HOW TO GUIDE

The FINANCE module

energyPRO

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About energyPRO

energyPRO is a Windows-based modeling software package for combined techno-economic analysis and optimisation of complex energy projects with a combined supply of electricity and thermal energy from multiple different energy producing units.

The unique programming in energyPRO optimises the operations of the plant including energy storage (heat, fuel, cold and electrical storages) against technical and financial parameters to provide a detailed specification for the provision of the defined energy demands, including heating, cooling and electricity use.

energyPRO also provides the user with a detailed financial plan in a standard format approved by international banks and funding institutions. The software enables the user to calculate and produce a report of the emissions by the proposed project.

energyPRO is very user-friendly and is the most advanced and flexible software package for making a combined technical and economic analysis of multi-dimensional energy projects.

For further information concerning the applications of energyPRO please visit www.emd.dk.

Terms of application

EMD International A/S, January 2018

Contents

In this How-To-Guide, you will learn how to use the FINANCE module for making detailed economic analyses of a project for an unlimited number of years, which allows you to extend the calculations to cover the entire lifetime of a project.

With the FINANCE module, you can include your project's investments and financing and calculate detailed economic reports such as the monthly cash flows or internal rate of return and net present values. In this guide, you will also learn how to create indexes to describe the expected development of prices, demands, inflation etc. in order to analyze how future circumstances affect the investment or the daily operation.

How to enable the FINANCE module

To access the FINANCE module, you must first activate a valid license with access to the module. See the How To Guide "Installation and activation of energyPRO" on how to activate an energyPRO license. If you do not have a valid license or if you are having problems activating your license, please contact our support at energyPRO@emd.dk.

Once you have access to the Finance module, you enable the module by opening the Project identification window. Do this by selecting Project identification from the Project setup menu as shown in Figure 1 or by double-clicking on the project identification folder in the Input data window.

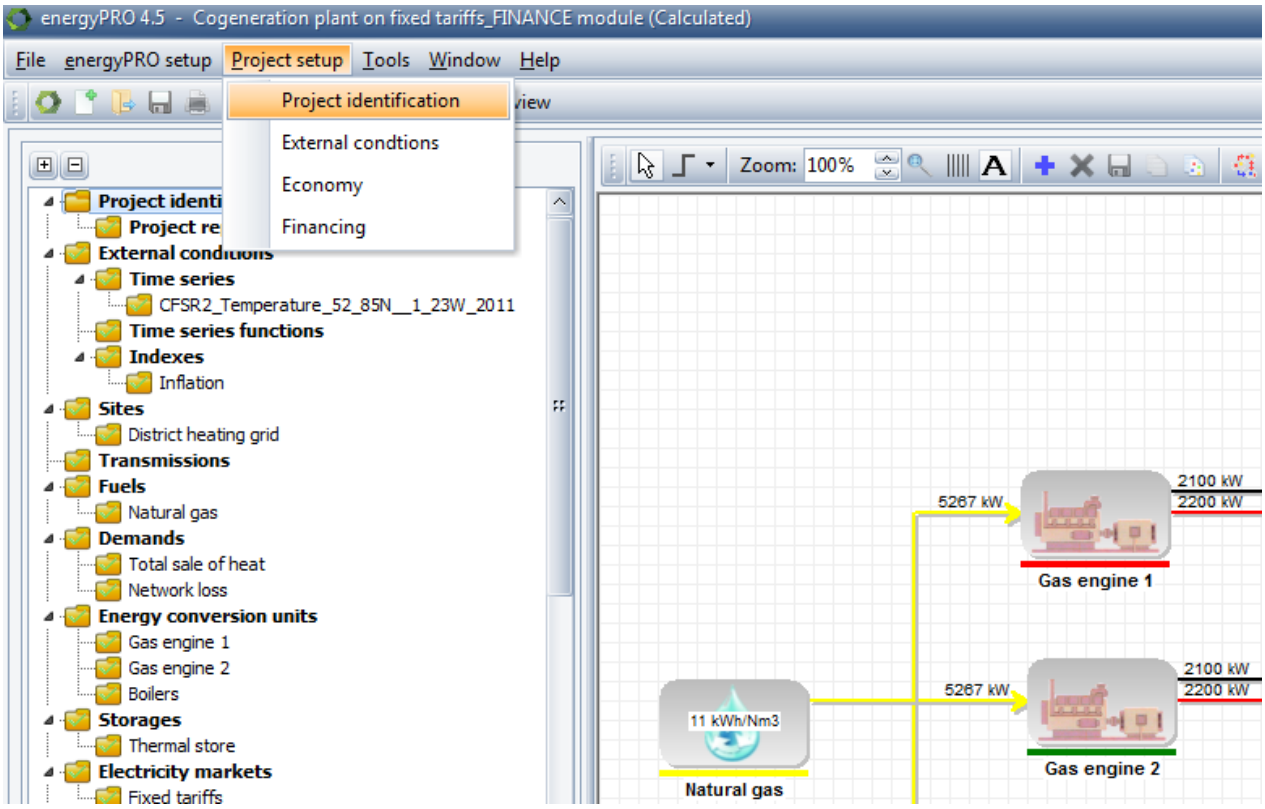


Figure 1. Open the Project identification window.

In the Project identification window, shown in Figure 2, you can select the desired calculation module. Select the FINANCE module to enable a FINANCE calculation.

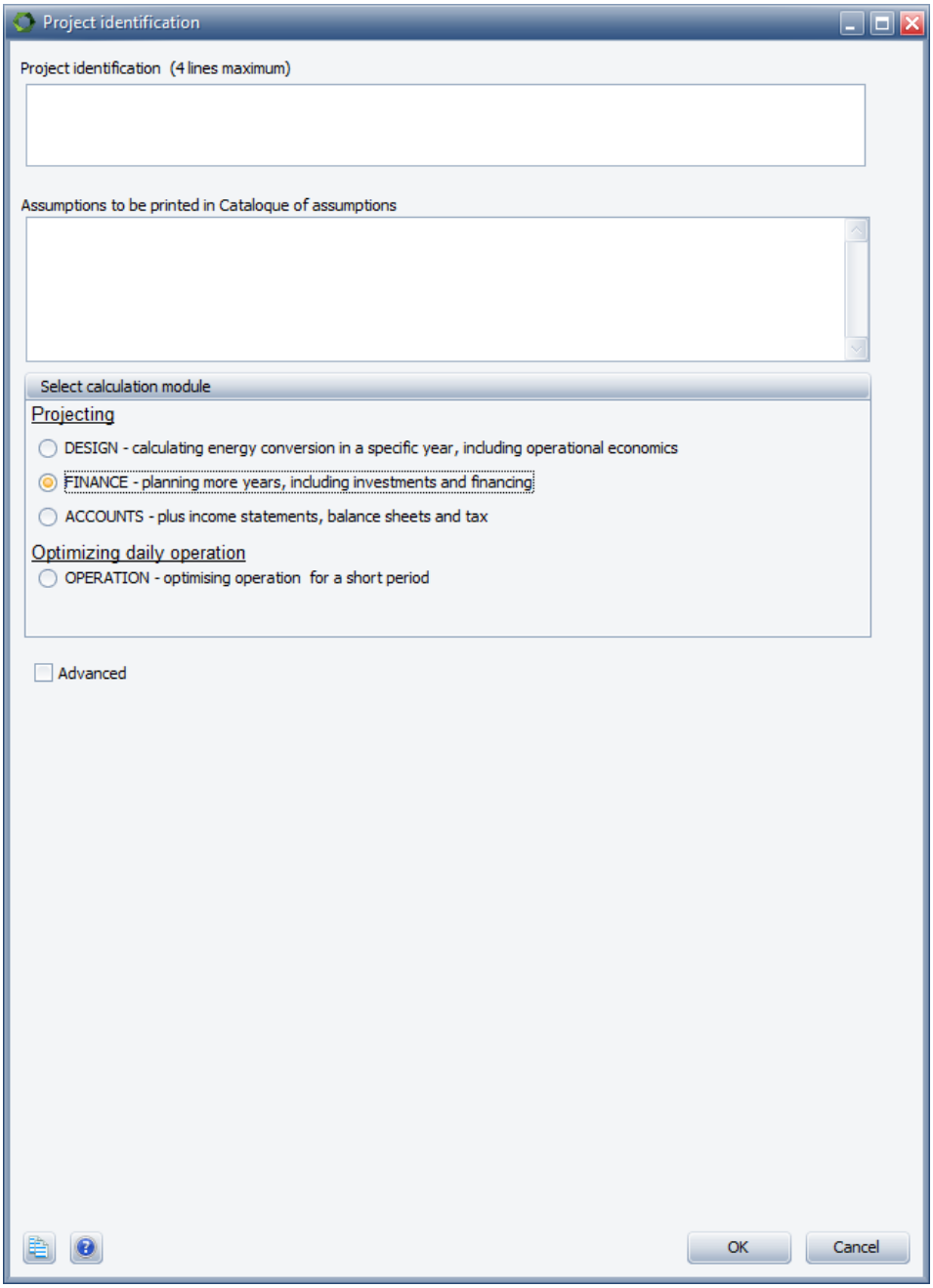


Figure 2. In Project identification, you select the calculation module.

Using the FINANCE module

With the FINANCE module, you are able to extend the planning period of your project to more than 1 year. This is done by opening the "External conditions" window by double-clicking the External conditions folder in the Input data window or by selecting External conditions in the Project setup menu.

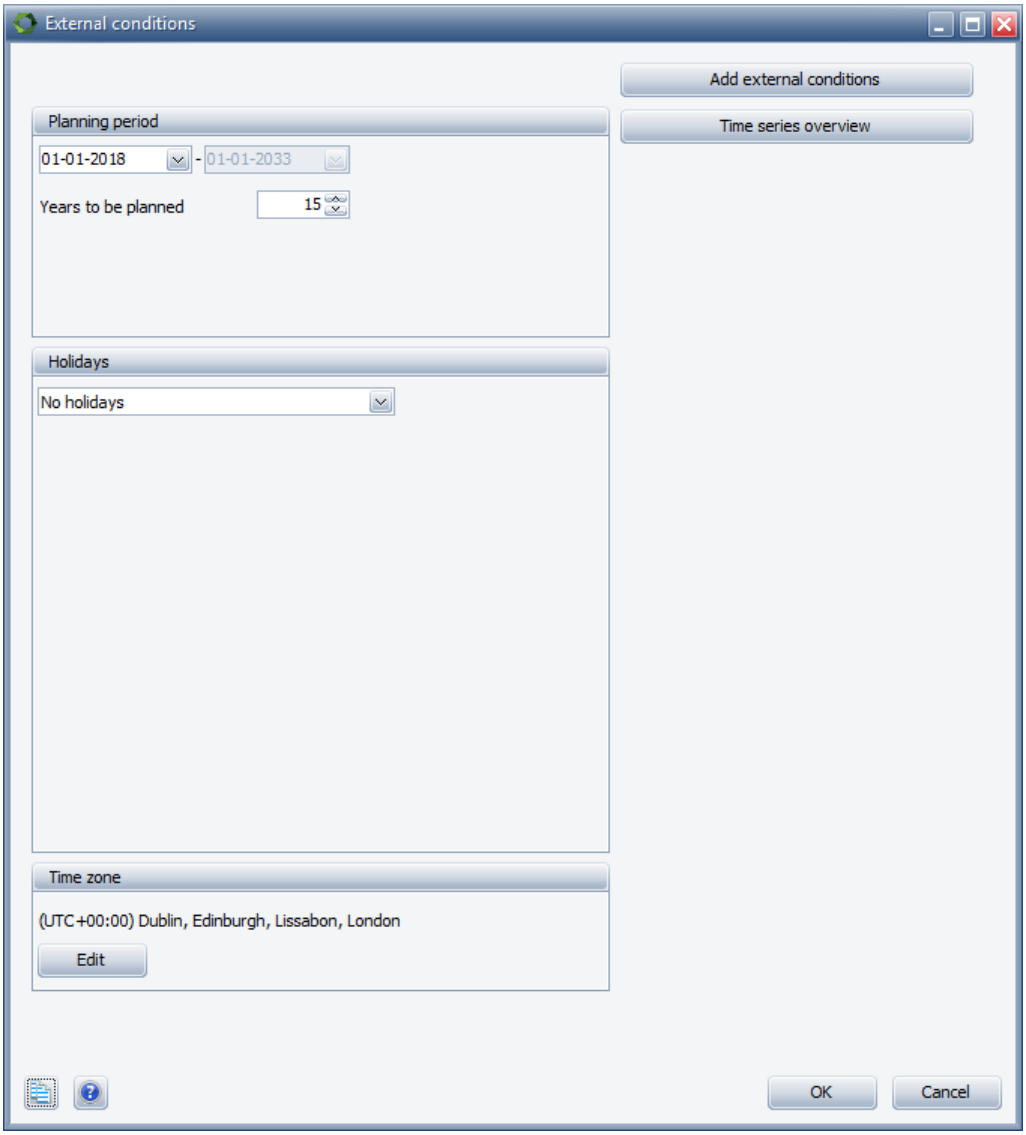


Figure 3. Setup the planning period from the External conditions window.

In this window, the starting point and the length of the planning period can be altered. In this example, we set the number of years to 15, beginning from the 1st of January 2018. When calculating the operation of the energy conversion units in the project, energyPRO will calculate the operation in every timestep throughout the entire planning period.

Add an index

Since the assumptions and conditions for the calculation may change during the planning period, it can be useful to create indexes that describe these developments over time. For instance, fuel prices, demands or units' production capacities might change during the planning period.

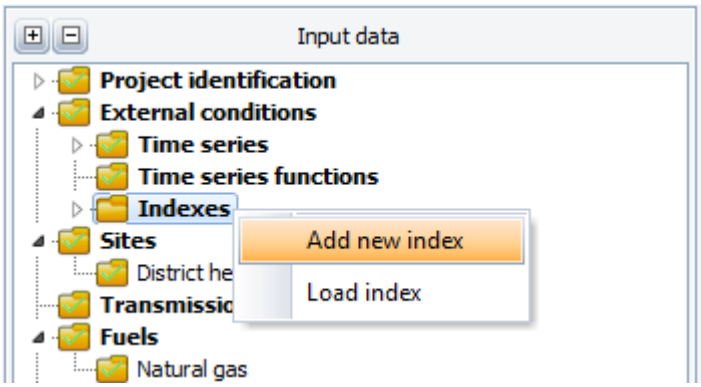


Figure 4. Add indexes by right-clicking Indexes under External conditions.

To add an index to a project, go to "External conditions" in the input data box. Right click on indexes and "Add new index". The window shown in Figure 5 will appear.

The window contains three different approaches for adding an index:

Constant annual increase. The index changes annually with the percentage typed in. In other words, it changes exponentially and is updated monthly. The index covers the total project period. Index is always 100 on the project start date.

Annual Increase is used if the index has to reflect a shift in rate of change. If the first year in the table is before the project start date, then the index on project start date is the value calculated based on input from the table. Index is always 100 on the index start date. The index changes exponentially (yearly update).

Index is used in situations, where you have a series of values (for instance the retail prices index) with values that you want to use if monthly specification is wanted. The index does not change between the indexes typed into the table.

In this example an index with a "Constant annual increase" of 2% is added. The index is named "Inflation".

The symbol is a unique short name of the index. The symbol is used for referencing the index elsewhere in the energyPRO. Any time series, time series functions and indexes, used in a project, must have unique symbols.

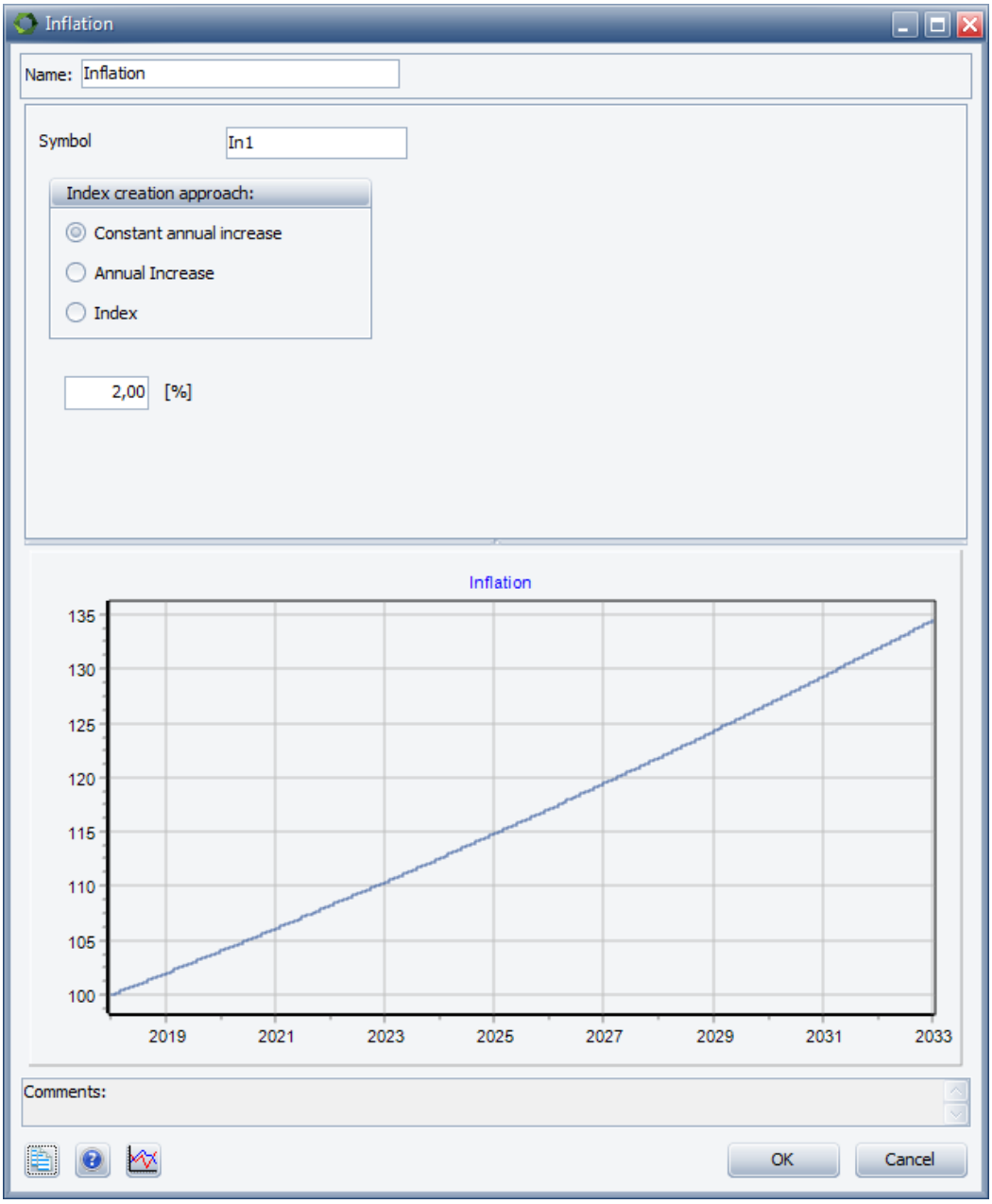


Figure 5: The feature of adding an index with the possible approaches

The Annual Increase index could be useful for describing the expected development in the heat demand. If more new buildings are being connected to the district heating grid while older buildings are continuously being renovated, the heat demand could follow an index like the one shown in Figure 6.

In this index, the heat demand increases with 0.5% each year from 2018-2021, then it decreases with 1.0% each year until 2026 where the annual decrease drops to 0.5% per year in the rest of the planning period.

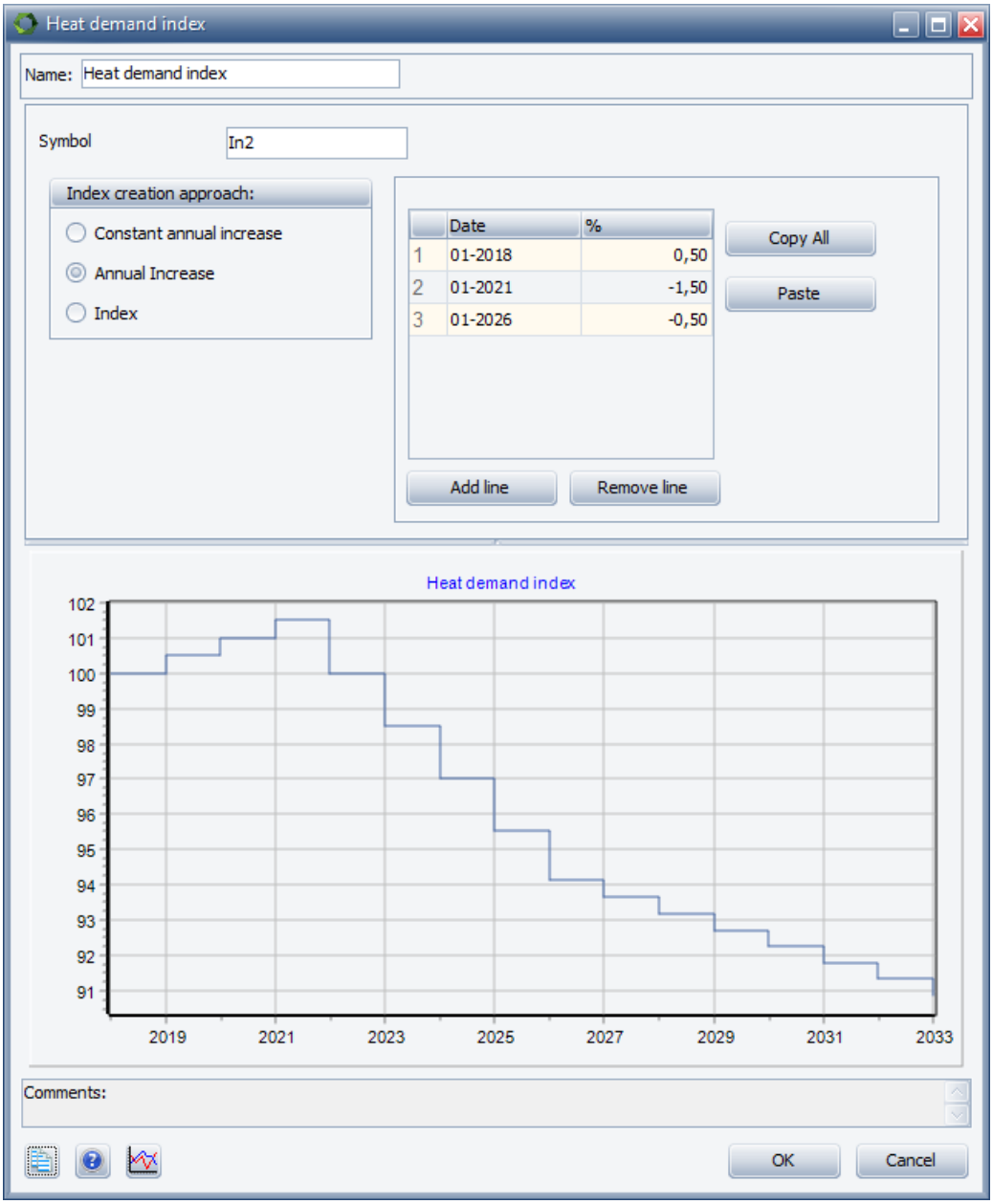


Figure 6: Example of an Annual Increase index describing the heat demand during the planning period.

Apply an index

Once you have designed your index, it is time to make use of it. As mentioned you can use an index to describe changes in your project's conditions and assumptions. Here are given a few examples of how to apply indexes.

Let's start with the inflation index from before. In order to use this index as the general inflation on all payments in you project, you go to "Project setup" in the menu and select

"Economy". You can also access the same window by right-clicking the blue "Economy"-folder in the "Input data" window, as shown in Figure 7.

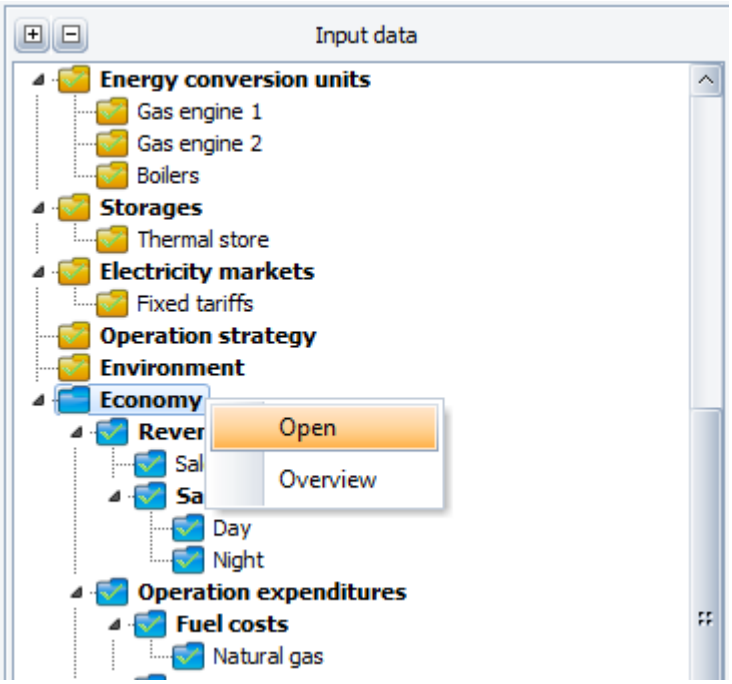


Figure 7. The economy settings window.

This will open the window seen in Figure 8. In the tab next to Inflation, it is possible to point out the different indexes created in the project. In this case we select the index with the name "Inflation" and all revenues and expenditures will now follow the inflation index (unless stated otherwise in the specific payment).

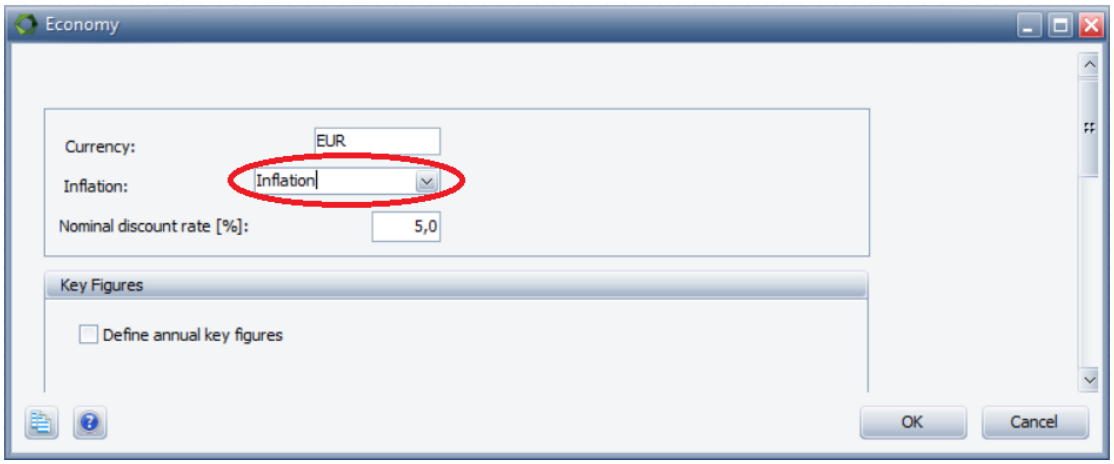


Figure 8: Select the inflation index you just made, to include it in the calculations

In this window it is also possible to change the currency used in the project and the nominal discount rate used to calculate the Net Present Value (NPV).

When opening a specific payment, in this case the revenue "Sale of heat", we see that the development of the unit price is now following the inflation index.

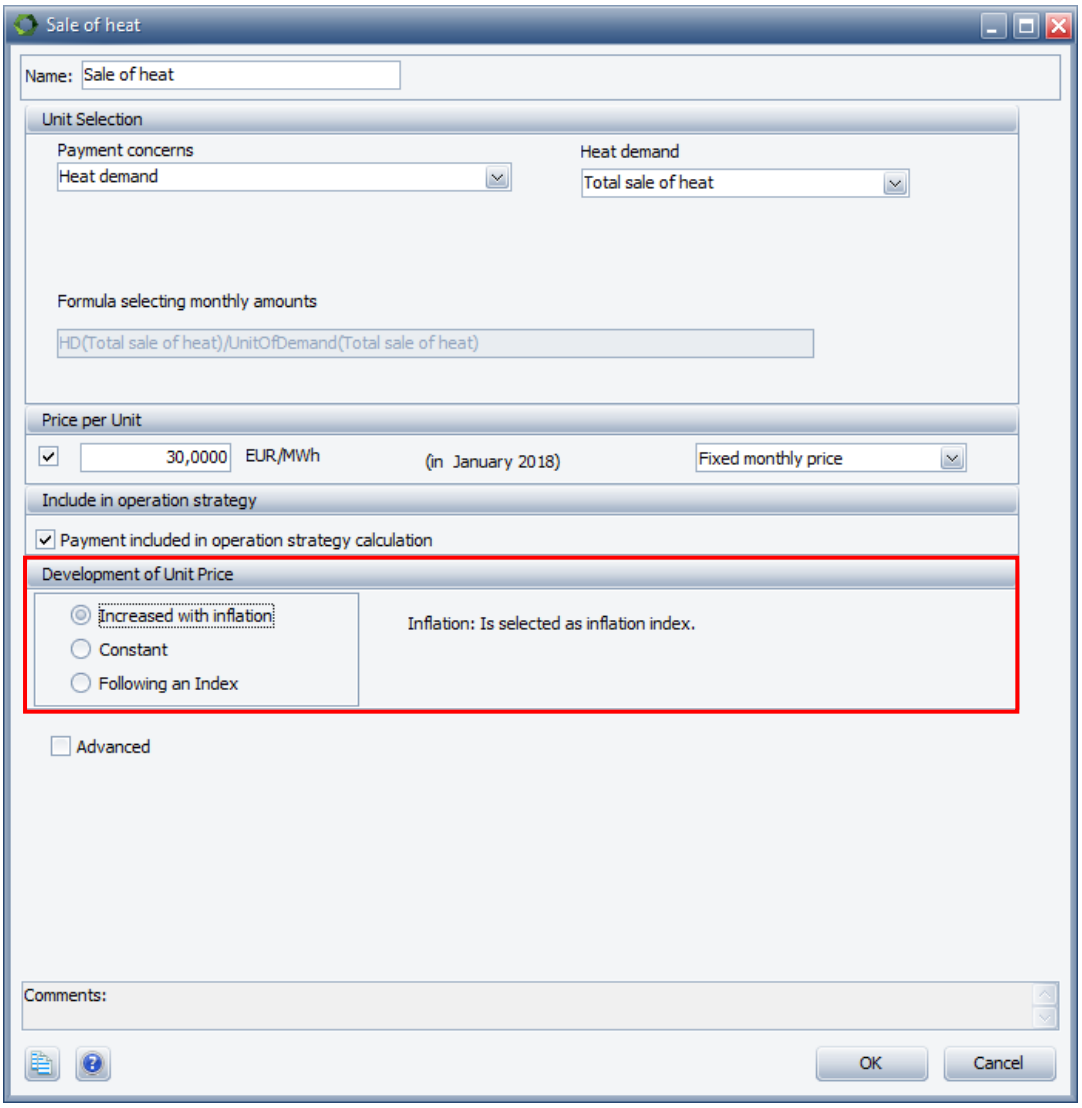


Figure 9. The revenue "Sale of heat" is now following an index.

If you do not want this payment to be following an index you select "Constant" instead of "Increased with inflation". If you want the payment to follow another index, select "Following an Index" and point out the preferred index.

In order to apply the "Heat demand index", first open the heat demand window. The window will be similar to the one in Figure 10 depending on how the heat demand is designed. Next, mark the small checkbox "Developing over the years" and select the relevant index in the dropdown list.

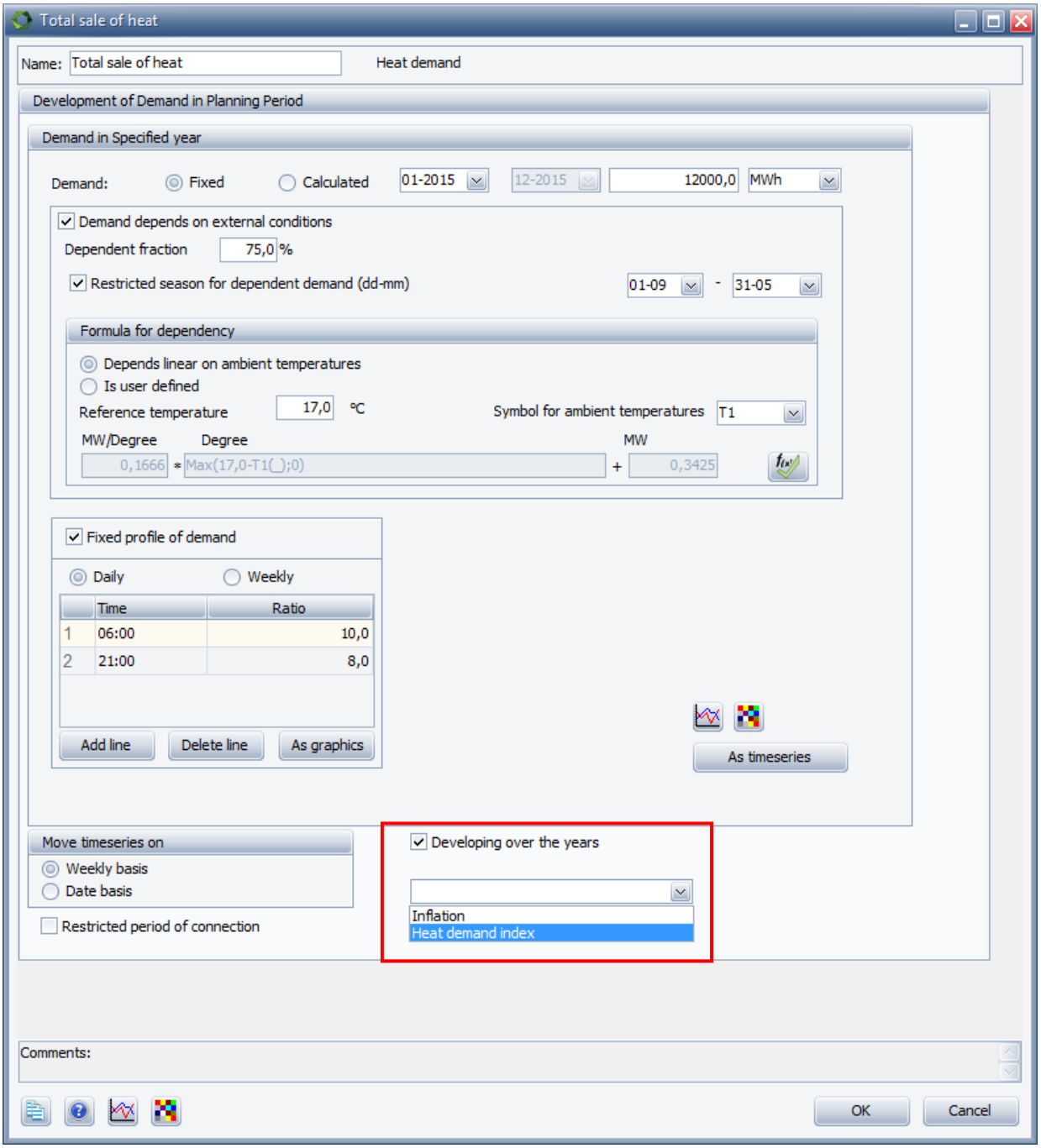


Figure 10: To connect the heat saving index with the heat demand, you have to go to the heat demand and choose "Developing over years"

Add investment costs

The operation costs and the revenues from the production are already included in the project file. However, when you in the beginning of this guide selected the FINANCE module both an "Investment" folder and a "Financing" folder was added to the "Economy" folder in the left part of energyPRO – see Figure 11.

Figure 11: The FINANCE module also includes investments and financing

To add an investment right click on the "Investments" and click on "Add new investments" and a new folder will appear under "Investments". Let's assume that the investment concerns a new boiler at our plant – name the investment "New boiler" and open it. In this window the date and amount of the investment is specified. You can also split up the investment in several amounts on different dates as seen in Figure 12.

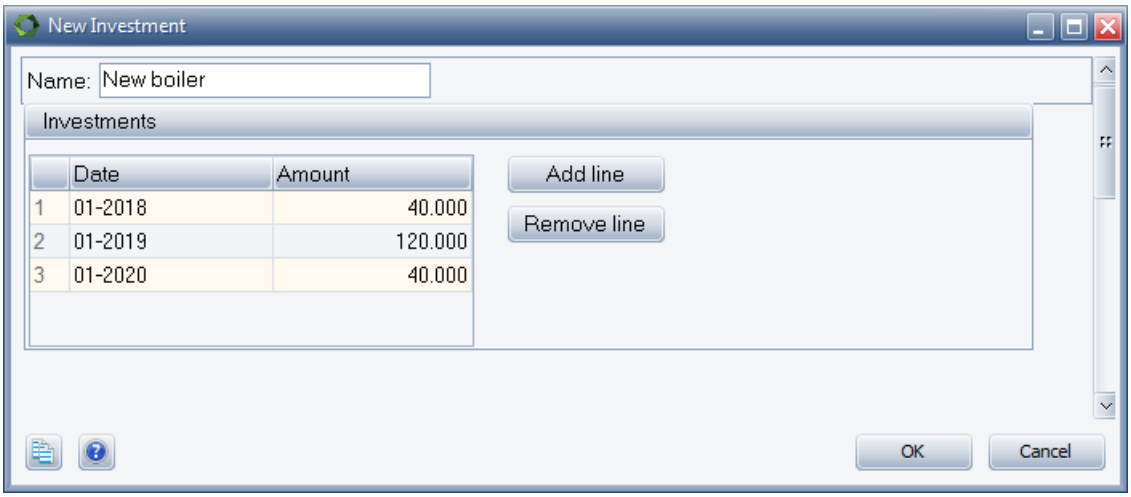


Figure 12: The investment is in this project paid over three periods

In this case, the total investment is split in three. 20% when the contract is signed, 60% at operation start and the last 20% one year after the commissioning. The total investment cost for the boiler is 200.000 EUR.

Add financing

In "Financing", you can specify how an investment is financed. Financing can take place by use of five different options: "Nominal loan", "Foreign loan", "Indexed loan", "Owners capital" or "Extraordinary income" (e.g. a grant). If "Foreign Loan" or "Index Loan" is selected, an index is required.

In this example, we assume that the investment from the previous section is financed by a "Nominal loan". To set up the loan, right-click on the "Financing" folder and click on "Add new financing". Name the appearing folder "loan" and open it. You will now see a window similar to the one in Figure 13.

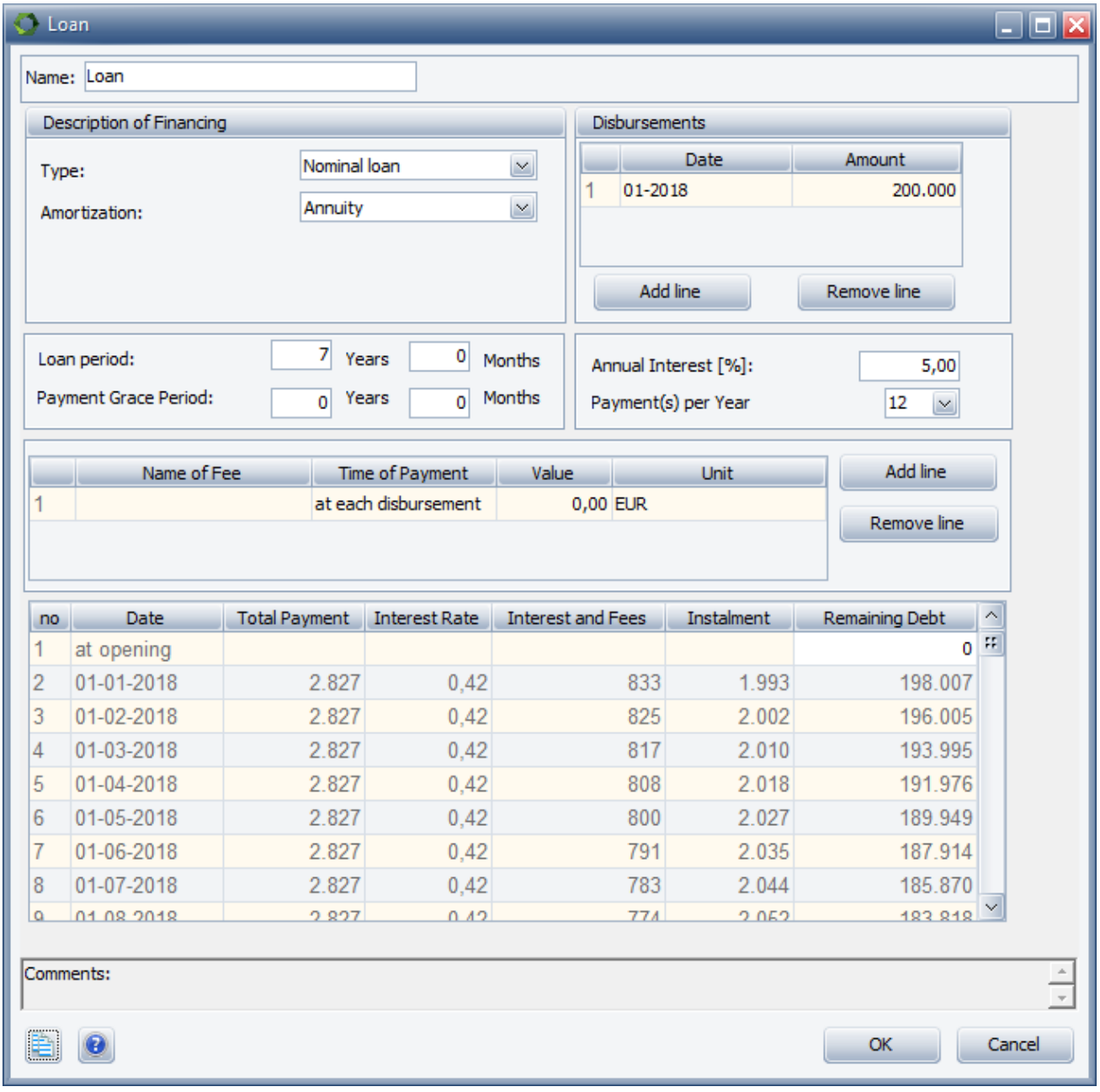


Figure 13: Setup the type of financing for your investment.

In the top left of the window under "Description of Financing", select "Nominal loan" as the type of financing. For amortization, there are three options: "Annuity", "Serial" and User defined". If "User defined" is chosen you get access to type in your own amounts for payments and interest rate in the payment overview table at the bottom of the window. In this case select "Annuity" as the type of amortization.

Next, type the amounts and dates for the disbursements under "Disbursements". Finally, you need to specify the loan period, payment grace period, the annual interest rate and the number of payments per year.

When the setup is complete, you can see an overview of the payments in the table in the bottom of the window in Figure 13. This table is updated every time you alter one of the values above.

The total payment consists of interest, fee and instalment. The interest percentage stated in this table is the interest percentage for the settled period for payment calculated by use of the annual rate stated. The remaining debt is calculated as the remaining debt after the last payment minus the instalment. If the loan type is "Foreign Loan" or "Index Loan" the remaining debt will be increased by the selected index before calculating interest and a new remaining debt.

Setting up a cash account

Details regarding a cash account can be specified in "Financing" under "Project setup" in the menu.

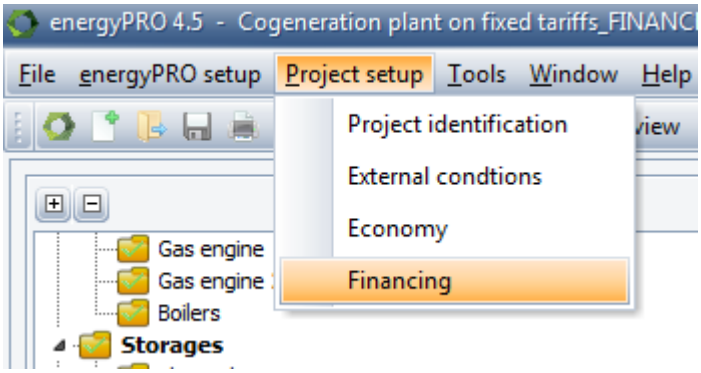


Figure 14: The financing tab appears when the module is changed to FINANCE

When opening the Financing menu, it is possible to specify the annual interest for respectively positive and negative amounts. Furthermore, you can determine the balance on the cash account at project start – see Figure 15.

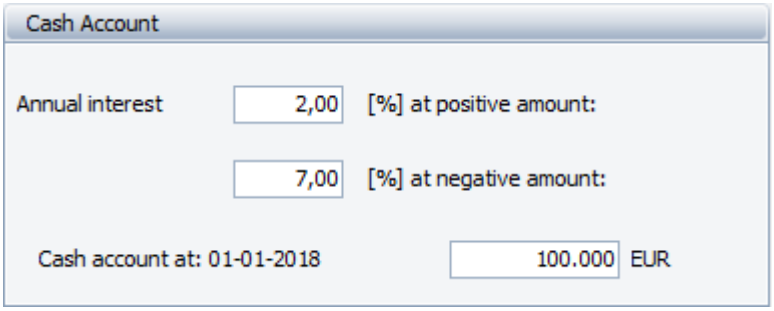


Figure 15. Specify the Cash account interests and balance.

Results

The technical and economic results are found in the “Reports” box. Depending on which modules you have enabled, different reports are available. When the FINANCE module is enabled, the following reports are available.

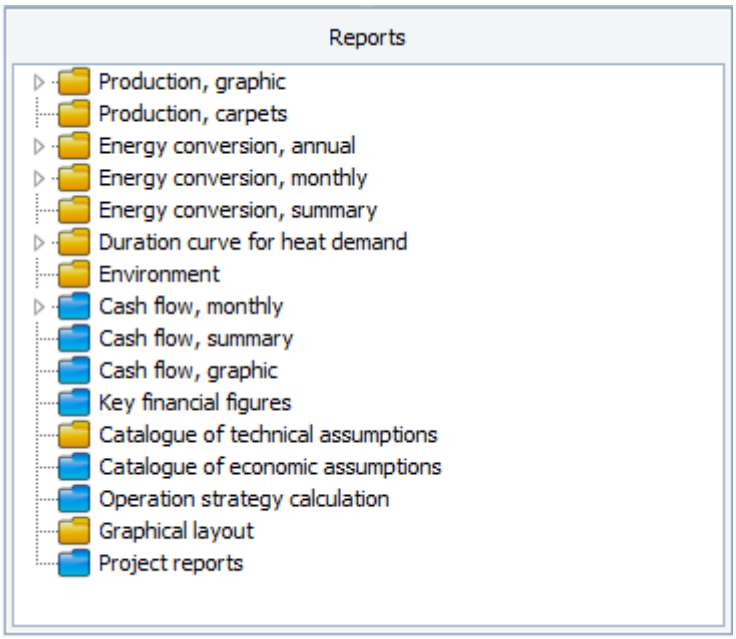
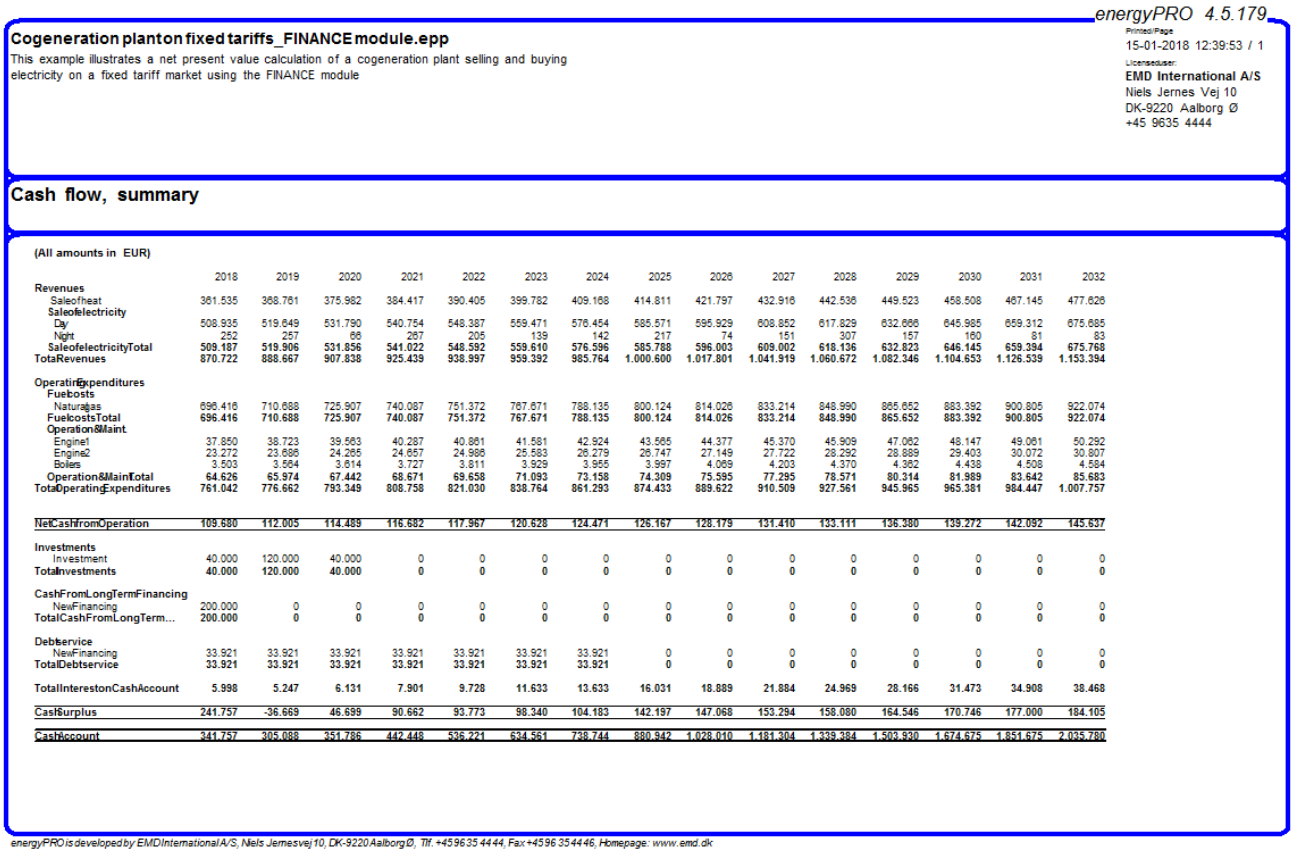


Figure 16: Reports available with FINANCE module.

The yellow folders represent technical reports and the blue folders represent economic reports. Click on a folder to see the different results.

For instance, the “Cash flow, monthly” report shows the revenues and expenses in each month of every year of the project period. By expanding this folder, you can select the report for a specific year in the planning period. In the “Cash flow, summary” report, the monthly payment from each year are accumulated and shown in a column for every year in the planning period, as shown in Figure 17. This gives an overview of the different payments during the entire planning period.



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Cogeneration plant on fixed tariffs_FINANCE module.epp

This example illustrates a net present value calculation of a cogeneration plant selling and buying electricity on a fixed tariff market using the FINANCE module

Cash flow, summary

(All amounts in EUR)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Revenues															
Saleofheat	361.535	368.761	375.982	384.417	390.405	399.782	409.168	414.811	421.797	432.916	442.536	449.523	458.508	467.145	477.626
Saleofelectricity															
Day	508.935	519.649	531.790	540.754	548.387	559.471	576.454	585.571	595.929	608.852	617.829	632.666	645.985	659.312	675.685
Night	252	257	66	267	205	139	142	217	74	151	307	157	160	81	83
SaleofelectricityTotal	509.187	519.906	531.856	541.022	548.592	559.610	576.596	585.788	596.003	609.002	618.136	632.823	646.145	659.394	675.768
TotaRevenues	870.722	888.667	907.838	925.439	938.997	959.392	985.764	1.000.600	1.017.801	1.041.919	1.060.672	1.082.346	1.104.653	1.126.539	1.153.394
OperatingExpenditures															
Fuelcosts															
Naturalgas	696.416	710.688	725.907	740.087	751.372	767.671	788.135	800.124	814.026	833.214	848.990	865.652	883.392	900.805	922.074
FuelcostsTotal	696.416	710.688	725.907	740.087	751.372	767.671	788.135	800.124	814.026	833.214	848.990	865.652	883.392	900.805	922.074
Operation&Maint.															
Engine1	37.850	38.723	39.563	40.287	40.861	41.581	42.924	43.565	44.377	45.370	45.909	47.062	48.147	49.061	50.292
Engine2	23.272	23.698	24.265	24.657	24.988	25.583	26.279	26.747	27.149	27.722	28.292	28.889	29.403	30.072	30.907
Boiles	3.503	3.564	3.614	3.727	3.811	3.929	3.955	3.997	4.069	4.203	4.370	4.382	4.438	4.508	4.584
Operation&MaintTotal	64.626	65.974	67.442	68.671	69.658	71.093	73.158	74.309	75.595	77.295	78.571	80.314	81.989	83.642	85.683
TotaOperatingExpenditures	761.042	776.662	793.349	808.758	821.030	838.764	861.293	874.433	889.622	910.509	927.561	945.965	965.381	984.447	1.007.757
NetCashfromOperation	109.680	112.005	114.489	116.682	117.967	120.628	124.471	126.167	128.179	131.410	133.111	136.380	139.272	142.092	145.637
Investments															
Investment	40.000	120.000	40.000	0	0	0	0	0	0	0	0	0	0	0	0
TotalInvestments	40.000	120.000	40.000	0	0	0	0	0	0	0	0	0	0	0	0
CashFromLongTermFinancing															
NewFinancing	200.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TotalCashFromLongTerm...	200.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debtservice															
NewFinancing	33.921	33.921	33.921	33.921	33.921	33.921	33.921	0	0	0	0	0	0	0	0
TotalDebtservice	33.921	33.921	33.921	33.921	33.921	33.921	33.921	0	0	0	0	0	0	0	0
TotalInterestonCashAccount	5.998	5.247	6.131	7.901	9.728	11.633	13.633	16.031	18.889	21.884	24.969	28.166	31.473	34.908	38.468
CashSurplus	241.757	-36.669	46.699	90.662	93.773	98.340	104.183	142.197	147.068	153.294	158.080	164.546	170.746	177.000	184.105
CashAccount	341.757	305.088	351.786	442.448	536.221	634.561	738.744	880.942	1.028.010	1.181.304	1.339.384	1.503.930	1.674.675	1.851.675	2.035.780

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Figure 17. Example of a Cash flow, summary report.

Net present value

A project's Net Present value (NPV) is a measure of the potential profit caused by a project, taking into account *time value of money*. *Time value of money* is the basic idea in investment theory that the money available today is worth more than the same amount of money in the future due to its potential earnings capacity. How much future earnings are worth today, is determined with the *discount rate*.

In the energyPRO report, "Key financial figures", the NPV of the project is calculated. The calculation is based on all payments in the planning period and the discount rate entered in the economy window as shown in Figure 8.

The formula used to calculate the NPV is:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

Where:

C_t = net cashflow during the period t

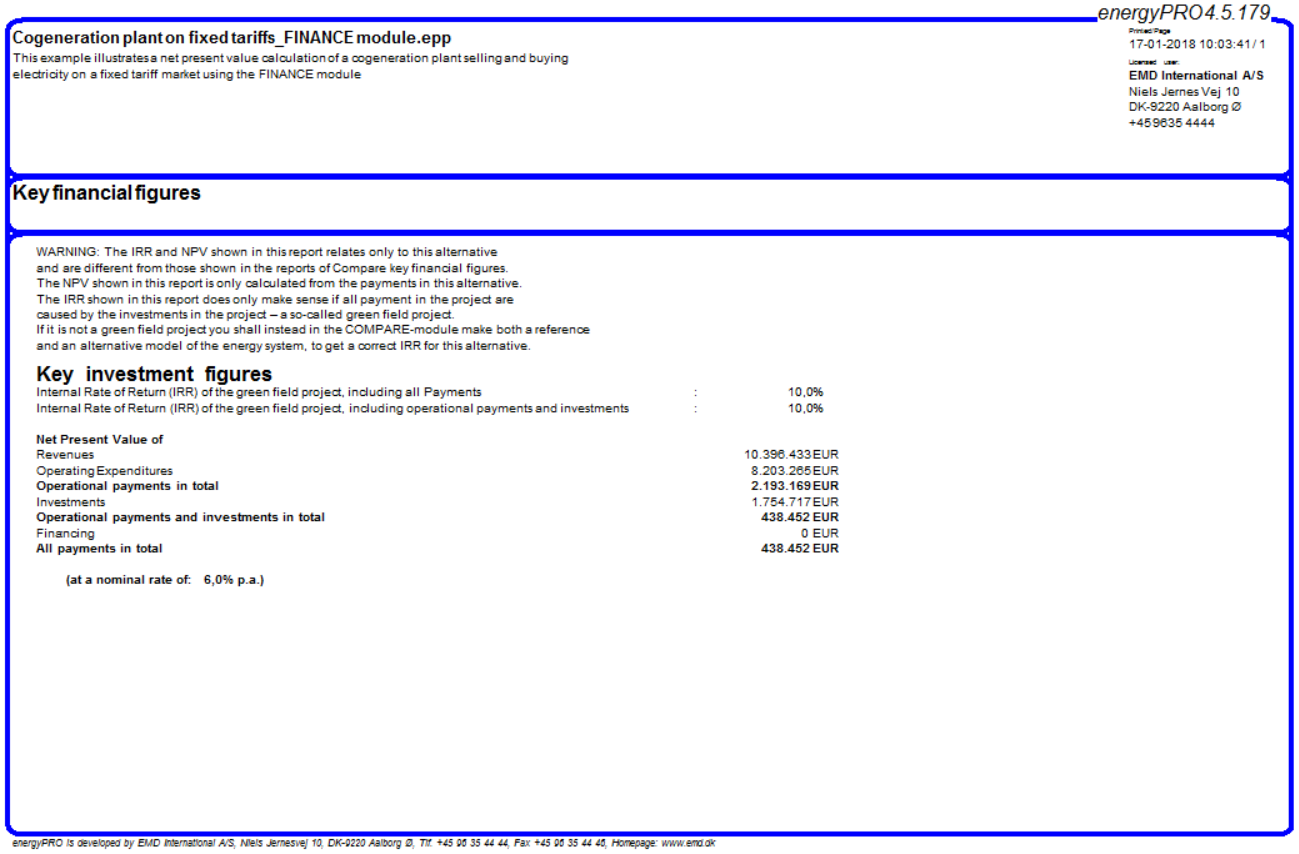
C_0= total initial investment costs

r = discount rate

t = number of time periods

NOTE: Since all payments are included in the NPV calculation, the NPV is a measure of the value of the entire energyPRO project compared to nothing. This only makes sense if all payments in the project are caused by the investments in the project (a so-called green field project). If you wish to calculate the NPV of the investment in a new unit which is added to an existing project, you must first calculate the NPV of the project without the new unit and then the NPV including the new unit – now you can calculate the difference in the NPVs caused by the investment in the new unit. This comparison is done automatically in the COMPARE module.

The Key financial figures report is shown in Figure 18.



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Cogeneration plant on fixed tariffs_FINANCE module.epp

This example illustrates a net present value calculation of a cogeneration plant selling and buying electricity on a fixed tariff market using the FINANCE module

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Key financial figures

WARNING: The IRR and NPV shown in this report relates only to this alternative and are different from those shown in the reports of Compare key financial figures. The NPV shown in this report is only calculated from the payments in this alternative. The IRR shown in this report does only make sense if all payment in the project are caused by the investments in the project – a so-called green field project. If it is not a green field project you shall instead in the COMPARE-module make both a reference and an alternative model of the energy system, to get a correct IRR for this alternative.

Key investment figures

Internal Rate of Return (IRR) of the green field project, including all Payments	:	10,0%
Internal Rate of Return (IRR) of the green field project, including operational payments and investments	:	10,0%

Net Present Value of	
Revenues	10.396.433 EUR
Operating Expenditures	8.203.265 EUR
Operational payments in total	**2.193.169 EUR**
Investments	1.754.717 EUR
Operational payments and investments in total	**438.452 EUR**
Financing	0 EUR
All payments in total	**438.452 EUR**

(at a nominal rate of: 6,0% p.a.)

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Figure 18. The Key financial figures report.

Internal rate of return

The Internal Rate of Return (IRR) is also calculated in the Key financial figures report. The IRR is the discount rate that makes the Net Present Value (NPV) of all cashflows in a project equal to zero.

The IRR is calculated using the equation in page 19, setting the NPV equal to zero and solve for the discount rate *r*.

NOTE: As mentioned in the section *Net present value*, the NPV is based on all payment in the project and therefore the IRR only makes sense if all payments are caused by the investments in the project (a so-called green field project). With the COMPARE module, the IRR can be calculated for new investments done in an existing project.

Please notice, that you can find more information on how to use energyPRO in the How to Guides, User's Guide and tutorials on EMD's website:

http://www.emd.dk/energypro/

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