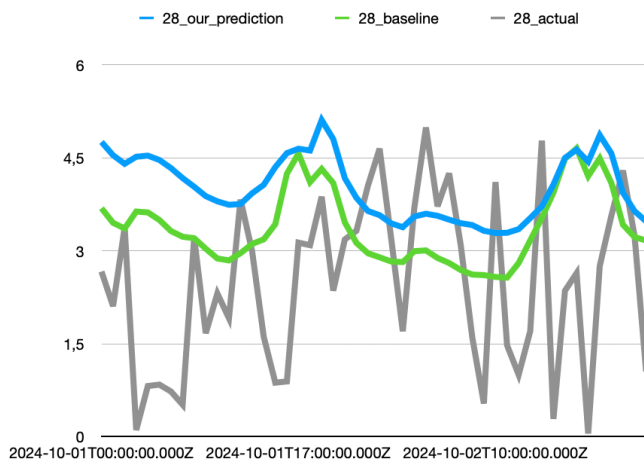Predicting Electricity Consumption with Power Line Prophet

The knowledge of future electricity consumption is critical for the stability of the electrical grid. That is why our solution helps to estimate and predict the power usage both on the short-term and long-term. These forecasts help to optimize energy production and grid management while avoiding imbalances and managing price risks.

The short-term forecast predicts the next two days of demand so Fortum can buy the right amount of energy in the day-ahead market. The long-term forecasts helps Fortum to decide how much energy to contract or hedge for the upcoming year.

Our solution is based on a Sarimax machine learning model which is designed to make predictions while accounting for seasonality and external factors. We leverage data concerning historical consumption patterns, corresponding day-ahead electricity prices and open datasets like the weather forecasts. More precisely, we used data about the electricity prices only on our short-term model. Using weather data boosts both of the models' performances.
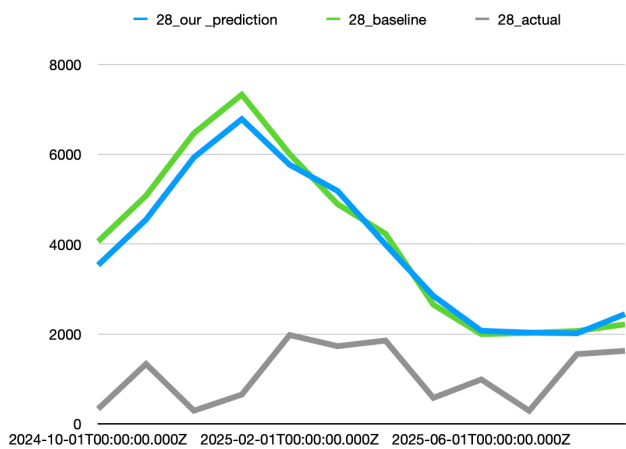
Let's take a look at our models results for customer group 28. Here is a diagram showing our short-term prediction, the given baseline and the actual data. The table below shows the data and calculations that the diagram is based on. According to the calculations, our model is almost 500% better at predicting the electricity consumption compared to the baseline.

