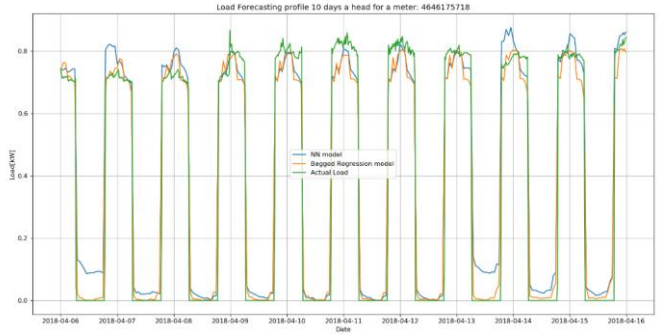

Fig 2.2: 10 days look-ahead, with 1 year history of load forecast. No better forecast. Consumer type:

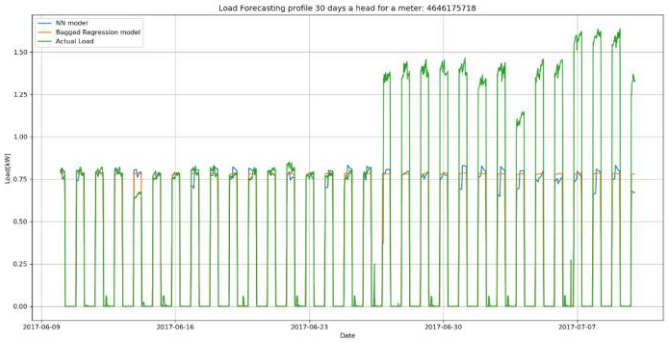

Fig. 2.3: 30 days look-ahead, with two months history of load forecast. Consumer suddenly consumes more, but forecast didn't catch up. Consumer type:

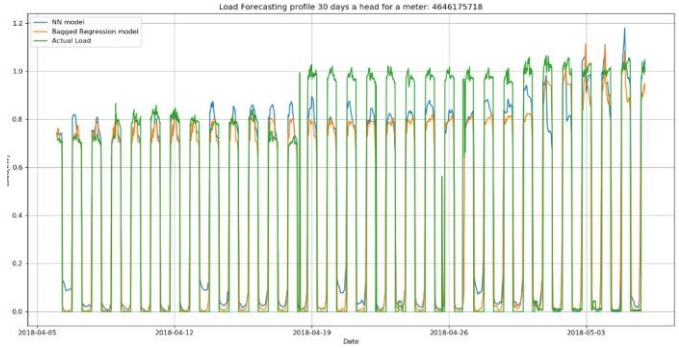

Fig 2.4: 30 days look-ahead, with 1 year history of load forecast. Forecast eventually catch-up consumption. Consumer type:

2.3 meter #3

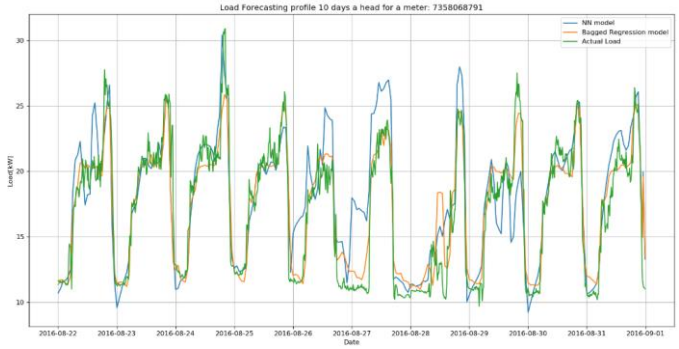

Fig 3.1: 10 days look-ahead, with 2 months history of load profile. Consumer type:

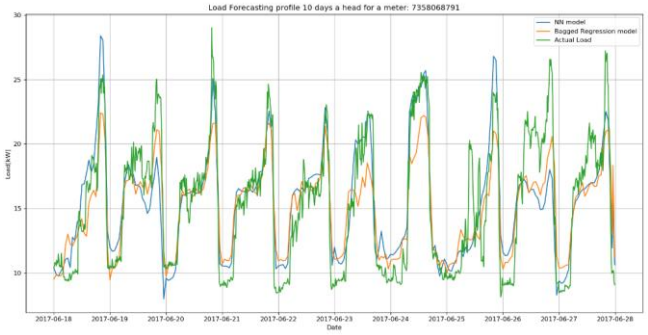

Fig 3.2: 10 days look-ahead, with 1 year history of load forecast. An improved, forecast. Consumer type:

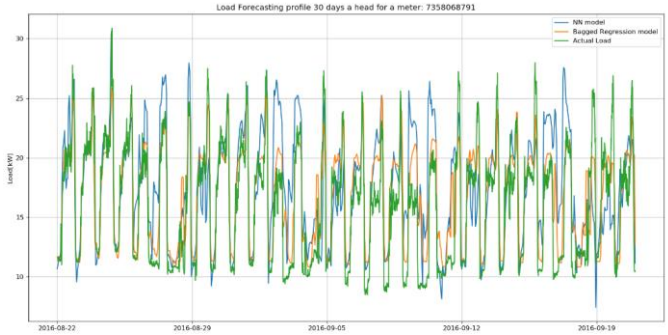

Fig. 3.3: 30 days look-ahead, with two months history of load forecast. Not so bad forecast. Consumer type:

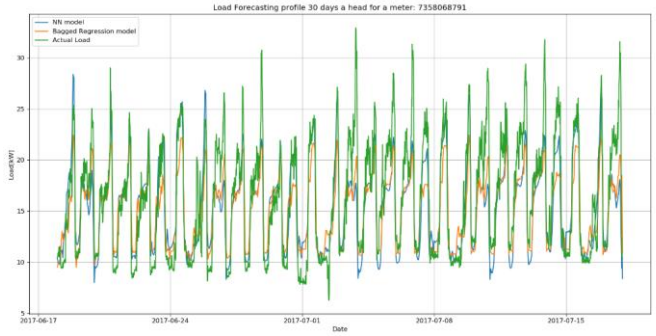

Fig 3.4: 30 days look-ahead, with 1 year history of load forecast. Forecast eventually catch-up consumption. An improved, forecast. Consumer type

2.4. meter #4:

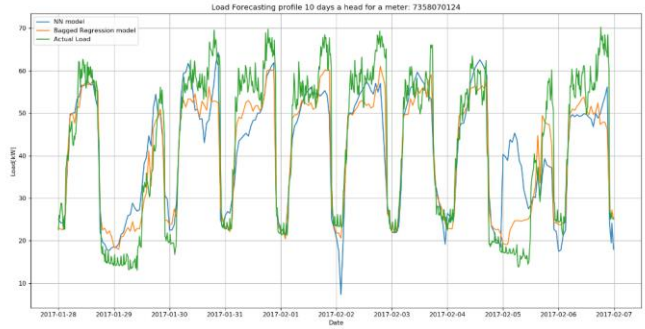

Fig 4.1: 10 days look-ahead, with 2 months history of load profile. We study from the bad accuracy points. Consumer type:

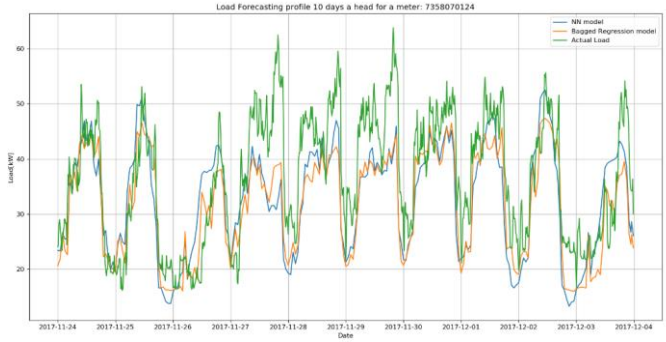

Fig 4.2: 10 days look-ahead, with 1 year history of load forecast. An improved, forecast: ANN is improved, bagged is improved. Consumer type:

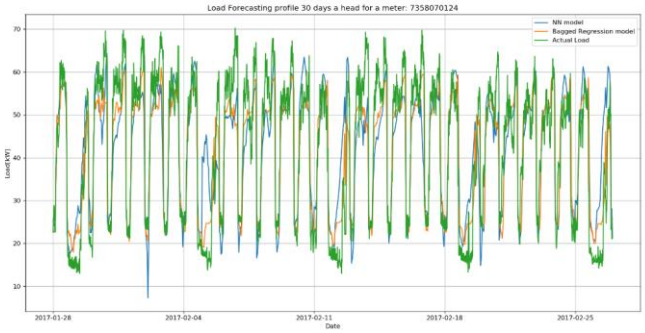

Fig. 4.3: 30 days look-ahead, with two months history of load forecast. Not so bad forecast. Consumer type:

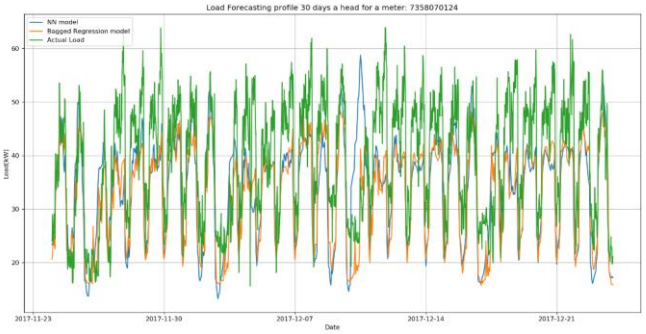

Fig 4.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. An improved, forecast. Consumer type

2.5. meter #5

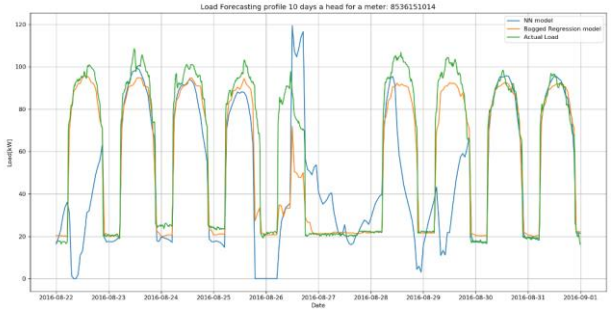

Fig 5.1: 10 days look-ahead, with 2 months history of load profile. We study from the bad accuracy points. Consumer type:

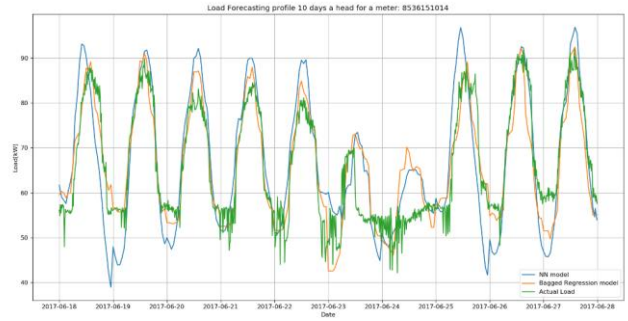

Fig 5.2: 10 days look-ahead, with 1 year history of load forecast. An improved, forecast: ANN is improved, bagged is improved. Consumer type:

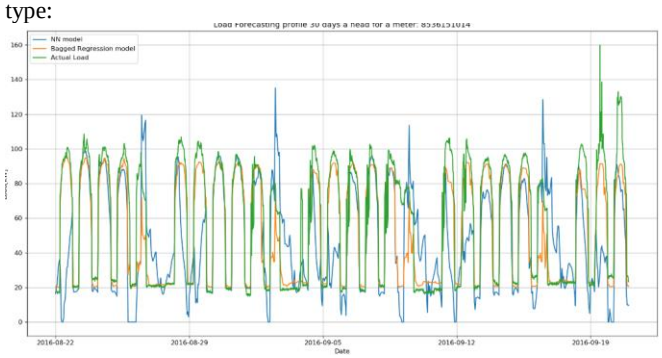

Fig. 5.3: 30 days look-ahead, with two months history of load forecast. Not so bad forecast. Consumer type:

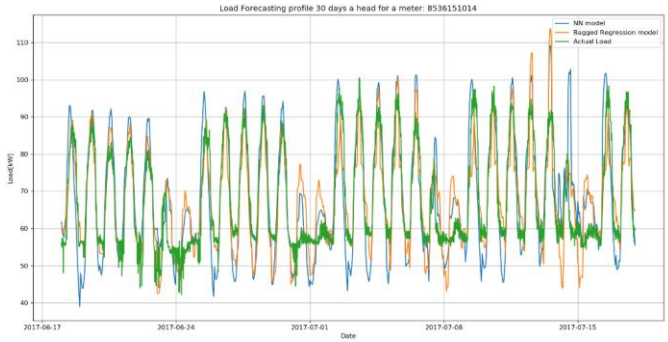

Fig 5.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not such a good forecast. An improved, forecast. Consumer type

