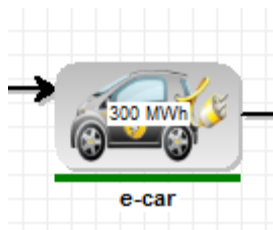




E-cars and Batteries in energyPRO



e-car

Name: e-car

Storage and charging **Charging Restrictions**

Battery and Demand Non availability periods

Capacity MWh

Driving demand as time series:

Charging / Discharging

	Capacity	Efficiency
Charging Power	<input type="text" value="30,0"/> MW	<input type="text" value="90,0"/> %
Discharging Power	<input type="text" value="30,0"/> MW	<input type="text" value="90,0"/> %

Battery

Name: Battery

Battery Non availability periods

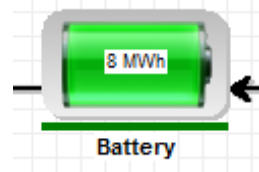
Max Capacity MWh

Utilization %

Capacity MWh

Charging / Discharging

	Capacity	Efficiency
Charging Power	<input type="text" value="3,0"/> MW	<input type="text" value="90,0"/> %
Discharging Power	<input type="text" value="3,0"/> MW	<input type="text" value="90,0"/> %



1. Introduction

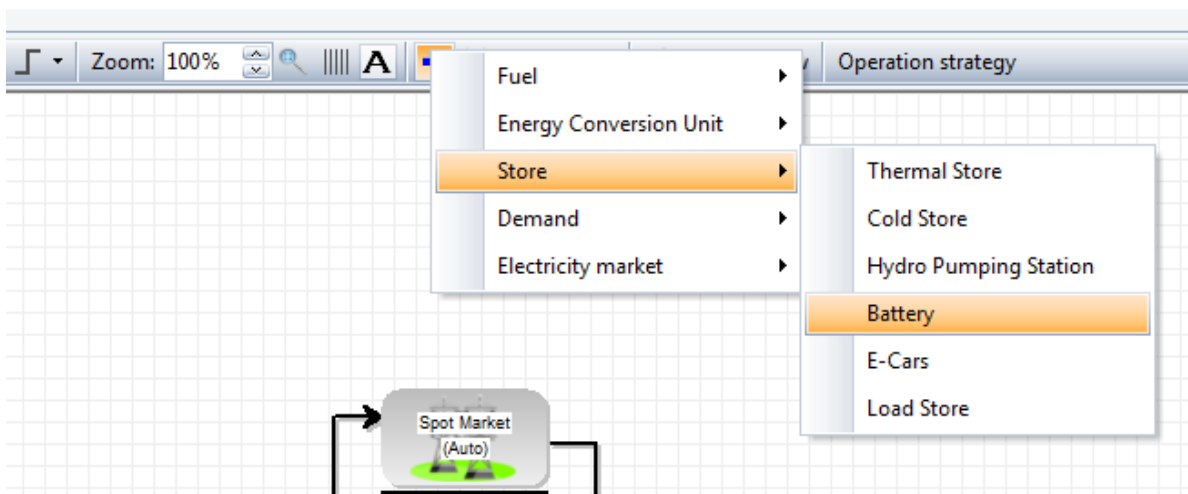
With energyPRO 4.1.2 we introduce two new components: E-cars and Batteries.

With E-cars you can state a driving demand and a battery capacity and let the e-cars participate on the electricity market.

Similar with Batteries, only batteries is a purely electricity storage.

2. Batteries

Battery is a electricity storage and in energyPRO you can find battery under Store:



The user interface consists of a few input fields:

A screenshot of the 'Battery' configuration window in energyPRO. The window title is 'Battery'. It contains several input fields and checkboxes:

- Name: Battery
- Battery section:
 - Max Capacity: 10,0 MWh
 - Utilization: 80,0 %
 - Capacity: 8,0 MWh
- Non availability periods:
- Charging / Discharging section:

	Capacity	Efficiency
Charging Power	3,0 MW	90,0 %
Discharging Power	3,0 MW	90,0 %

Max Capacity multiplied with the Utilization sets the usable capacity of the batteries.

Unlike thermal stores the charging and discharging capacity of Batteries is not unlimited. You have to set charging and discharging power together with an efficiency factor.

2.1 Operation strategy

Typically, batteries will be used in island systems, where there is no or limited connection with the surrounding grid, or it will be used in spot markets where it can charge when the price is low and discharge at high spot prices.

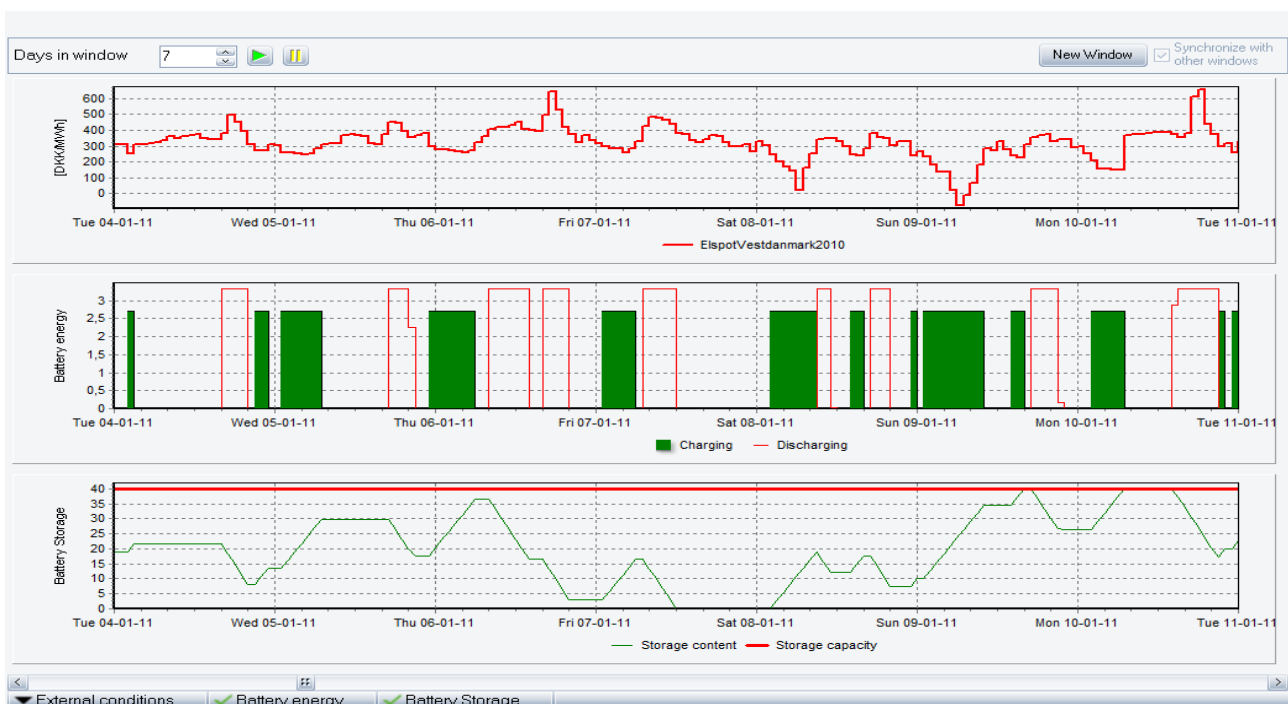
In Island operation the electricity producing units will start by covering the electricity demand. Then if they still have surplus capacity in a given period, they will charge the battery. The battery will be discharged in periods where the electricity demand exceeds the production.

In a spot market situation the battery will discharge and sell electricity when the spot price is high. It needs to charge the battery first by buying electricity when the spot price is low.

How low the price for buying has to be depends on the efficiency of the charging and any costs connected to buying and selling electricity.

2.2 Reports

Below is an example of the report Production, graphic, in a case where a battery operates on the spot market:



The battery appears as follows in Energy conversion, annual:

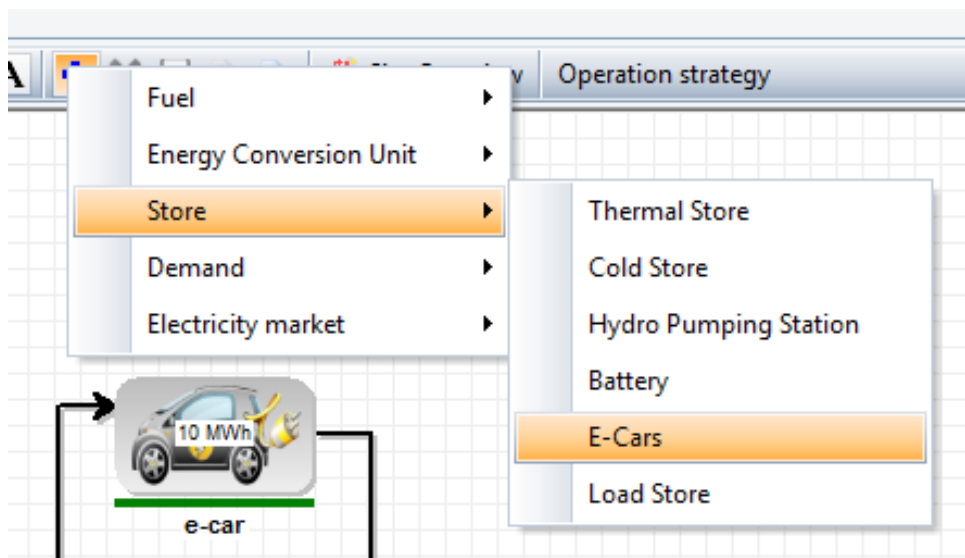
Electric storage:	
Battery	
Charging	6.554,1 MWh-elec.
Discharging	-5.308,8 MWh-elec.
Change in storage content	0,0 MWh (As potential elec. output)
Losses	-1.188,3 MWh-elec.

And in Operation Income:

(All amounts in)						
Revenues						
Sale on spot	:			=	2.298.944	
Total Revenues						2.298.944
Operating Expenditures						
Buy on spot	:			=	1.704.021	
trading cost, selling electricity	:	5.308,8 MWh	at	8,0	=	42.470
trading cost, buying electricity	:	6.554,1 MWh	at	8,0	=	52.433
O&M discharging	:	5.308,8 MWh	at	5,0	=	26.544
O&M charging	:	6.554,1 MWh	at	5,0	=	32.770
Total Operating Expenditures						1.858.239
Operation Income						
						440.706

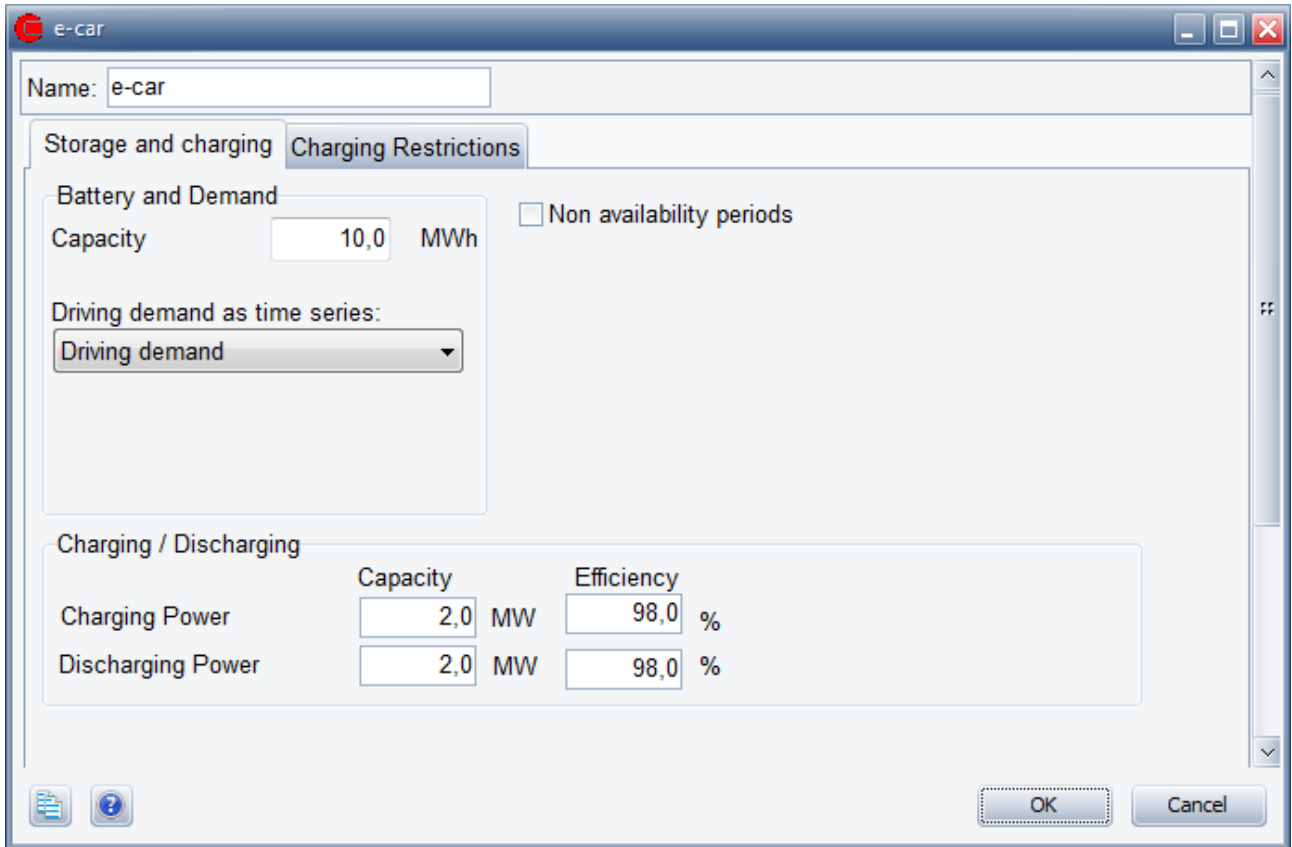
3. E-cars

Like batteries E-car is defined as a store in energyPRO:



The user interface consists of two tabs:

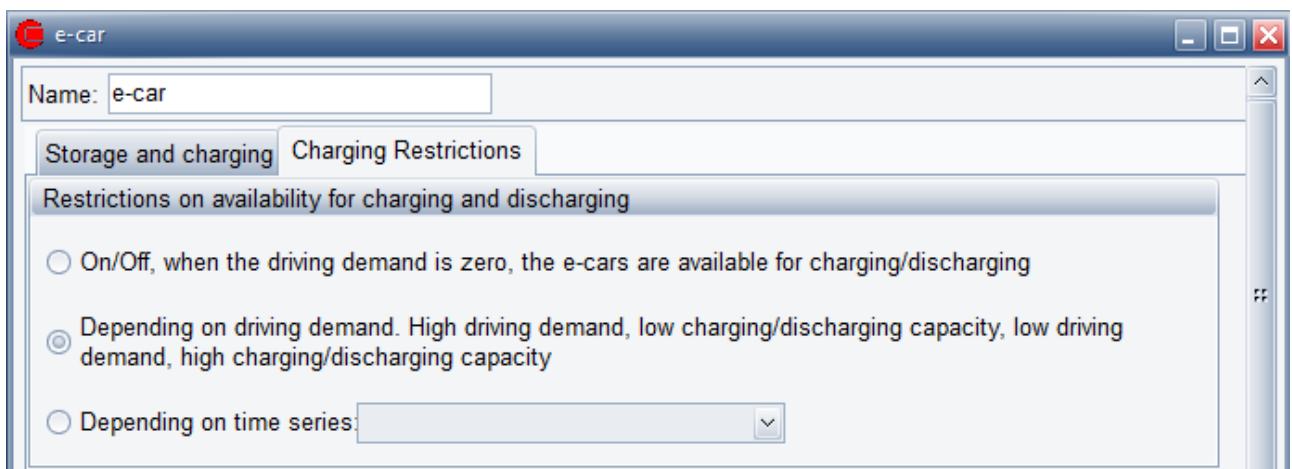
The first tab, Storage and charging is very similar to the battery interface:



You add the driving demand as a time series and select the time series in the e-car interface.