measured_at	28_our_prediction	28_baseline	28_actual	error_our_prediction	error_baseline	FVA	FVA average
2024-10-01T00:00:00.000Z	4,755362057448880	3,686500253	2,664540354	2,09082170344888	1,021959899	-104,589407617146	483,534948192779
2024-10-01T01:00:00.000Z	4,541105779940120	3,450650715	2,106751482	2,43435429794012	1,343899233	-81,1411330673868	
2024-10-01T02:00:00.000Z	4,402833940505260	3,359934633	3,376114133	1,02671980750526	-0,016179500	6445,80677712698	
2024-10-01T03:00:00.000Z	4,517213665817840	3,632633371	0,107872862	4,40934080381784	3,524760509	-25,0961815011029	
2024-10-01T04:00:00.000Z	4,534940883184100	3,618576061	0,817609087	3,7173317961841	2,800966974	-32,7160166717517	
2024-10-01T05:00:00.000Z	4,464492468185290	3,496537465	0,839918297	3,62457417118529	2,656619168	-36,4355950918626	
2024-10-01T06:00:00.000Z	4,333129958623480	3,317606269	0,728677603	3,60445235562348	2,588928666	-39,2256342540525	
2024-10-01T07:00:00.000Z	4,172871464154690	3,226399102	0,516659681	3,65621178315469	2,709739421	-34,9285379553361	
2024-10-01T08:00:00.000Z	4,032014616112630	3,202809197	3,208138453	0,82387616311263	-0,005329256	15559,4968436988	
2024-10-01T09:00:00.000Z	3,880997610611440	3,032877927	1,670121041	2,21087656961144	1,362756886	-62,2355823202525	
2024-10-01T10:00:00.000Z	3,7973676126033500	2,875415861	2,310712539	1,48665507360335	0,564703322	-163,2630295742	
2024-10-01T11:00:00.000Z	3,741704770321450	2,844020081	1,911836511	1,82986825932145	0,932183570	-96,299132296598	
2024-10-01T12:00:00.000Z	3,754262141730980	2,961638912	3,824531945	-0,07026980326902	-0,862893033	91,856487353396	
2024-10-01T13:00:00.000Z	3,927988757099830	3,110249566	2,990535446	0,93745331109983	0,119714120	-683,076642170389	
2024-10-01T14:00:00.000Z	4,063639582929000	3,184151926	1,612517386	2,451122196929	1,571634540	-55,9600616138788	
2024-10-01T15:00:00.000Z	4,3499646655759700	3,428411295	0,872246462	3,47771820357597	2,556164833	-36,0521887586727	
2024-10-01T16:00:00.000Z	4,575376498982850	4,24312932	0,891193911	3,68418258798285	3,351935409	-9,91209968100104	
2024-10-01T17:00:00.000Z	4,646490759636050	4,569053362	3,130800506	1,51569025363605	1,438252856	-5,38412959258188	
2024-10-01T18:00:00.000Z	4,617342041762800	4,107471034	3,090283491	1,5270585507628	1,017187543	-50,1255654644603	
2024-10-01T19:00:00.000Z	5,110014078985550	4,319760371	3,872308651	1,23770542798555	0,447451720	-176,612061740549	
2024-10-01T20:00:00.000Z	4,8021885171456600	4,092249378	2,35678141	2,44540710714566	1,735467968	-40,9076486709123	
2024-10-01T21:00:00.000Z	4,170383327113660	3,458236791	3,182524621	0,98785870611366	0,275712170	-258,293471816518	
2024-10-01T22:00:00.000Z	3,8535288980943200	3,127764273	3,32170553	0,53182336809432	-0,193941257	374,218789916536	
2024-10-01T23:00:00.000Z	3,6409998162467000	2,95911814	4,053765007	-0,4127651907533	-1,094646867	62,2923882398231	
2024-10-02T00:00:00.000Z	3,574495821970400	2,894157125	4,647387891	-1,0728920690296	-1,753230766	38,8048573048141	
2024-10-02T01:00:00.000Z	3,4419512024517100	2,826815342	3,19829932	0,24365188245171	-0,371483978	165,588799754834	
2024-10-02T02:00:00.000Z	3,380096299131250	2,817853192	1,70069929	1,67939700913125	1,117153902	-50,3281692992064	
2024-10-02T03:00:00.000Z	3,553171423477840	2,993298809	3,697891034	-0,14471961052216	-0,704592225	79,460515545405	
2024-10-02T04:00:00.000Z	3,5975074970871200	3,005719966	4,989600114	-1,39209261691288	-1,983880148	29,8298025555483	
2024-10-02T05:00:00.000Z	3,56429185281029	2,8839958	3,717519702	-0,15322784918971	-0,833523902	81,6168619973528	
2024-10-02T06:00:00.000Z	3,5020757450399300	2,80214321	4,249010874	-0,74693512896007	-1,446867664	48,3757120609705	
2024-10-02T07:00:00.000Z	3,4457072556692800	2,689484094	3,092368082	0,35333917366928	-0,402883988	187,702461302404	
2024-10-02T08:00:00.000Z	3,414182140204500	2,616193928	1,599522144	1,8146599962045	1,016671784	-78,4902487472299	
2024-10-02T09:00:00.000Z	3,3223158336189700	2,606776646	0,535800978	2,78651485561897	2,070975668	-34,5508254237476	
2024-10-02T10:00:00.000Z	3,2865121587349200	2,577974682	4,108768127	-0,82225596826508	-1,530793445	46,2856356649032	
2024-10-02T11:00:00.000Z	3,2900976649427600	2,566620118	1,475937686	1,81415997894276	1,090682432	-66,3325570960292	
2024-10-02T12:00:00.000Z	3,34844516909548	2,802184765	0,999248053	2,34919711609548	1,802936712	-30,2983682377576	
2024-10-02T13:00:00.000Z	3,5271616737845200	3,167568998	1,704499794	1,82266187978452	1,463069204	-24,5779676587684	
2024-10-02T14:00:00.000Z	3,7153693226274600	3,530329294	4,777313962	-1,06194463937254	-1,246984668	14,8389978943558	
2024-10-02T15:00:00.000Z	4,069405868307050	3,938652298	0,286923918	3,78248195030705	3,651728380	-3,58059408315166	
2024-10-02T16:00:00.000Z	4,498826362118760	4,483691133	2,356253721	2,14257264111876	2,127437412	-0,711430053518303	
2024-10-02T17:00:00.000Z	4,6306901699334900	4,652327575	2,63829971	1,99239045993349	2,014027865	1,07433494056995	
2024-10-02T18:00:00.000Z	4,438007031945850	4,203709524	0,051056715	4,38695031694585	4,152652809	-5,6421164668055	
2024-10-02T19:00:00.000Z	4,865777587436960	4,490852542	2,75534334	2,11043424743696	1,735509202	-21,6031724294459	
2024-10-02T20:00:00.000Z	4,571777405203040	4,093488334	3,565325556	1,00645184920304	0,528162778	-90,5571333546417	
2024-10-02T21:00:00.000Z	3,9371478619435700	3,420275131	4,294671372	-0,35752351005643	-0,874396241	59,1119571091077	
2024-10-02T22:00:00.000Z	3,640288384392620	3,221484206	3,239405724	0,40088266039262	-0,017921518	2336,87893175466	
2024-10-02T23:00:00.000Z	3,474659053805250	3,165492149	1,053110289	2,42154876480525	2,112381860	-14,6359382581164	

