

# Cost model

## Output

This model calculates the annual total cost of the Swiss energy system, which is decomposed into the following elements:

- Nuclear
- Fossil electricity
- Hydro
- Wind
- Solar PV
- Deep geothermal
- Electricity grid
- Seasonal storage
- Electricity import
- Cogeneration
- Boilers
- Other heat
- Transport fuels
- Energy efficiency

For each of these elements the annual total cost ( $C_{i,t}$ ) is calculated as shown in the following equation,

$$C_{i,t} = C_{f,i,t} + C_{om,i,t} + \frac{C_{inv,i,t}}{T}$$

where

- $C_{f,i,t}$  is the cost of all consumed fuels and imported electricity for one year, it accounts of the yearly operating time
- $C_{om,i,t}$  is the annual **Operation and Maintenance cost**
- $C_{inv,i,t}$  is the annualised investment cost for each element. Some elements only include one cost component, e.g. "Transport fuels" has only the  $C_{f,i,t}$  or "Elec. Grid" with  $C_{om,i,t}$ . In this approach cogeneration systems are represented by a single element in the legend, "Combined Heat&Power". This avoids calculating the cost allocation to electricity and heat production, which is an advantage in comparison to the approaches based on levelized cost of electricity and heat.

The investment cost is calculated for each year (2011, 2035 and 2050) by assuming that the complete energy system is entirely replaced during the selected year, taking into account the relative prices and the technology development status. The investment cost is annualised based on the interest rate as in the following equation,

$$C_{inv,i,t} = \frac{C_{tot,i,t}}{1 - (1 + r)^{-T}}$$

where

- $C_{tot,i,t}$  is the total investment cost,
- $r$  is the interest rate
- $T$  is the technology life time in years.

This assumption allows comparing the investment cost of 2011 with those for 2035 and 2050, without having to consider any installation/decommissioning pathway.

## Input

The inputs of the cost sub-model are the “Fuel Prices”, “Investment cost” and “Interest rate” sliders. The extreme values of these three inputs are “1” and “3”, with “1” assuming the lowest value for the costs, and “3” the highest values.

### Fuel prices

The “Fuel prices” input defines which of the 3 price levels is selected for the cost calculation. The following table shows the production prices, or prices at the Swiss border, if the resource is imported. Taxation is not accounted for in the cost calculations.

ctsCHF/kWh <sub>fuel</sub>	2010	2035			2050		
		MIN(1)	MID(2)	MAX(3)	MIN(1)	MID(2)	MAX(3)
<b>Gasoline</b>	8.59 <sup>[1][2]</sup>	9.18	11.30	14.76	8.55	12.90	16.51
<b>Diesel</b>	8.41 <sup>[1][2]</sup>	8.99	11.07	14.46	8.38	12.64	16.18
<b>Bioethanol</b>	7.36 <sup>[8]</sup>	9.18	11.30	14.76	8.55	12.90	16.51
<b>Biodiesel</b>	11.93 <sup>[8]</sup>	8.99	11.07	14.46	8.38	12.64	16.18
<b>Heating fuel oil</b>	6.54 <sup>[1][3]</sup>	6.99	8.60	11.24	6.52	9.83	12.58
<b>Kerosene</b>	5.91 <sup>[4]</sup>	6.32	7.78	10.16	5.89	8.88	11.37
<b>Gas</b>	6.50 <sup>[5]</sup>	6.15	10.07	13.00	6.62	12.07	15.87
<b>Wood</b>	3.01 <sup>[7]</sup>	6.82	7.81	8.80	7.41	8.96	10.50
<b>Coal</b>	3.60 <sup>[6]</sup>	3.76	5.34	7.26	3.68	5.43	6.51
<b>Imported electricity [ctsCHF/kWh<sub>e</sub>]</b>	15.90 <sup>[5]</sup>	15.90	24.00	32.10 <sup>[7]</sup>	15.90	24.75	33.60 <sup>[7]</sup>

The prices for fossil fuels in 2035 and 2050 are calculated by the following equations, taking into account the 2010 prices and the three evolution paths forecast by the European Commission <sup>[9]</sup>.



Bioethanol and Biodiesel are considered to have the same price evolution as the fuel they substitute (gasoline and diesel respectively). The price for wood in 2035 and 2050 is calculated following the same methodology used for the fossil fuel prices, but the evolution is based on the wood price forecasts in <sup>[7]</sup>.

### Investment cost

The “Investment cost” input determines which of the 3 levels of specific investment cost is considered. More information about the considered specific investment costs is available in the supply

technology pages.

## Interest rate

The "Interest rate" slider sets the interest rate. The defined range for the interest rate is [1.73, 4.70] %. It should be noted that these values are based on the observed performances of the electricity production companies in 2012.

## References

- [1] [OFEN \(2012\), Evolution des marchés des énergies fossiles 3 / 2012](#)
- [2] [IPC, prix moyens annuels de l'essence et du diesel](#)
- [3] [IPC, prix moyens annuels pour 100 l de mazout pour des quantités types \(>20'000 l\)](#)
- [4] [EIA, Petroleum & Other Liquids](#)
- [5] [OFEN \(2012\), Statistique globale suisse de l'énergie 2011](#)
- [6] [VSE \(2012\), Centrale au charbon](#)
- [7] [PROGNOS \(2012\), Die Energieperspektiven für die Schweiz bis 2050, Energienachfrage und Elektrizitätsangebot in der Schweiz 2000–2050.](#)
- [8] [Jablonski et al. \(2010\), The role of bioenergy in the UK's energy future formulation and modelling of long-term UK bioenergy scenarios](#)
- [9] [European Commission \(2011\), Energy Roadmap 2050, Impact assessment and scenario analysis](#)

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