2.6. meter #6

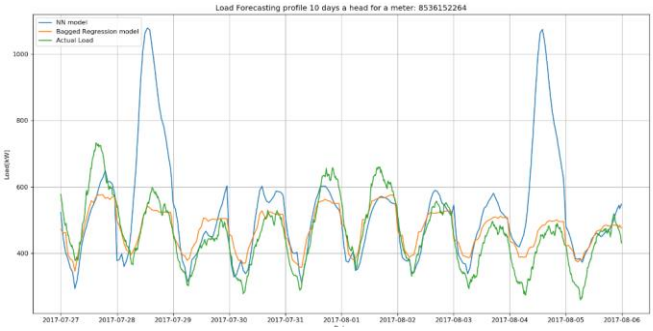

Fig 6.1: 10 days look-ahead, with 2 months history of load profile. Bagging is not so bad. Consumer type:

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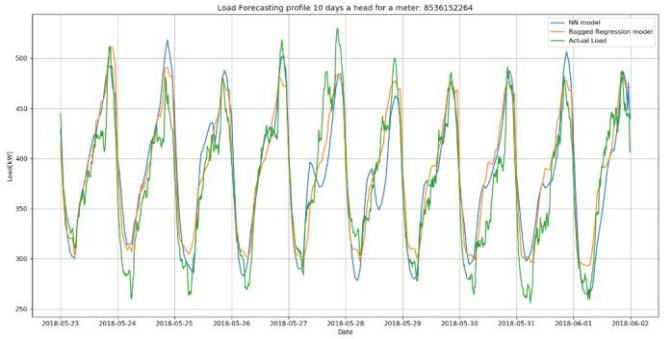

Fig 6.2: 10 days look-ahead, with 1 year history of load forecast. An improved, forecast: ANN, bagged are much improved. Consumer type:

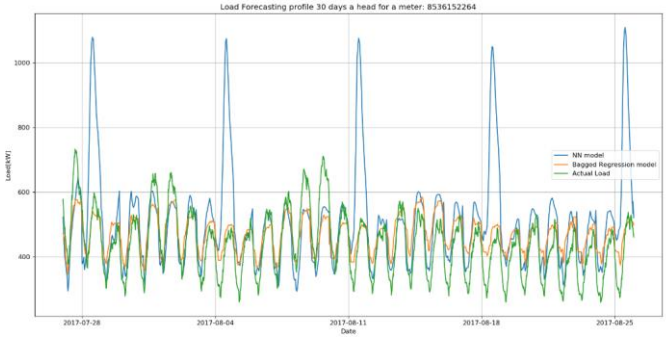

Fig. 6.3: 30 days look-ahead, with two months history of load forecast. Bagging is good, ANN lacks training data. Consumer type:

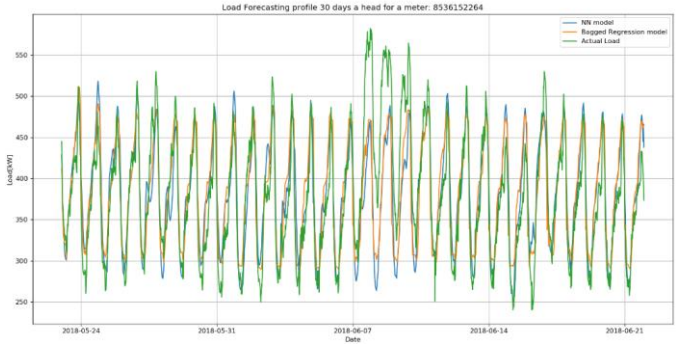

Fig 6.4: 30 days look-ahead, with 1 year history of load forecast. Usually: An improved, forecast especially for ANN. Consumer type

2.7. meter #7

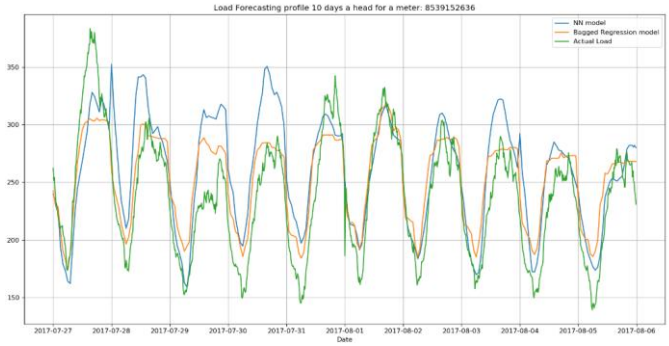

Fig 7.1: 10 days look-ahead, with 2 months history of load profile. Bagging is not so bad. Consumer type:

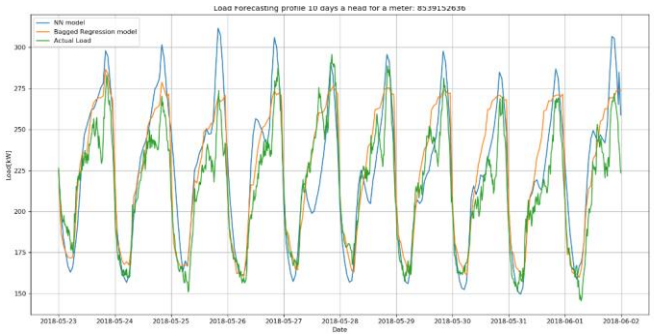

Fig. 7.2: 10 days look-ahead, with 1 year history of load forecast. An improved, forecast: ANN, bagged are much improved. Consumer type:

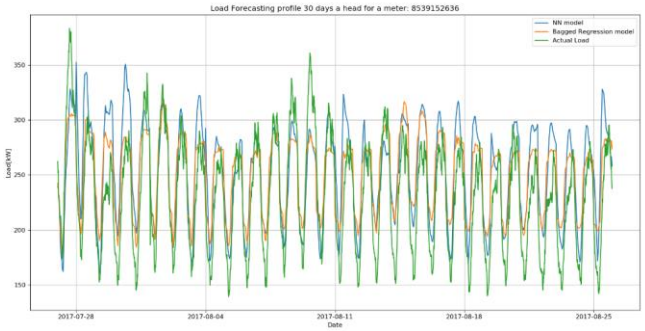

Fig. 7.3: 30 days look-ahead, with two months history of load forecast. Bagging is good, ANN lacks training data but is pretty accurate. Consumer type:

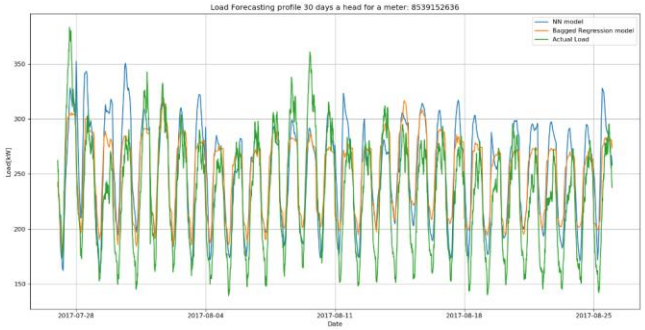

Fig 7.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. An improved, forecast. Consumer type

2.8. meter #8:

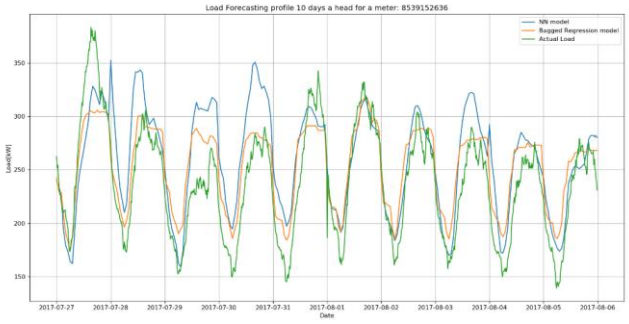

Fig 8.1: 10 days look-ahead, with 2 months history of load profile. Bagging is not so bad. Consumer type:

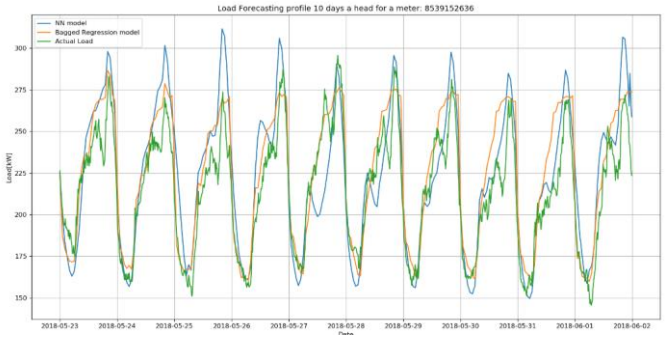

Fig. 8.2: 10 days look-ahead, with 1 year history of load forecast. An improved, forecast: ANN, bagged are much improved. Consumer type:

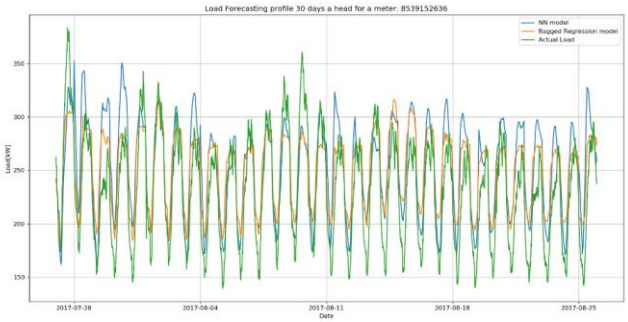

Fig. 8.3: 30 days look-ahead, with two months history of load forecast. Bagging, ANN pretty accurate. Consumer type:

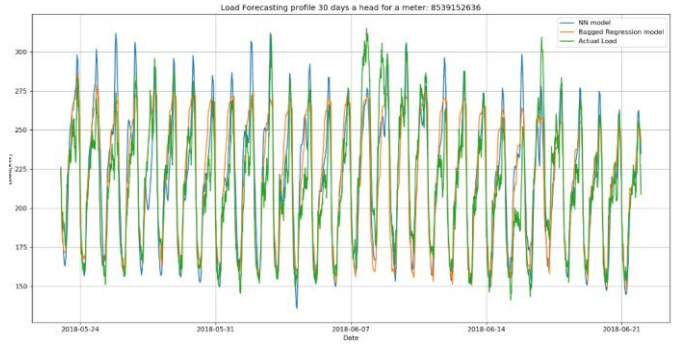

Fig 8.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. An improved, forecast. Consumer type

2.9. meter #9

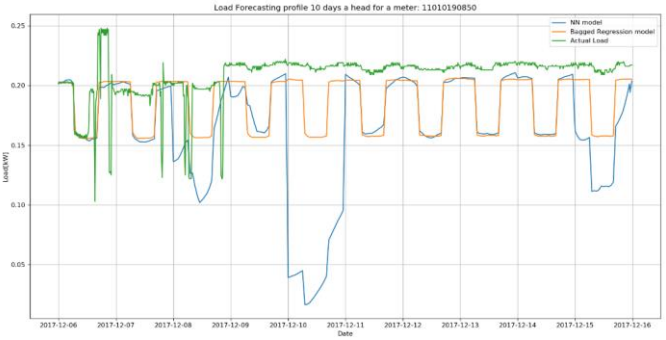

Fig 9.1: 10 days look-ahead, with 2 months history of load profile. Bagging is bad, although simple rectangular waveform- but it does not reach zero. Consumer type:

Fig. 9.2: 10 days look-ahead, with 1 year history of load forecast. ANN, bagged are much improved. Consumer type:

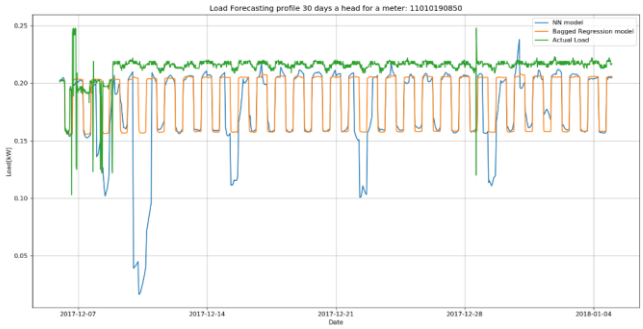

Fig. 9.3: 30 days look-ahead, with two months history of load forecast. ANN is more accurate than bootstrap and accurate most of time. Consumer type:

Fig 9.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. The rectangular waveform forecast is becoming worse in time. Possibly because consumption behavior is different than previous year. Consumer type:

2.10. meter #10

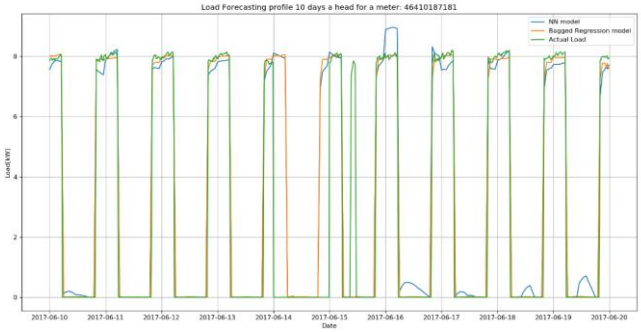

Fig. 10.1: 10 days look-ahead, with 2 months history of load profile. Any change in periodicity cannot be forecasted – farther away from forecasting point in time. Pattern and amplitude are ok forecasted. Difference from meter #9 is – it reaches zero values. Consumer type:

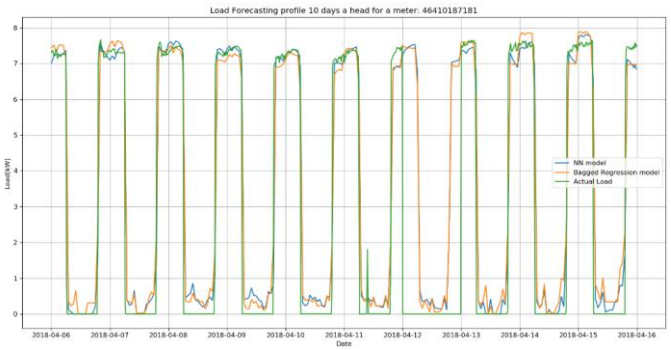

Fig. 10.2: 10 days look-ahead, with 1 year history of load forecast. ANN, bagged are much improved. Consumer type:

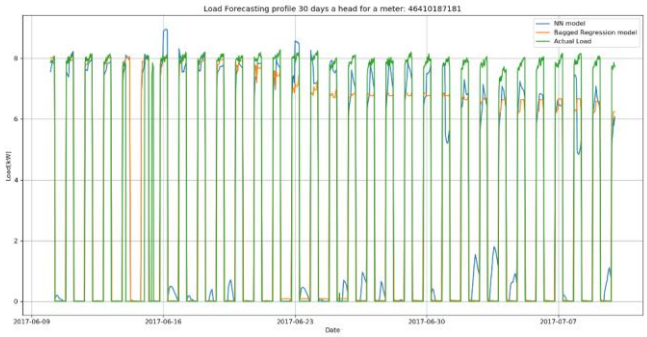

Fig. 10.3: 30 days look-ahead, with two months history of load forecast. ANN is more accurate than bootstrap and accurate most of time. Accuracy degrades with time. Consumer type:

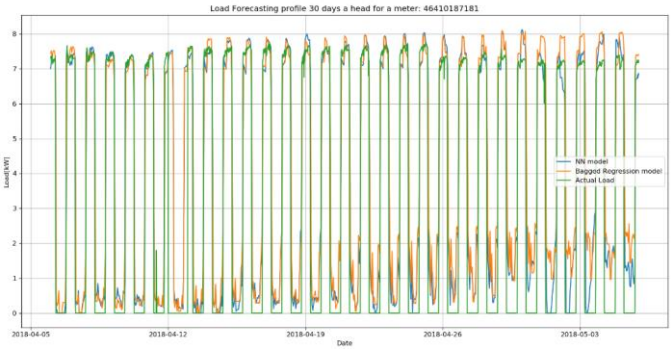

Fig 10.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. The rectangular waveform forecast is becoming worse in time. Consistent behavior with meter #9. Forecast accuracy increase from 10 to 30 days. Consumer type:

2.11. meter #11

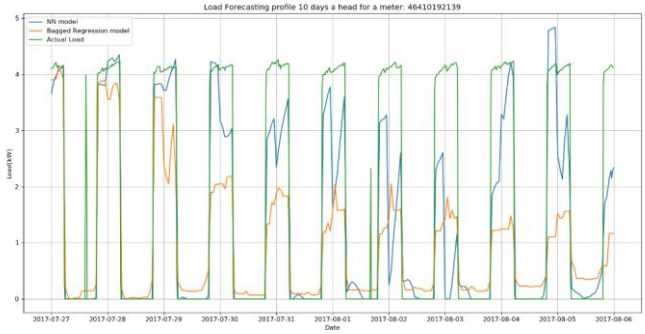

Fig. 11.1: 10 days look-ahead, with 2 months history of load profile. Difference from meter #10,9 is – it is worse values. Consumer type:

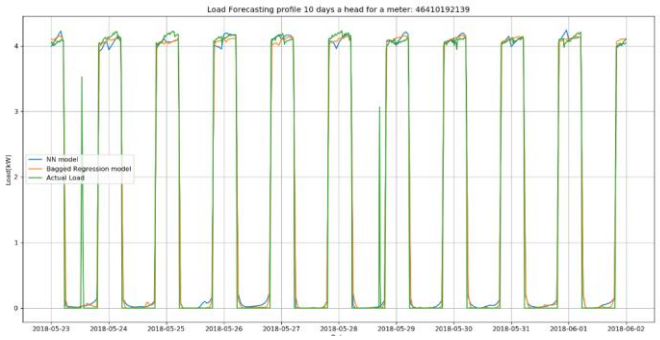

Fig. 11.2: 10 days look-ahead, with 1 year history of load forecast. ANN, bagged are much improved. Consumer type:

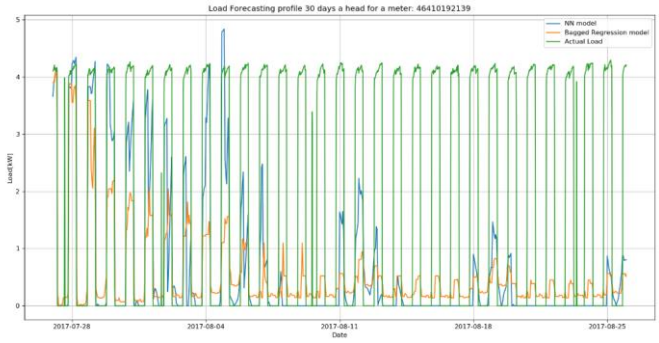

Fig. 11.3: 30 days look-ahead, with two months history of load forecast. ANN is more accurate than bootstrap 2 month history is insufficient for 30 days prediction. Accuracy degrades with time. Consumer type:

Following meters 9-11- an empiric observation: the random nature of back-propagation possibly insufficient training dataset to train the ANN.