Here is a diagram showing our long-term predictions, also with the baseline and actual data. Again, the data is shown in the table below. Our estimation significantly improved the forecast.

forecast_12m

measured_at	28_our _prediction	28_baseline	28_actual	error_our_prediction	error_baseline	FVA
2024-10-01T00:00:00.000Z	3533,11246460561	4059,004303078	329,8054105	3203,30705410561	3729,198892578	14,102005648426
2024-11-01T00:00:00.000Z	4544,578879079000	5077,161679219	1330,596433	3213,982446079	3746,565246219	14,2152282194332
2024-12-01T00:00:00.000Z	5929,135282796840	6468,410224101	290,989144	5638,14613879684	6177,421080101	8,72977467961991
2025-01-01T00:00:00.000Z	6782,180371480110	7327,93823286	650,1687932	6132,01157828011	6677,769439663	8,17275688108262
2025-02-01T00:00:00.000Z	5765,125912464860	6004,471396519	1974,793094	3790,33281846486	4029,678302519	5,93956802716788
2025-03-01T00:00:00.000Z	5183,117635852260	4889,955089141	1727,660404	3455,45723185226	3162,294685141	-9,27056381205626
2025-04-01T00:00:00.000Z	3989,444747910400	4231,259828379	1851,964007	2137,4807409104	2379,295821379	10,1633045498499
2025-05-01T00:00:00.000Z	2846,2336557858800	2651,608845064	576,9474222	2269,28623358588	2074,661422864	-9,38103965191617
2025-06-01T00:00:00.000Z	2068,8893145307900	1995,219505137	986,1302177	1082,75909683079	1009,089287437	-7,30062347415311
2025-07-01T00:00:00.000Z	2029,6000266328800	2021,441607901	289,3898588	1740,21016783288	1732,051749101	-0,471026269054289
2025-08-01T00:00:00.000Z	2013,3783924355400	2064,546836514	1550,689762	462,68863043554	513,857074514	9,95771910445225
2025-09-01T00:00:00.000Z	2441,2097732503400	2213,186940167	1622,347415	818,86235825034	590,839525167	-38,5930228718009

With our models Fortum can predict the electricity consumption more precisely thus making it easier to buy the right amount of power.

Power Line Prophet. Making electricity more predictable.