It is possible to define that the e-cars batteries are available for discharging. This means that if we have high spot prices and the batteries are charged you can sell on the electricity market. If you don't want that option, set the Discharging power to zero.

In the second tab, Charging Restrictions, you can select between three different restrictions on availability for charging and discharging.



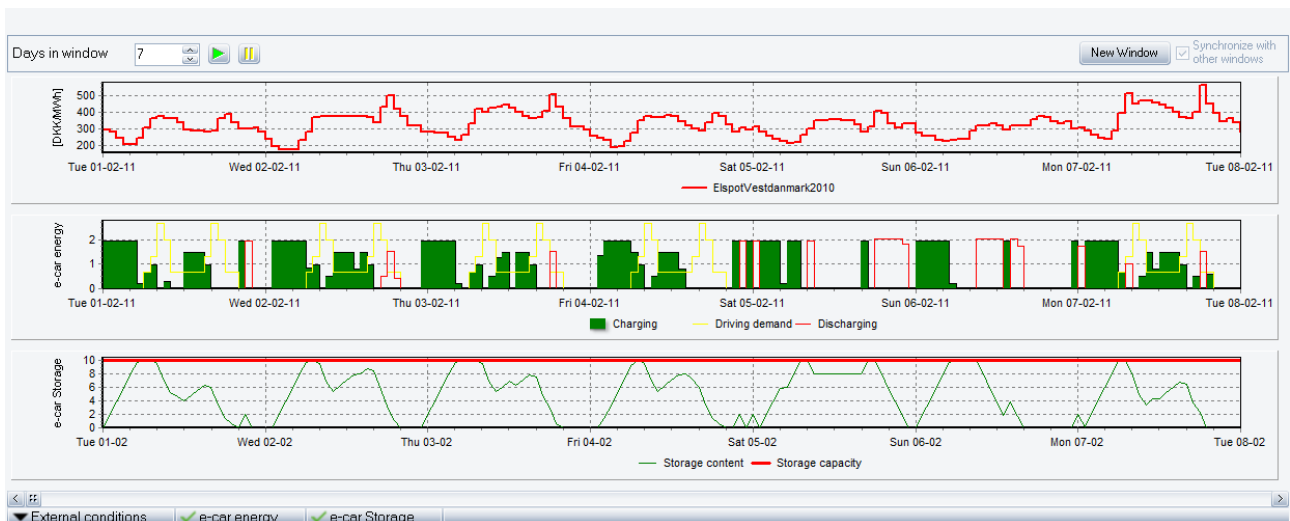
If your e-car unit represents a single car you select the On/Off option. Are you simulating a number of cars, the availability is not on/off but varies depending on driving demand.

3.1 Operation strategy

First of all, the operation strategy shall insure that the driving demand is covered. Next, if discharging is enabled the operation strategy for charging and discharging is similar to the operation strategy for batteries.

3.2 Reports

The Production, graphic shows how the e-car batteries are charged during the night and discharged by the driving demand during the day. In the weekend without driving demand the e-cars are used for buying and selling on the electricity marked.



The Energy conversion, annual report sums up the demand, charging, discharging and losses.

Electric storage:	
e-car	
Charging	127,3 MWh-elec.
Driving demand	-88,4 MWh (As needed elec. input)
Discharging	-37,3 MWh-elec.
Change in storage content	0,0 MWh (As needed elec. input)
Losses	-3,3 MWh-elec.