E-LAND

MULTI VECTOR SIMULATION - REPORT SHEET

Information

MVS Release: 0.5.5dev (2020-12-18)

Simulation date: 2021-02-23

Project name : Borg Havn (ID: 1)

Scenario name : Warehouse 14 (ID: 1)

Scenario description : "Scenario 1, Main features, "Demand of habour and shore power. Connection to National grid (0.54 NOK/kWh electricity price, 60 NOK/kW monthly peak demand pricing, 0.54 NOK/kWh*0.8 feedin tariff. PV system of 300 kWp" Objective, Optimize battery capacity Outcomes, "Capacity battery and utilization profile. Consumption from national grid. Feed-in into national grid" Outlook, "With this, it can be compared whether or not the battery reduced the peak demand expenditures. Later, the simulation results should be compared to the consumption from national grid without batteries.""

The energy system with the *Borg Havn (ID: 1)* for the scenario *Warehouse 14 (ID: 1)* was simulated with the Multi-Vector simulation tool MVS 0.0x developed from the E-LAND toolbox developed in the scope of the Horizon 2020 European research project. The tool was developed by Reiner Lemoine Institute and utilizes the OEMOF framework.

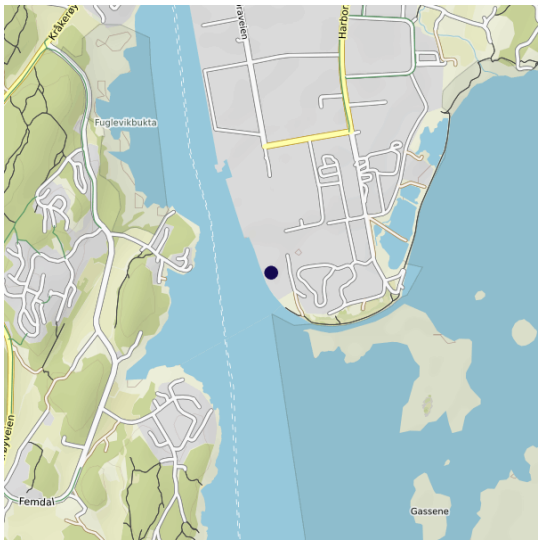
Input Data

Project Data

The most important simulation data will be presented below. Detailed settings, costs, and technological parameters can be found in the appendix.

Project Location

The blue dot in the below map indicates the location of the project.



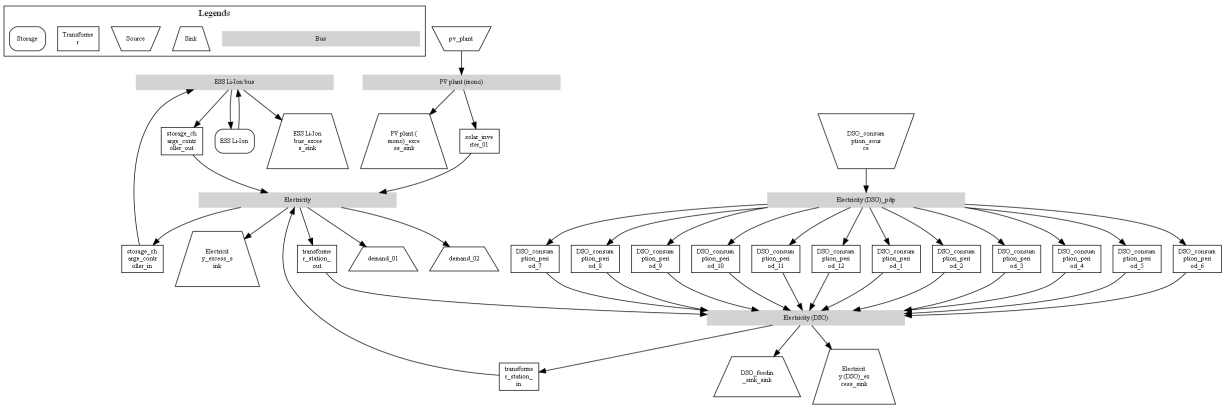
Project at a Glance

Label	Value
Country	Norway
Project ID	1
Scenario ID	1
Currency	NOK
Project Location	Fredrikstad
Discount Factor	0.06
Tax	0

Simulation Settings

Setting	Value
Evaluated period	365
Start date	2018-01-01T00:00:00
Timestep length	60