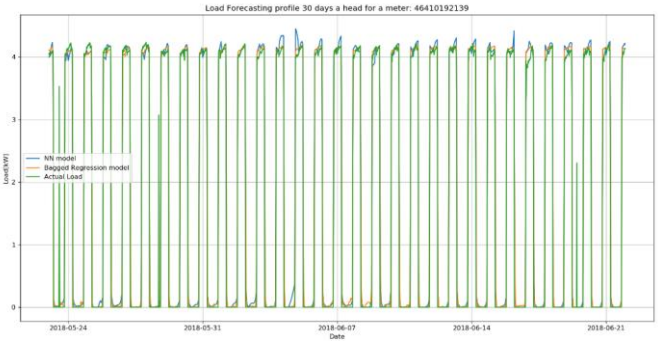

Fig 11.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. The rectangular waveform forecast is becoming worse in time. Consistent behavior with meter #9. Forecast accuracy increase from 10 to 30 days. Consumer type:

Numerous meters are such as 9-11.

2.12. meter #12:

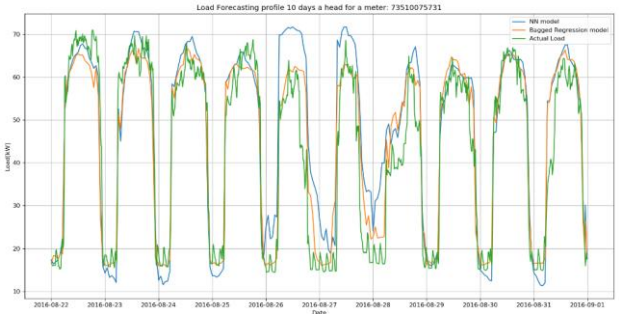

Fig. 12.1: 10 days look-ahead, with 2 months history of load profile. Not such a bad forecast for non-square wave consumption. Consumer type:

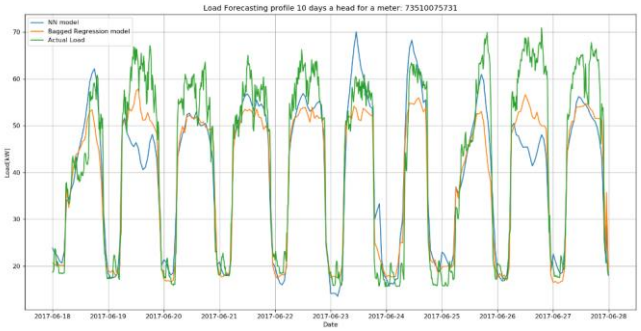

Fig. 12.2: 10 days look-ahead, with 1 year history of load forecast. ANN, bagged are much improved. Consumer type:

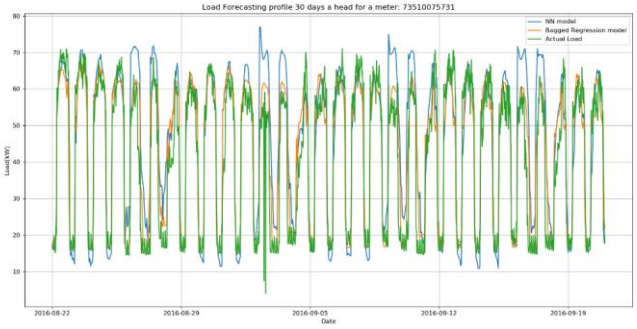

Fig. 12.3: 30 days look-ahead, with two months history of load forecast. Not such a bad forecast. Consumer type:

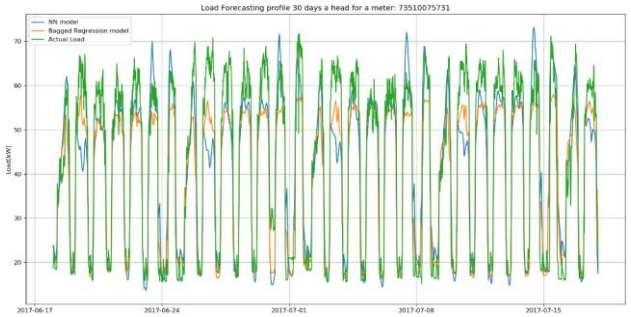

Fig 12.4: 30 days look-ahead, with 1 year history of load forecast. Usually: not a bad forecast. It proves, combined with 12.3 that for this consumer two months for 30 days look-ahead load forecast is ok.

2.13. meter #13:

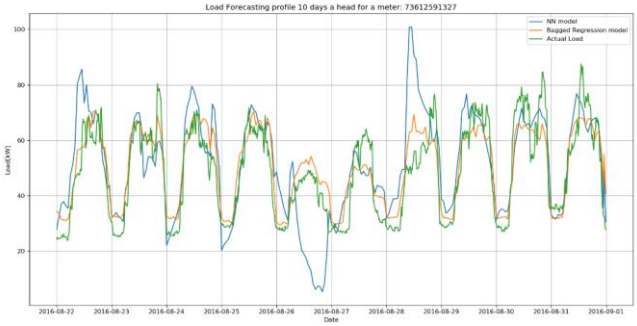

Fig. 13.1: 10 days look-ahead, with 2 months history of load profile. Not such a bad forecast for non-square wave consumption. Consumer type:

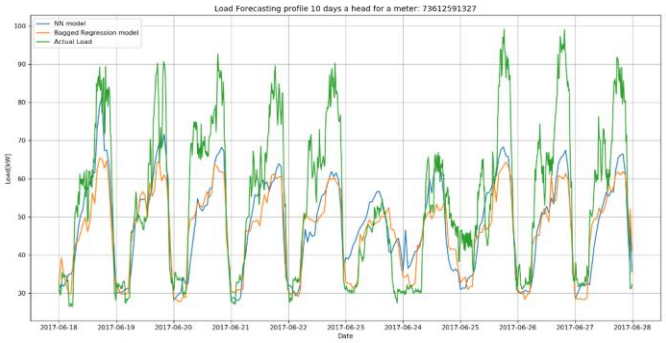

Fig. 13.2: 10 days look-ahead, with 1 year history of load forecast. ANN, bagged are not improved. Consumer type:

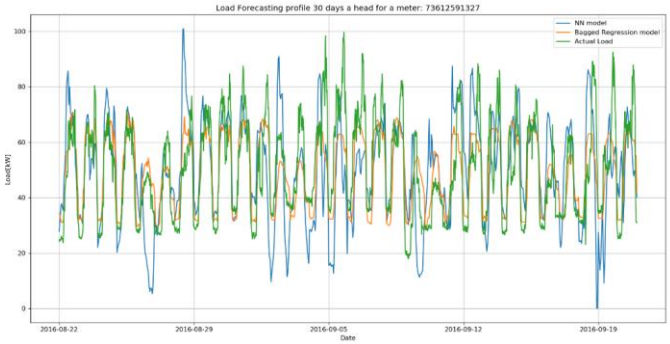

Fig. 13.3: 30 days look-ahead, with two months history of load forecast. Bagging is not such a bad forecast. Consumer type:

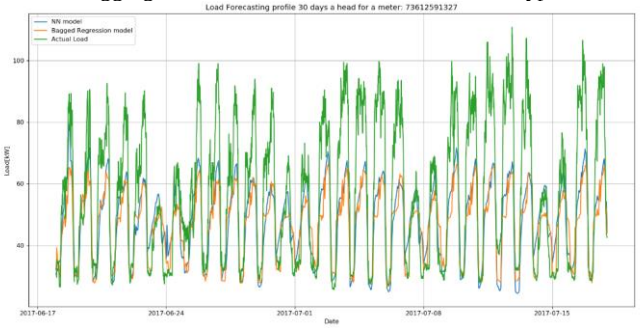

Fig 13.4: 30 days look-ahead, with 1 year history of load forecast. This is a unique case were more history doesn't seem to improve forecast. Consumer type:

2.14. meter #14

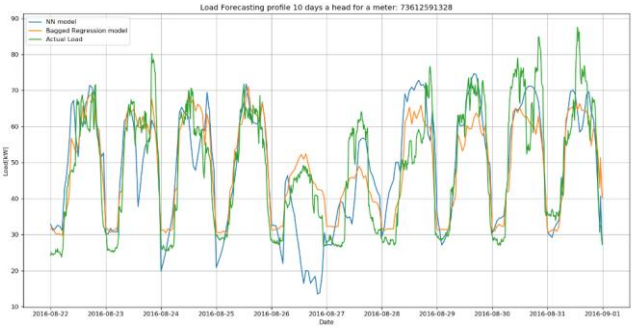

Fig. 14.1: 10 days look-ahead, with 2 months history of load profile. Not such a bad forecast. Consumer type:

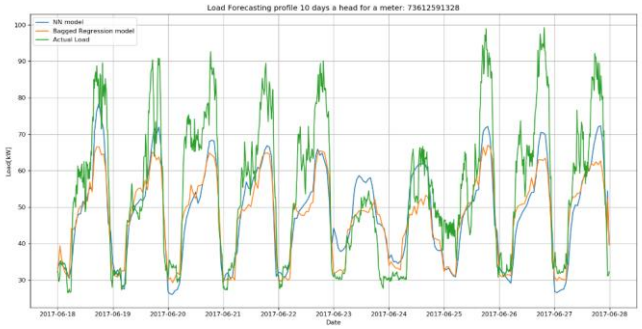

Fig. 14.2: 10 days look-ahead, with 1 year history of load forecast. ANN, bagged are not improved. Consumer type:

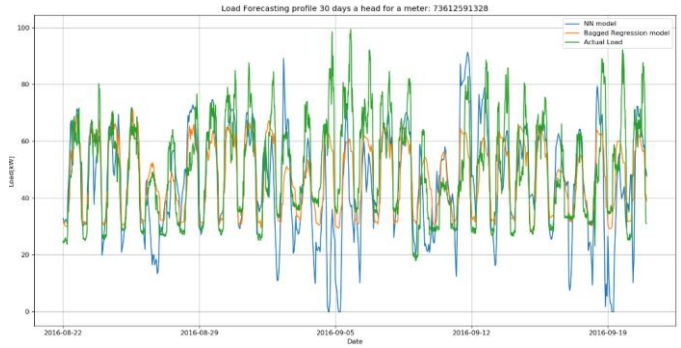

Fig. 14.3: 30 days look-ahead, with two months history of load forecast. Bagging is not such a bad forecast. Consumer type:

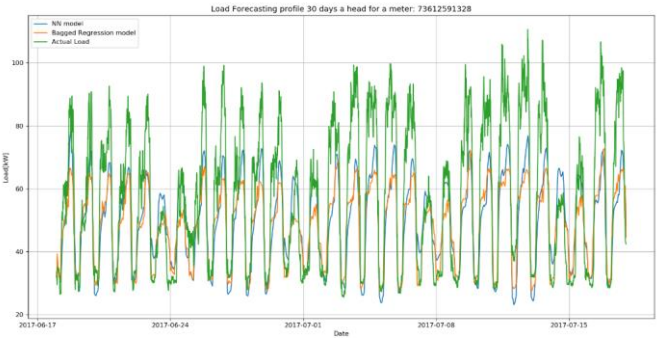

Fig 14.4: 30 days look-ahead, with 1 year history of load forecast. This is a unique case were more history doesn't seem to improve forecast. Consumer type:

2.15. meter #15

Fig. 15.1: 10 days look-ahead, with 2 months history of load profile. Very accurate, looks like an automatic operation. Consumer type:

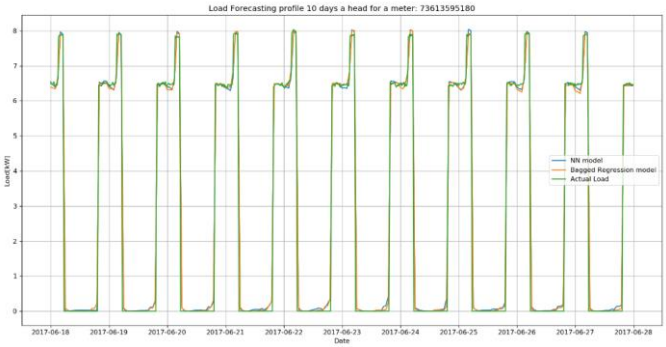

Fig. 15.2: 10 days look-ahead, with 1 year history of load forecast. Excellent forecast, nothing to improve over 14.1. Consumer type:

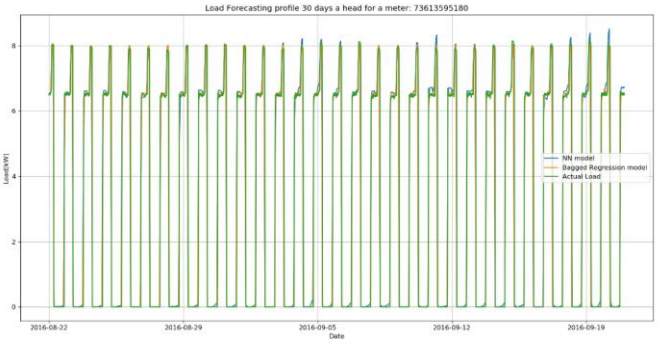

Fig. 15.3: 30 days look-ahead, with two months history of load forecast. Bagging, ANN excellent forecast. Consumer type:

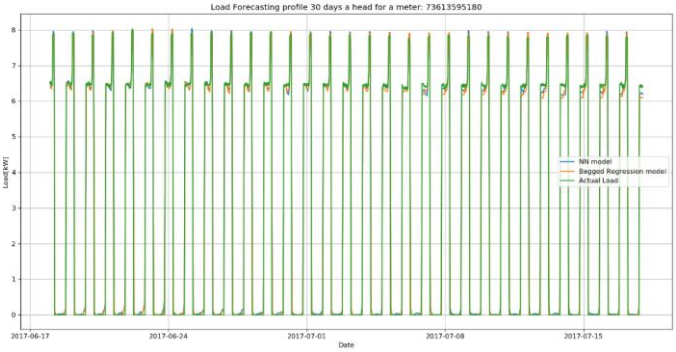

Fig 15.4: 30 days look-ahead, with 1 year history of load forecast. Excellent forecasting, not too difficult. Consumer type:

2.16. meter #16

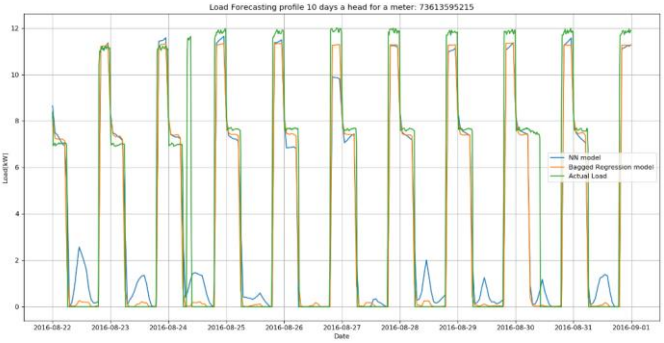

Fig. 16.1: 10 days look-ahead, with 2 months history of load profile. Bagged very accurate and ANN not too bad, looks like an automatic operation. Consumer type:

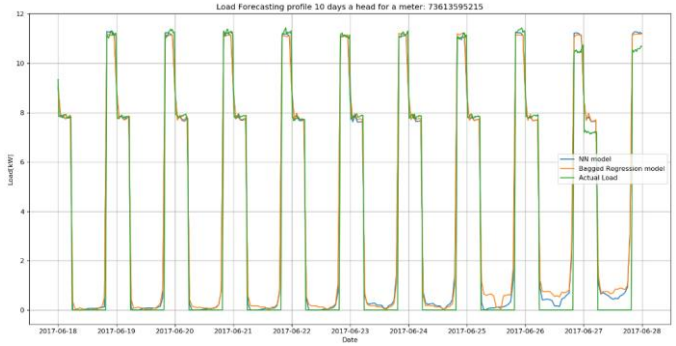

Fig. 16.2: 10 days look-ahead, with 1 year history of load forecast. Excellent forecast. Consumer type:

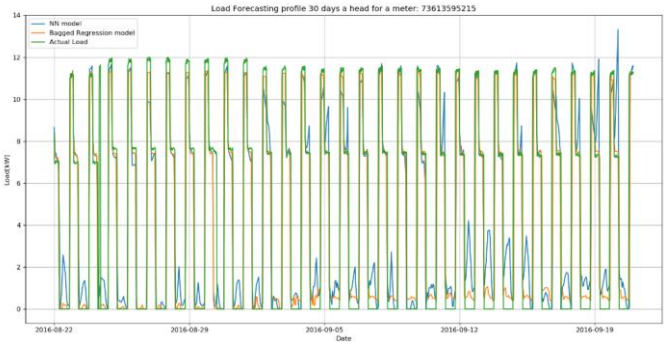

Fig. 16.3: 30 days look-ahead, with two months history of load forecast. Bagging, ANN medium quality forecast. The zero levels are not so accurately forecasted. Consumer type:

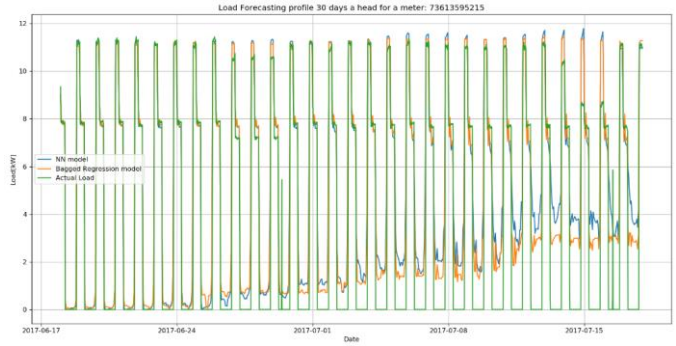

Fig 16.4: 30 days look-ahead, with 1 year history of load forecast. Medium accuracy forecasting, The zero levels are not so accurately forecasted. Consumer type:

2.17. meter #17

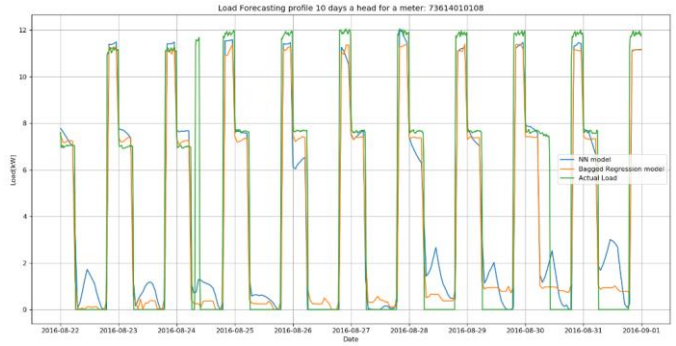

Fig. 17.1: 10 days look-ahead, with 2 months history of load profile. Bagged very accurate and ANN not too bad, looks like an automatic operation. One a-periodicity is unpredictable. Consumer type:

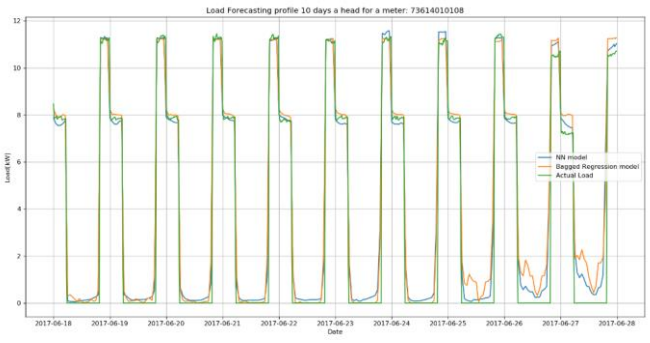

Fig. 17.2: 10 days look-ahead, with 1 year history of load forecast. Excellent forecast. Consumer type: