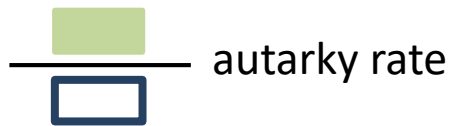
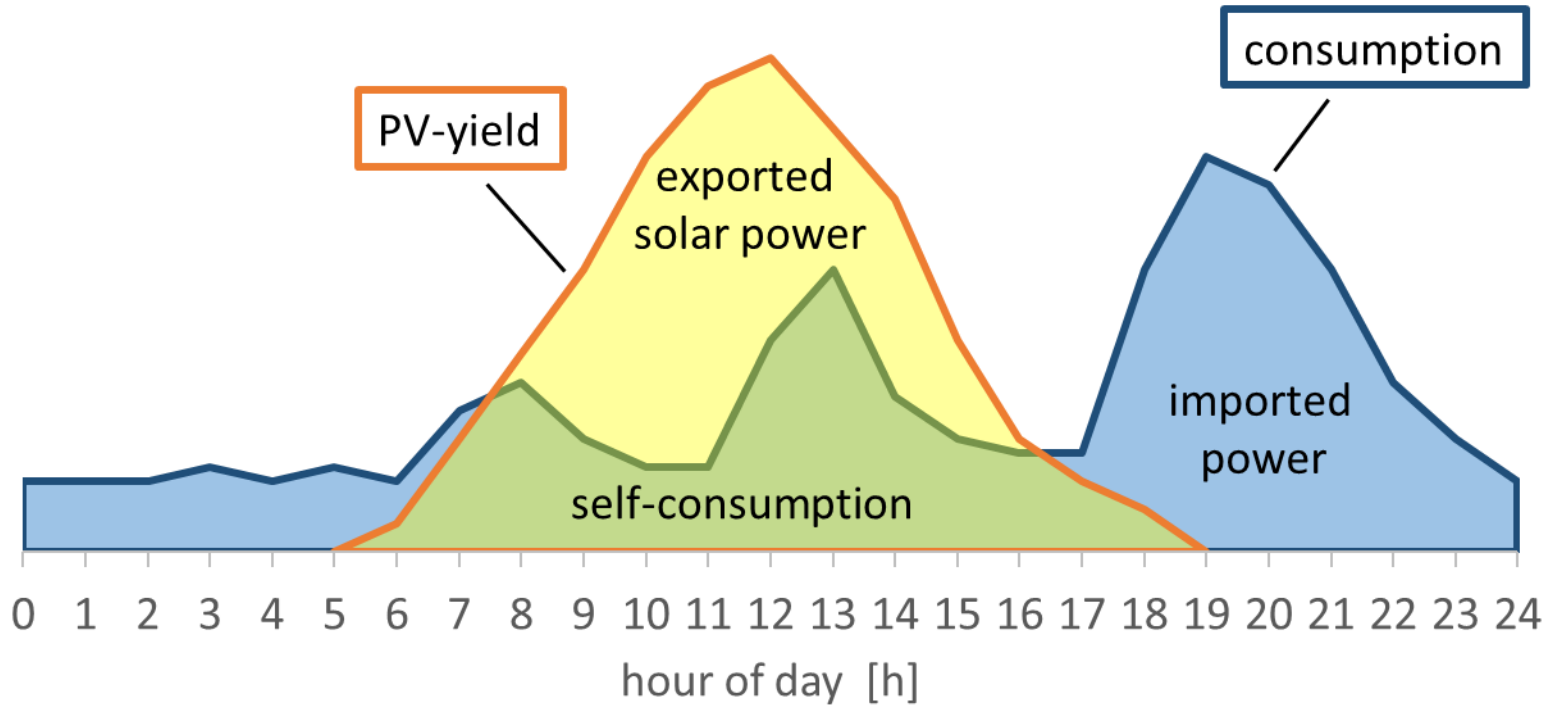


Impact of different energy balancing methods on Net Zero Energy Buildings

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Definitions



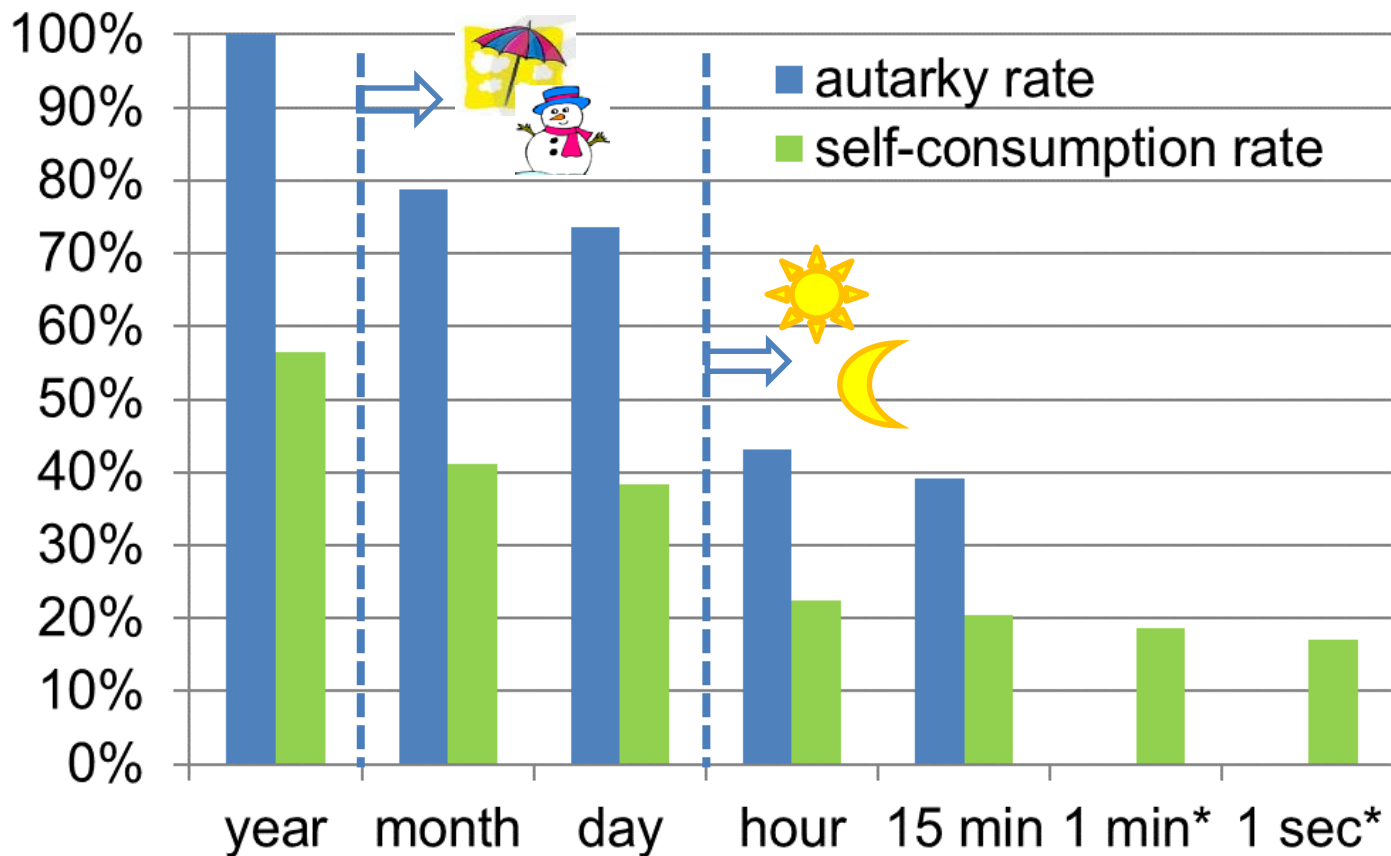
Case study



© Setz Architektur

- Apartment building
- 320 m² heated area
- Minergie-P
- Heatpump
- Mechanical ventilation
- 20 kWp PV (South, 10°)
- 15 min monitored data

Annual balance with different resolutions



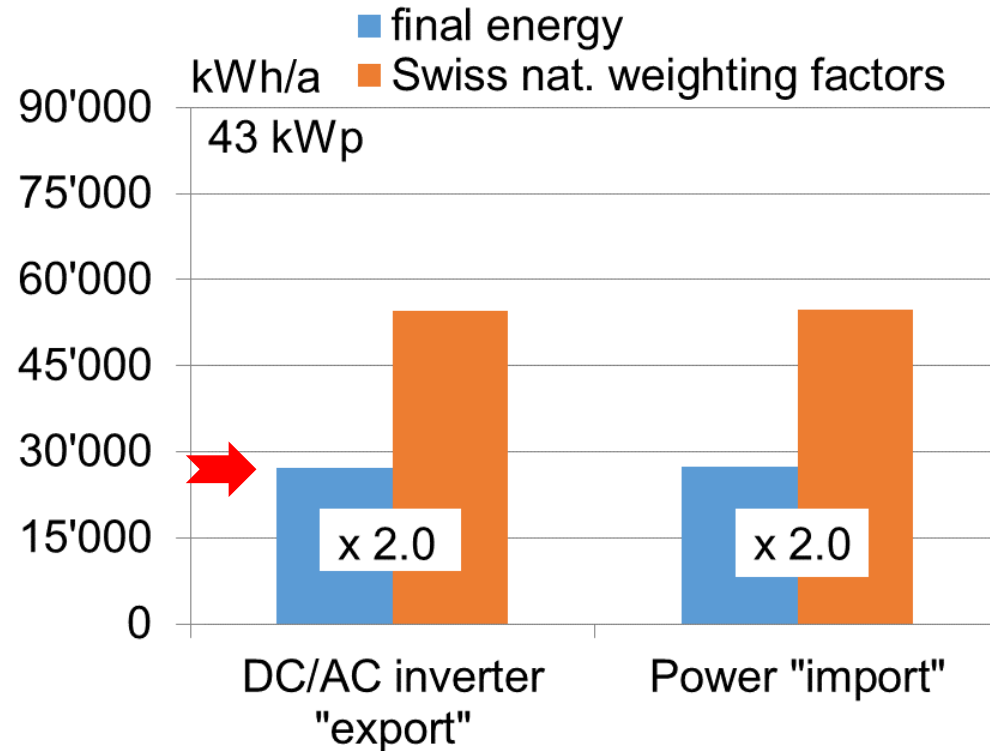
* Source Staudacher T., Eller S.: "Dezentrale Stromversorgung eines Einfamilienhauses" www.ffe.de, *BWK*, vol. 4, no. 6, pp. 66–72, 2012. Plugradt N.: "Personal information" Berner Fachhochschule, Burgdorf, 2017.

Weighting factors for im-/exported energy

Apartment building

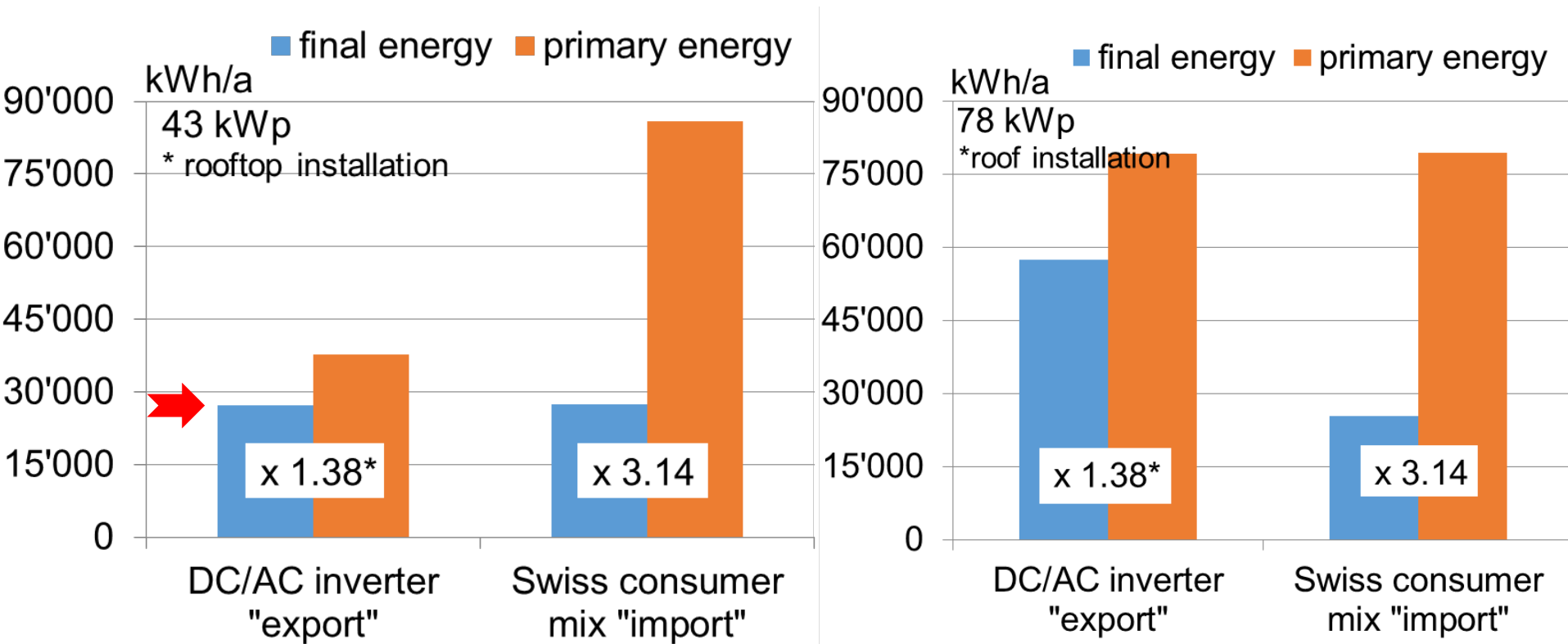
- 1'200 m² heated area
- heat pump
- PV 43 kWp (S, 30°)

- annual demand: 39'600 kWh/a
- self-consumption: 12'120 kWh/a
- im-/export: 27'480 kWh/a



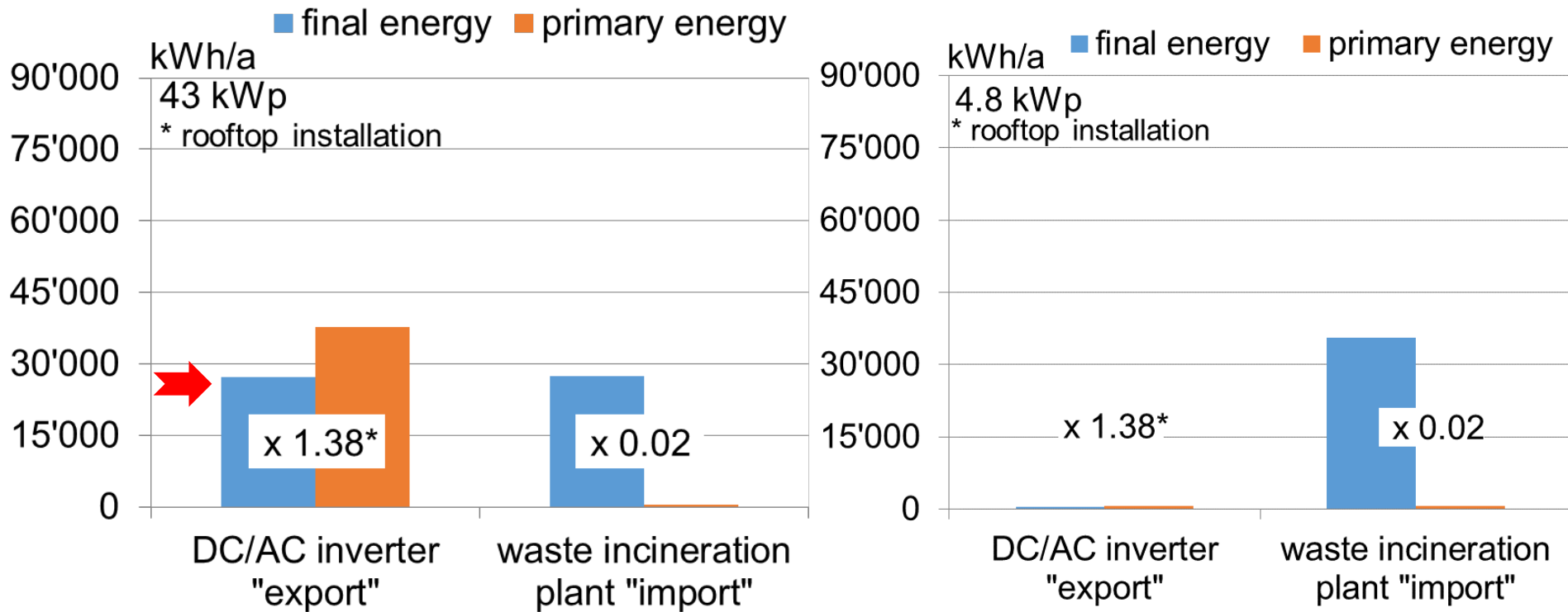
(based on 1 h resolution)

Impact of different weighting factors SIA 380:2015



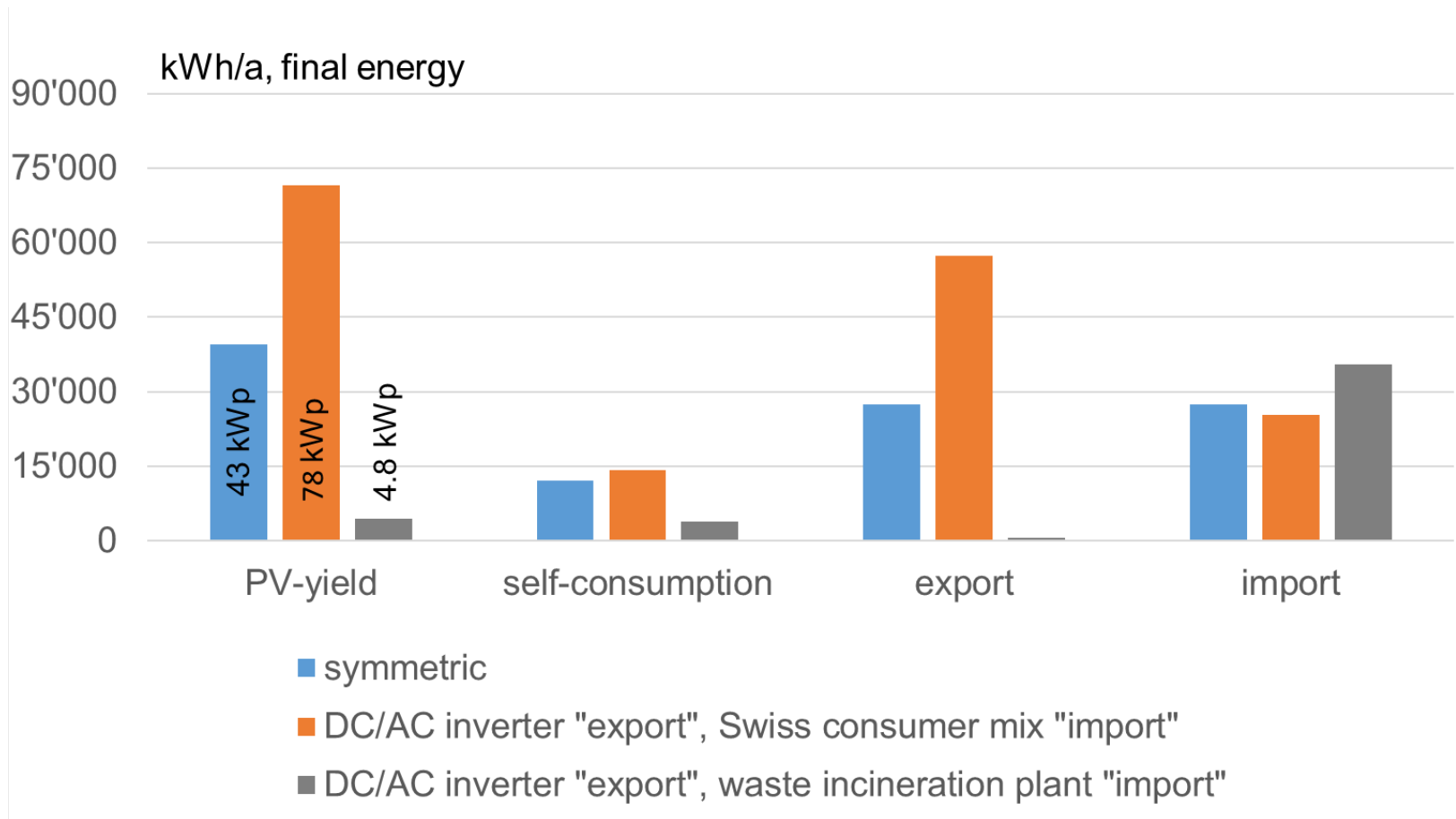
(based on 1 h resolution)

Impact of different weighting factors SIA 380:2015



(based on 1 h resolution)

Impact of different weighting factors SIA 380:2015



(based on 1 h resolution)

Calculation of self-consumption

input

- info about the building
- 4 utilization zones
- consumer
- devices for heating and DHW
- PV-yield
- battery

year
month

distribution calculation

- load profile
- clima data
- default values

hour

balance

- with battery
- without battery

hour

results

- self-consumption
- autarky rate
- grid interaction

year
month

Calculation of self-consumption

- Criteria for daylight

Profil SIA 2024

Hour	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1	1.6	1.7	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.7
2	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
3	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
4	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
5	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
6	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
7	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
8	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
9	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
10	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
11	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
12	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
13	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
14	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
15	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
16	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
17	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
18	36.0	34.3	36.0	36.9	36.0	36.9	36.0	36.0	36.9	36.0	36.9	36.0
19	61.3	73.4	61.3	79.7	61.3	79.7	61.3	61.3	79.7	61.3	79.7	61.3
20	61.3	73.4	61.3	79.7	61.3	79.7	61.3	61.3	79.7	61.3	79.7	61.3
21	61.3	73.4	61.3	79.7	61.3	79.7	61.3	61.3	79.7	61.3	79.7	61.3
22	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
23	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6
24	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.6	1.7	1.6

Profil SIA 2024 + 200 W/m²

Hour	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
2	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
3	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
4	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
5	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
6	2.2	2.0	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2
7	2.2	2.0	2.2	2.1	1.7	1.9	1.5	2.0	2.2	2.2	2.2	2.2
8	47.6	42.1	40.4	30.5	29.9	22.1	29.9	25.7	27.6	46.7	46.2	47.6
9	47.6	41.0	36.2	25.2	24.7	17.9	24.7	19.2	26.4	36.4	46.2	47.6
10	45.7	31.6	26.9	21.0	24.7	16.9	19.4	19.4	22.1	26.9	36.9	47.6
11	26.2	25.2	24.7	21.0	22.6	16.9	19.4	19.4	20.0	26.9	30.5	40.4
12	26.2	25.2	21.5	16.9	24.7	16.9	17.2	17.2	18.9	26.9	22.6	26.2
13	26.2	26.2	26.9	20.0	22.6	17.9	19.4	15.2	22.1	26.9	21.5	26.2
14	26.2	22.2	22.6	20.0	24.7	16.9	20.5	15.2	22.1	27.6	27.6	42.5
15	44.6	27.4	26.9	20.0	26.9	20.0	20.5	16.4	27.2	26.9	42.1	47.6
16	47.6	27.9	26.9	22.1	26.9	21.0	22.6	22.6	21.5	42.5	46.2	47.6
17	47.6	42.1	42.5	29.4	29.9	25.2	26.9	22.6	44.1	47.6	46.2	47.6
18	47.6	42.1	47.6	46.2	26.2	21.5	25.2	45.7	46.2	47.6	46.2	47.6
19	102.2	92.2	102.2	99.9	102.2	99.9	102.2	102.2	99.9	102.2	99.9	102.2
20	102.2	92.2	102.2	99.9	102.2	99.9	102.2	102.2	99.9	102.2	99.9	102.2
21	102.2	92.2	102.2	99.9	102.2	99.9	102.2	102.2	99.9	102.2	99.9	102.2
22	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
23	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
24	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2

(Apartment building: 1'600 m², lighting demand: 5 kWh/m², 40% independent of daylight)

Calculation of self-consumption – design tool “PVopti”

PVopti MINERGIE® EPDK

Projektname: 305, vom 20.10.2016 bis 21. Dezember 2016

Objektname: ... Datum: ...

Geobildschraube: ...

Ordnung: ...

Druckenergie (kWh/m²): ...

Wärmeverbrauch: ...

Photovoltaik Anlage Nr. 1: ...

Photovoltaik Anlage Nr. 2: ...

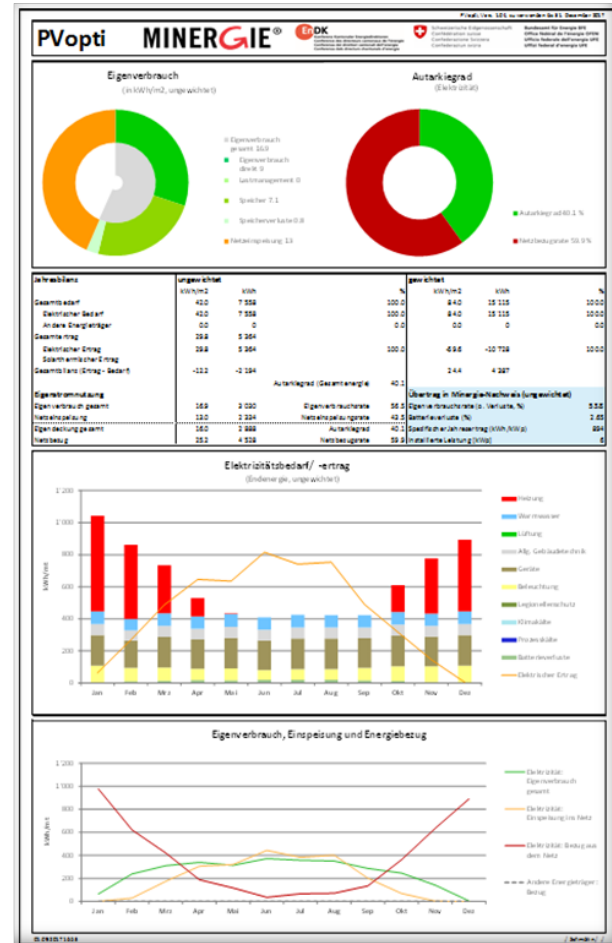
Photovoltaik Anlage Nr. 3: ...

Elektrischer Speicher: ...

Prozessliste: ...

Anleitung: ...

Ergebnisse: ...



(https://www.minergie.ch/media/pvopti_1.04_de.xlsx, d+f+i, en coming soon)

Conclusion

- Resolution has a high impact on the resulting autarky/self-consumption rate
- Self-consumption design tool “PVopti”
- Physical exchange of final energy is strongly effected by the PE-factors
 - Symmetrical weighting factors
 - $f_{PE, import} = f_{PE, export}$
 - SIA 380 demands asymmetrical PE-factors
 - $f_{PE, import} > f_{PE, export} \rightarrow PV \text{ size } \uparrow$
 - $f_{PE, import} < f_{PE, export} \rightarrow PV \text{ size } \downarrow$
- Symmetrical weighting factors seem to be the best choice

Project no. SI/501240-01
«Energetische Flexibilität von Gebäuden»
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IEA Annex 67 «Energy Flexible Buildings»
funded by
Swiss Federal Office of Energy SFOE



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE

Thank you for
your attention.