Energy system



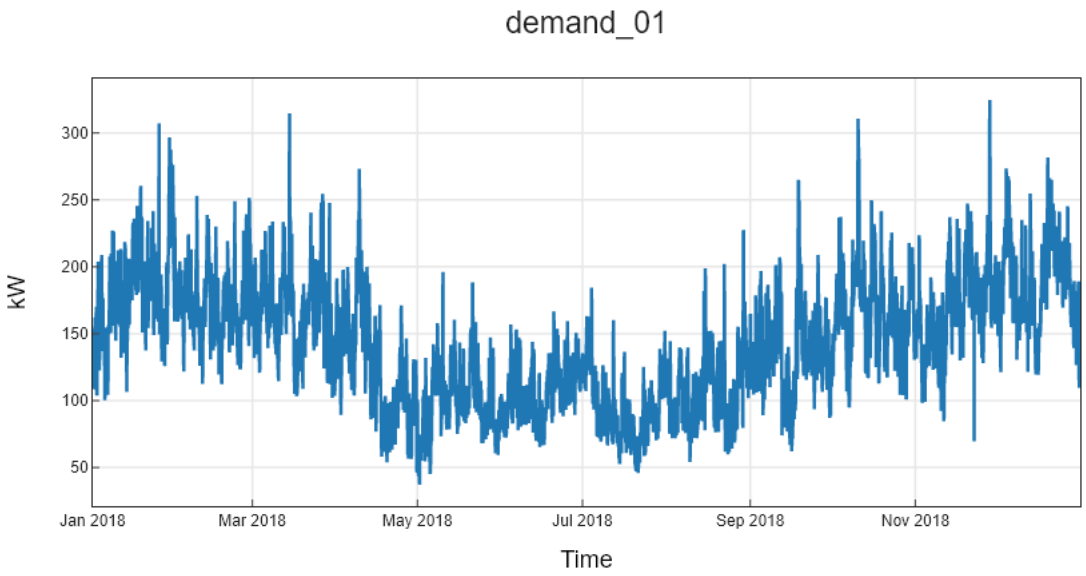
Energy Demands

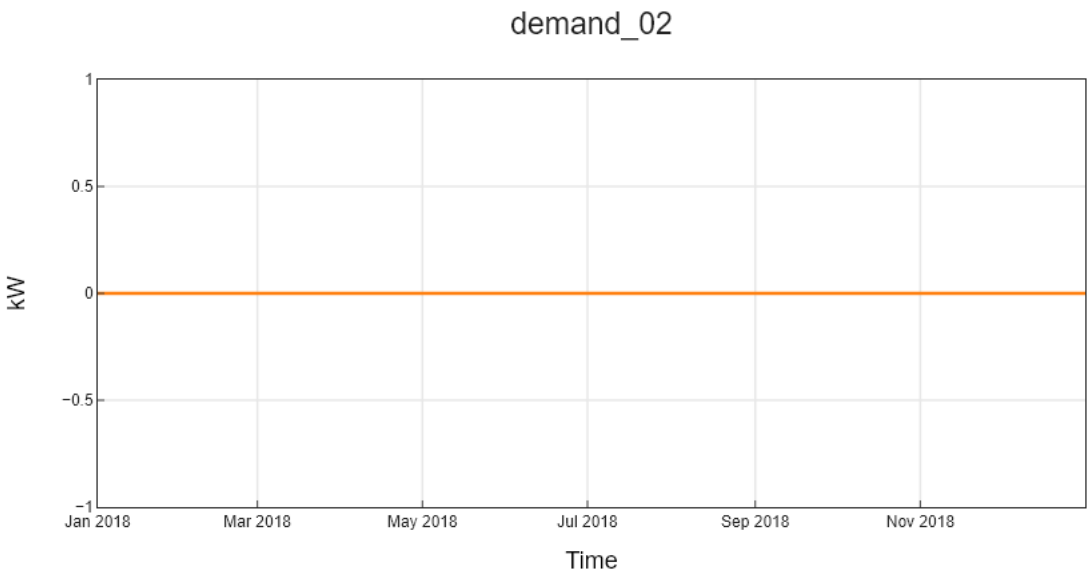
The simulation was performed for the energy system covering the following sectors:

• ELECTRICITY

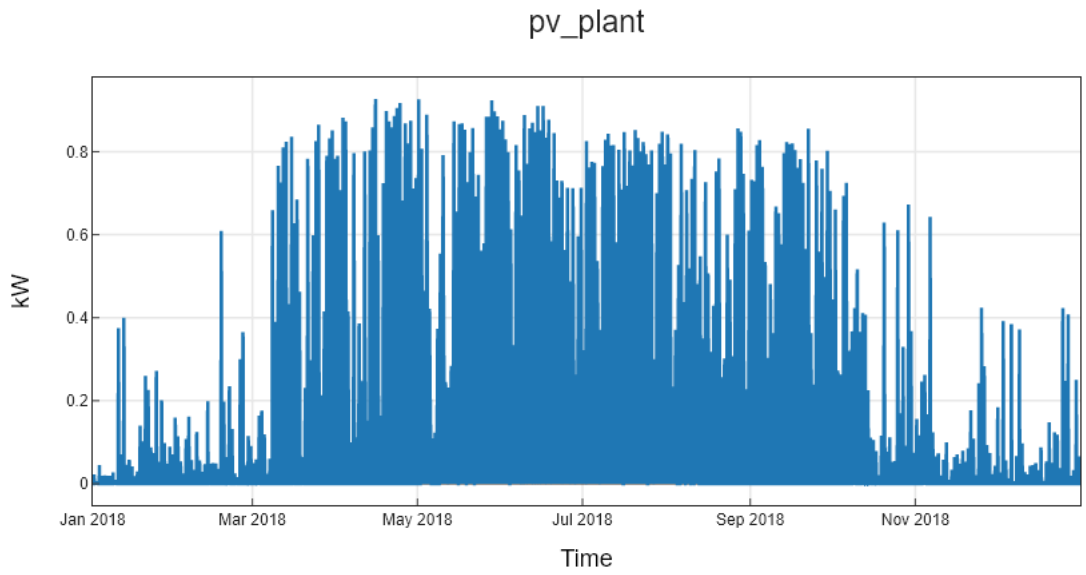
Electricity Demands

Demands	unit	Type of Demand	Peak Demand	Mean Demand	Total Annual Demand
demand_01	kW	Electricity	324.65	142.39	1247298.48
demand_02	kW	Electricity	0	0	0





Resources



Energy System Components

The energy system is comprised of the following components:

Component	Type of Component	Energy Vector	unit	Installed Capacity	Capacity optimization
pv_plant	source	Electricity	kWp	0	No
DSO_consumption	source	Electricity	?	0	Yes
solar_inverter_01	transformer	Electricity	kW	0	Yes
storage_charge_controller_in	transformer	Electricity	kW	0	Yes
storage_charge_controller_out	transformer	Electricity	kW	0	Yes
transformer_station_in	transformer	Electricity	kVA	1250	No
transformer_station_out	transformer	Electricity	kVA	1250	No
DSO_consumption_period_1	transformer	Electricity	?	0	Yes
DSO_consumption_period_2	transformer	Electricity	?	0	Yes
DSO_consumption_period_3	transformer	Electricity	?	0	Yes
DSO_consumption_period_4	transformer	Electricity	?	0	Yes
DSO_consumption_period_5	transformer	Electricity	?	0	Yes
DSO_consumption_period_6	transformer	Electricity	?	0	Yes
DSO_consumption_period_7	transformer	Electricity	?	0	Yes
DSO_consumption_period_8	transformer	Electricity	?	0	Yes
DSO_consumption_period_9	transformer	Electricity	?	0	Yes
DSO_consumption_period_10	transformer	Electricity	?	0	Yes
DSO_consumption_period_11	transformer	Electricity	?	0	Yes
DSO_consumption_period_12	transformer	Electricity	?	0	Yes
ESS Li-Ion input power	storage	Electricity	kWh	0	No
ESS Li-Ion storage capacity	storage	Electricity	kWh	0	No
ESS Li-Ion output power	storage	Electricity	kWh	0	No

Simulation Results

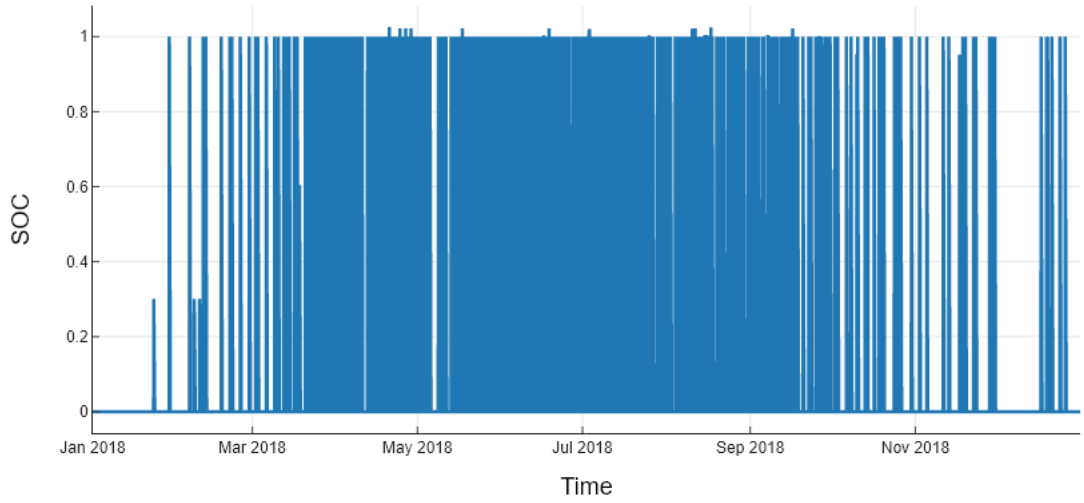
Dispatch & Energy Flows

The capacity optimization of components that were to be used resulted in:

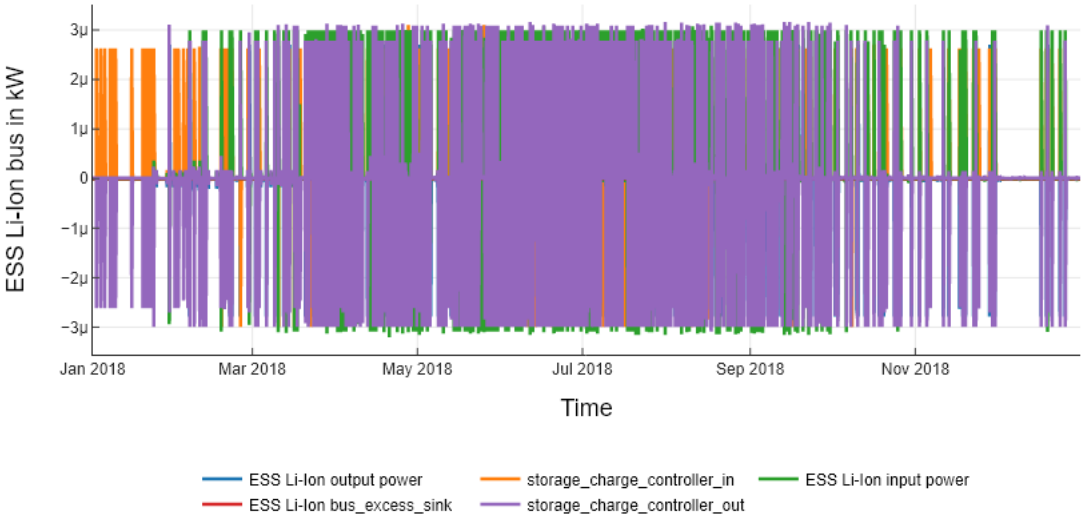
Component/Parameter	unit	installedCap	CAP	Aggregated Flow	Total emissions
ESS Li-Ion storage capacity	kWh	0	0	0	
ESS Li-Ion input power	kW	0	0	0	
ESS Li-Ion output power	kW	0	0	0	
solar_inverter_01	kW	0	193.21	245202.08	
storage_charge_controller_in	kW	0	0	0	
storage_charge_controller_out	kW	0	0	0	
transformer_station_in	kVA	1250	0	1040036.26	
transformer_station_out	kVA	1250	0	36422.27	
DSO_consumption_period_1	?	0	309.04	136573.57	
DSO_consumption_period_2	?	0	262.06	116499.08	
DSO_consumption_period_3	?	0	327.68	109622.57	
DSO_consumption_period_4	?	0	244.95	67266.92	
DSO_consumption_period_5	?	0	161.19	49233.21	
DSO_consumption_period_6	?	0	155.08	45801.57	
DSO_consumption_period_7	?	0	149.24	40602.4	
DSO_consumption_period_8	?	0	189.51	59112.5	
DSO_consumption_period_9	?	0	275.98	75401.88	
DSO_consumption_period_10	?	0	323.7	118479.5	
DSO_consumption_period_11	?	0	321.94	121965.57	
DSO_consumption_period_12	?	0	293.34	142812.36	
pv_plant	kWp	0	210.7	245207.56	0
DSO_consumption_source	?	0	327.68	1083371.11	20584.05106
demand_01	kW	0	0	1247298.48	
demand_02	kW	0	0	0	
ESS Li-Ion bus_excess_sink	?	0	0	0	
Electricity_excess_sink	?	0	0	0	
Electricity (DSO)_excess_sink	?	0	0	0	
PV plant (mono)_excess_sink	?	0	2.11	5.48	
DSO_feedin_sink_sink	?	0	142.68	36422.27	

With this, the demands are met with the following dispatch schedules:

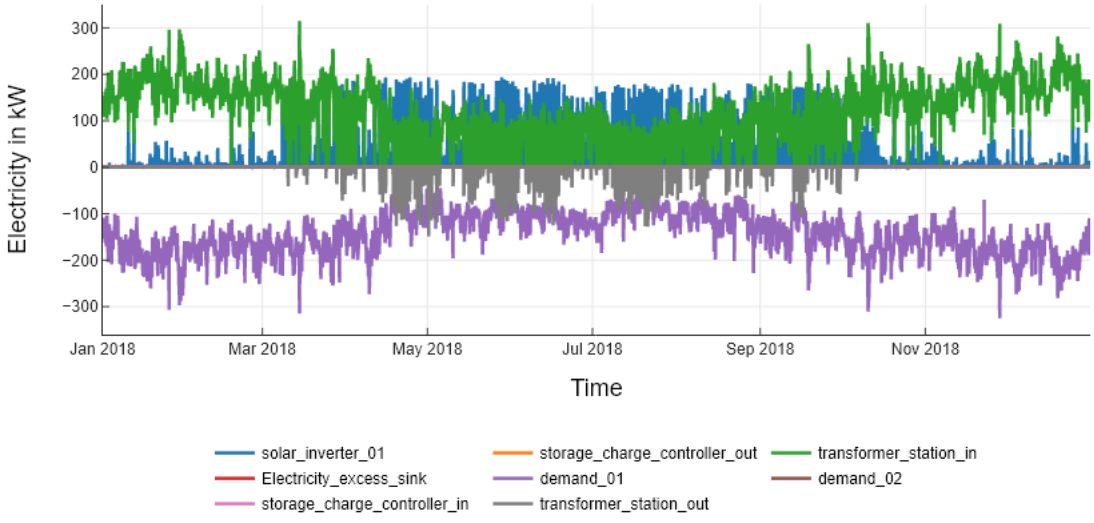
ESS Li-Ion bus storage SOC in LES: Borg Havn, Warehouse 14



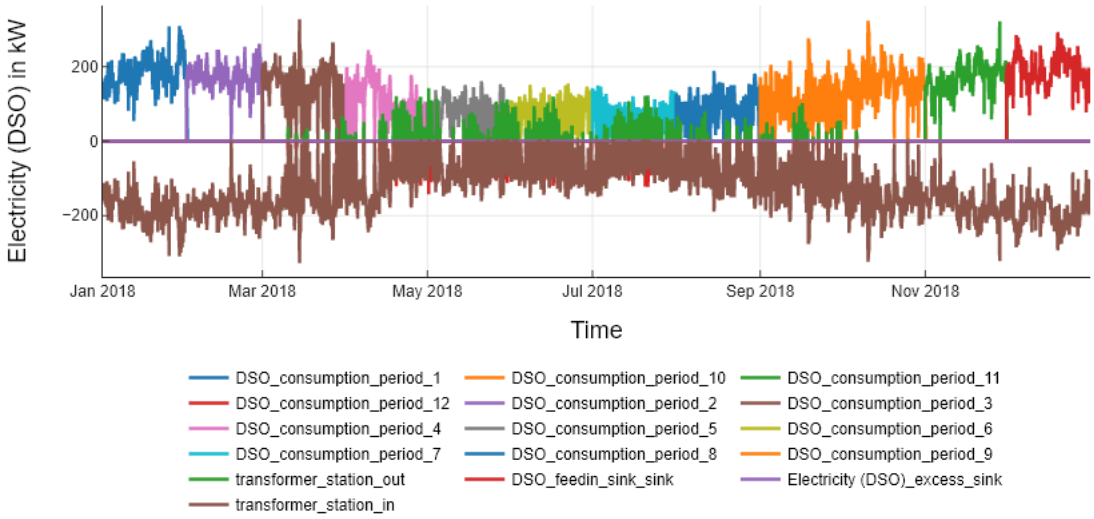
ESS Li-Ion bus power in LES: Borg Havn, Warehouse 14



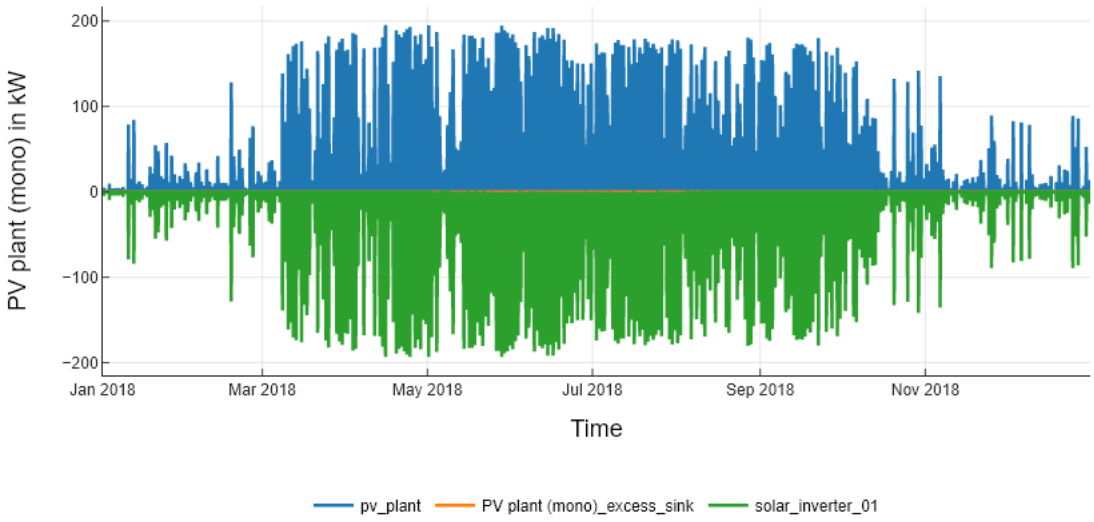
Electricity power in LES: Borg Havn, Warehouse 14



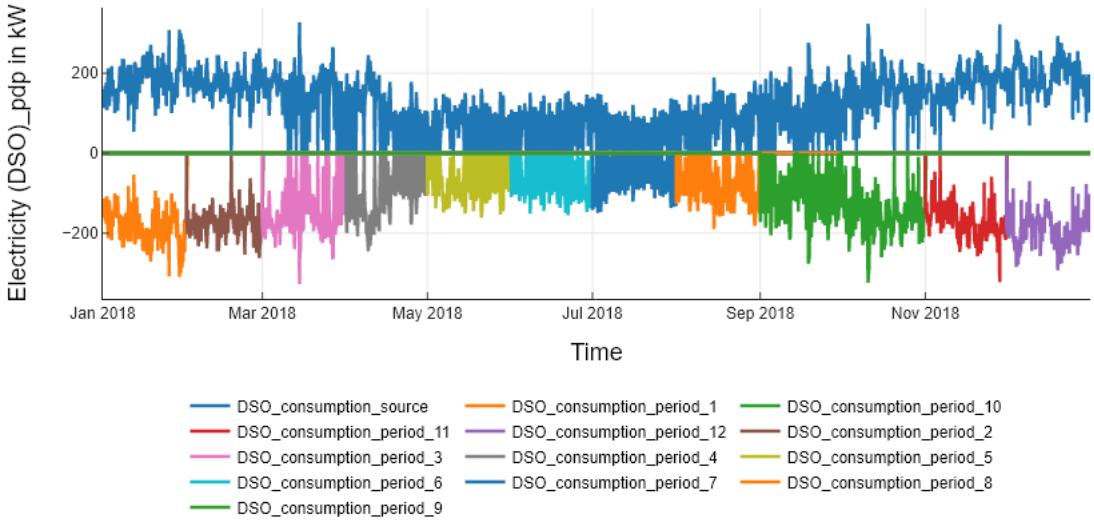
Electricity (DSO) power in LES: Borg Havn, Warehouse 14

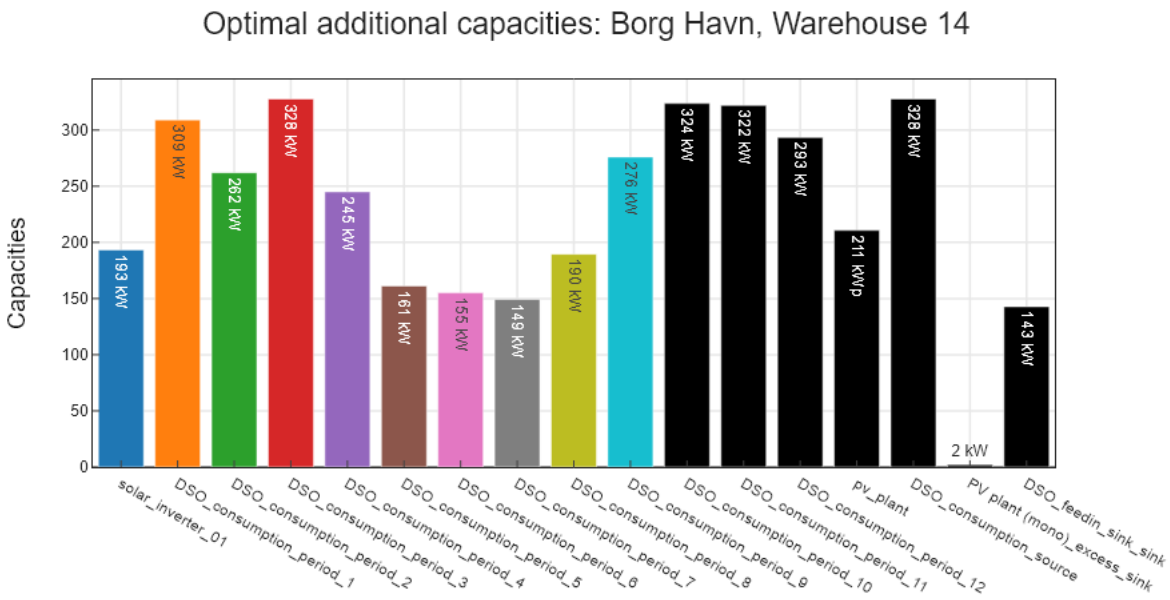


PV plant (mono) power in LES: Borg Havn, Warehouse 14



Electricity (DSO)_pdp power in LES: Borg Havn, Warehouse 14





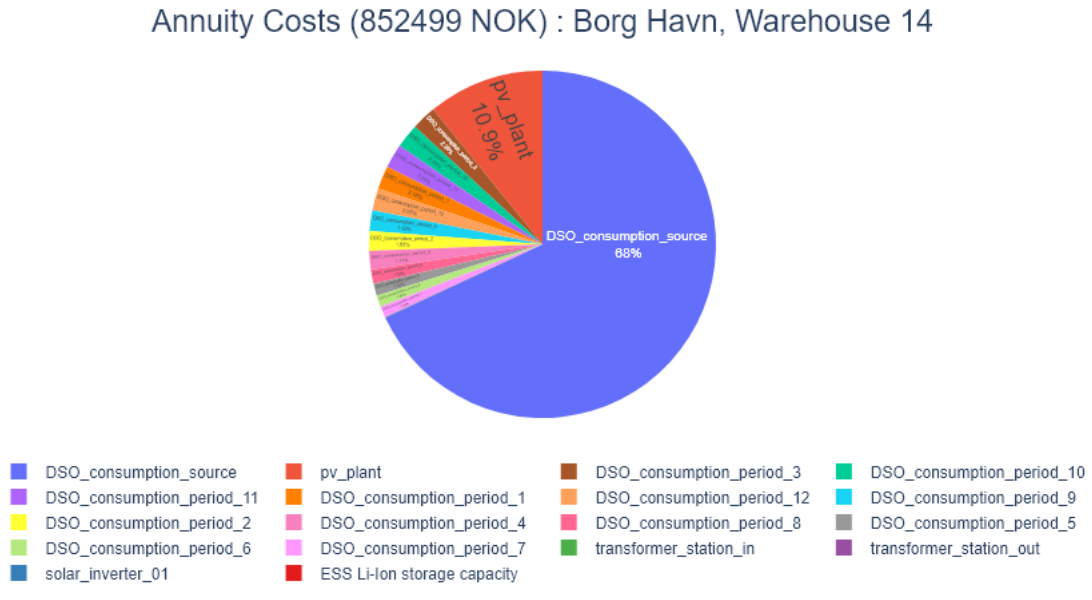
This results in the following KPI of the dispatch per energy sector:

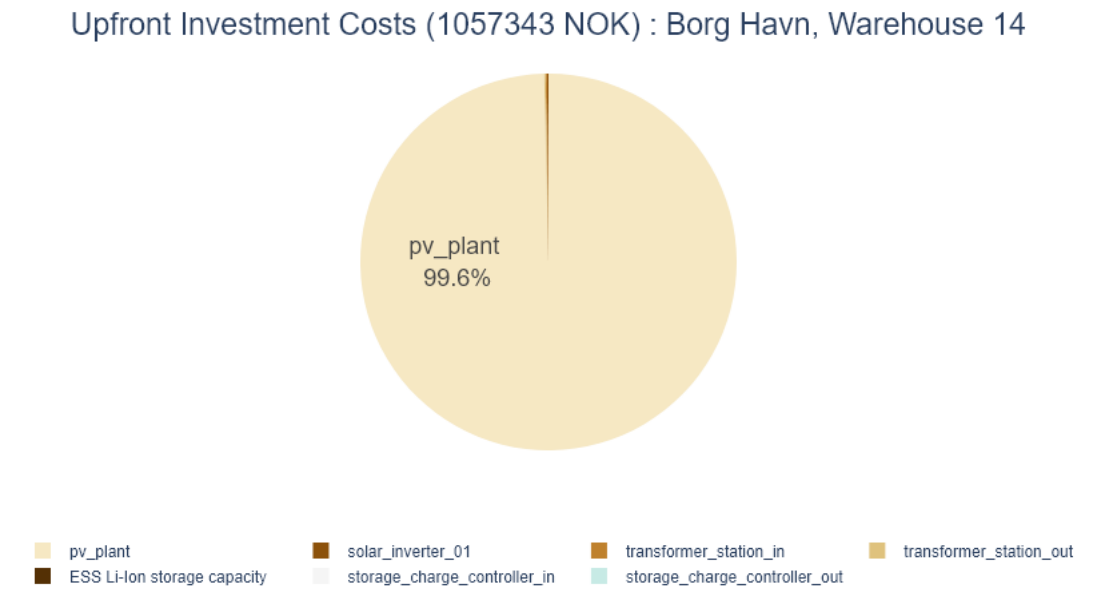
KPI	Electricity
Renewable factor	0.9836912765097602
Renewable share of local generation	1
Total internal non-renewable generation	0
Total internal non-renewable generation_electricity_equivalent	0
Total internal renewable generation	245207.56178967535
Total internal renewable generation_electricity_equivalent	245207.56178967535
Total non-renewable energy use	21667.422163415435
Total non-renewable energy use_electricity_equivalent	21667.422163415435
Total renewable energy use	1306911.2477970307
Total renewable energy use_electricity_equivalent	1306911.2477970307

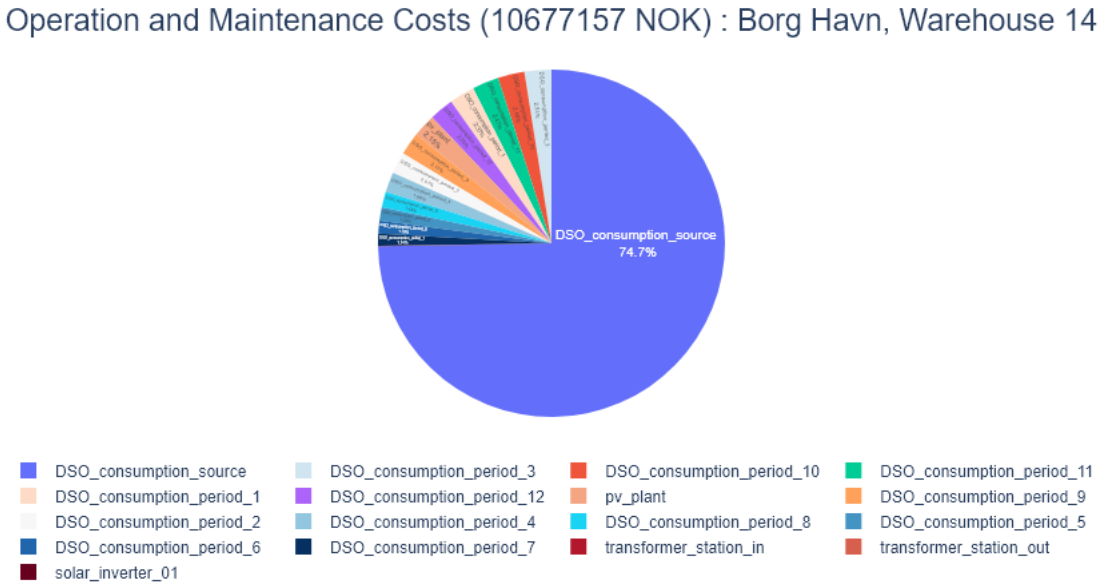
Economic Evaluation

The following installation and operation costs result from capacity and dispatch optimization:

Component	Total costs	Upfront Investment Costs	Replacement_costs_during_project_lifetime	annuity_total	annuity
ESS Li-Ion storage capacity	0.03	0.01	0.01	0	0
ESS Li-Ion input power	0	0	0	0	0
ESS Li-Ion output power	0	0	0	0	0
solar_inverter_01	1635.09	966.04	403.1	118.79	19.32
storage_charge_controller_in	0	0	0	0	0
storage_charge_controller_out	0	0	0	0	0
transformer_station_in	2965.56	0	1244.95	215.44	125
transformer_station_out	2965.56	0	1244.95	215.44	125
DSO_consumption_period_1	255234.38	0	0	18542.5	18542.
DSO_consumption_period_2	216436.48	0	0	15723.87	15723.
DSO_consumption_period_3	270630.34	0	0	19661	19661
DSO_consumption_period_4	202298.28	0	0	14696.75	14696.
DSO_consumption_period_5	133125.7	0	0	9671.44	9671.4
DSO_consumption_period_6	128080.89	0	0	9304.94	9304.9
DSO_consumption_period_7	123253.74	0	0	8954.25	8954.2
DSO_consumption_period_8	156514.73	0	0	11370.62	11370.
DSO_consumption_period_9	227928.39	0	0	16558.75	16558.
DSO_consumption_period_10	267338.82	0	0	19421.87	19421.
DSO_consumption_period_11	265884.44	0	0	19316.22	19316.
DSO_consumption_period_12	242269.63	0	0	17600.62	17600.
pv_plant	1285499.92	1053483.55	0	93390.17	16855.
DSO_consumption_source	8052707	0	0	585020.4	585020
demand_01	0	0	0	0	0
demand_02	0	0	0	0	0
ESS Li-Ion bus_excess_sink	0	0	0	0	0
Electricity_excess_sink	0	0	0	0	0
Electricity (DSO)_excess_sink	0	0	0	0	0
PV plant (mono)_excess_sink	0	0	0	0	0
DSO_feedin_sink_sink	-100269.28	0	0	-7284.45	-7284.







Energy System: Key Performance Indicators (KPIs)

In the following the key performance indicators of the of Borg Havn (ID: 1), scenario Warehouse 14 (ID: 1) are displayed. For more information on their definition, please reference `mvs-eland.readthedocs.io`.

kpi	unit	value
costs_total	NOK	11734499.70907
costs_om_total	NOK	10677157.08398
costs_investment_over_lifetime	NOK	1057342.6250600002
costs_upfront_in_year_zero	NOK	1054449.6080900002
Replacement_costs_during_project_lifetime	NA	2893.0169600000004
costs_dispatch	NOK	7952437.72876
costs_cost_om	NOK	2724719.3552200003
annuity_total	NOK/year	852498.6307200002
annuity_om	NOK/year	775683.8399600001
Total_demandElectricity	NA	1247298.4840000041
Total_demandElectricity_electricity_equivalent	NA	1247298.4840000041
Total_demand_electricity_equivalent	NA	1247298.4840000041
Total_excessElectricity	NA	5.4781144
Total_excessElectricity_electricity_equivalent	NA	5.4781144
Total_excess_electricity_equivalent	NA	5.4781144
Total_feedinElectricity	NA	36422.26862630878
Total_feedinElectricity_electricity_equivalent	NA	36422.26862630878
Total_feedin_electricity_equivalent	NA	36422.26862630878
Total_consumption_from_energy_providerElectricity	NA	1083371.1081707708
Total_consumption_from_energy_providerElectricity_electricity_equivalent	NA	1083371.1081707708
Total_consumption_from_energy_provider_electricity_equivalent	NA	1083371.1081707708
Attributed costsElectricity	NA	11734499.70907
Levelized costs of electricity equivalentElectricity	NA	0.6834760417653232
Levelized costs of electricity equivalent	NA	0.6834760417653232
Total internal renewable generation	NA	245207.56178967535
Total internal non-renewable generation	NA	0
Total renewable energy use	NA	1306911.2477970307
Total non-renewable energy use	NA	21667.422163415435
Total internal generation	NA	245207.56178967535
Renewable share of local generation	NA	1
Renewable factor	NA	0.9836912765097602
Onsite energy fraction	NA	0.8514635178439167
Onsite energy matching	NA	0.1673856079576265
Degree of autonomy	NA	0.13142594008735506
Degree of NZE	NA	0.1965865322700693
Total emissions	NA	20584.05106
Specific emissions per electricity equivalent	NA	0.01650290714215278

Logging Messages

Warning Messages

- The value of ESS Li-Ion charge flow is below 0 in 444 instances. At least one value is exceeds the scale of -1e-06. The highest negative value is -3.087404e-06. This is so far below 0, that the value is not changed. All oemof decision variables should be positive so this needs to be investigated.
- The value of ESS Li-Ion discharge flow is below 0 in 6855 instances. At least one value is exceeds the scale of -1e-06. The highest negative value is -2.7884583e-06. This is so far below 0, that the value is not changed. All oemof decision variables should be positive so this needs to be investigated.
- The value of storage_charge_controller_in flow is below 0 in 55 instances. At least one value is exceeds the scale of -1e-06. The highest negative value is -2.9978007e-06. This is so far below 0, that the value is not

changed. All oemof decision variables should be positive so this needs to be investigated.
- The value of storage_charge_controller_out flow is below 0 in 7332 instances. At least one value is exceeds the scale of -1e-06. The highest negative value is -3.1591009e-06. This is so far below 0, that the value is not changed. All oemof decision variables should be positive so this needs to be investigated.
- Attention, on bus ESS Li-Ion bus there is excessive excess generation, totalling up to 100% of the inflows. The total inflows are 531 and outflows 0 It seems to be cheaper to have this excess generation than to install more capacities that forward the energy carrier to other busses (if those assets can be optimized).
- SoC of storage_01 has at least one time step where its value is greater than 1. This is a physically impossible value!

Error Messages

- Energy system bus Electricity (DSO)_pdp has too few assets connected to it. The minimal number of assets that need to be connected so that the bus is not a dead end should be two, excluding the excess sink. These are the connected assets: DSO_consumption