Self-consumption with solar power systems

The potential for photovoltaic energy storage systems in single- and two-family homes, in agriculture and in the food trade

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Background

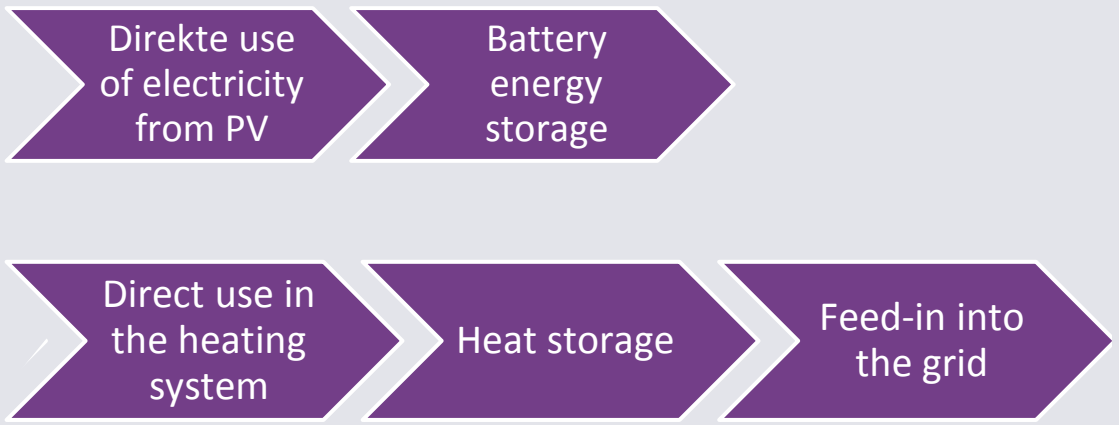
- More and more consumers are considering self-consumption with solar PV and possibly with battery energy storage. The economics of such installations depend on individual conditions.
- Agora Energiewende – in cooperation with the *Regulatory Assistance Project* – has commissioned Prognos AG to assess self-consumption cases with a high expected potential for self-consumption in
  - single- and two-family homes,
  - agriculture and food trade.
- Apartment buildings were not considered as most constellations of on-site solar power generation for apartment buildings *(“Mieterstrommodelle”)* are inconsistent with the definition of self-consumption used here.

Approach: An economic evaluation of 24 cases for the self-consumption potential until 2035

- **Building** variants:
  - New construction with heat pump
  - New construction without heat pump
  - Old, existing building without heat pump
- **Electricity demand** variants: 4000 and 7000 kWh per year
- **Storage** variants:
  - 5 kW_p PV without battery storage
  - 5 kW_p PV with 5 kWh battery storage
  - 5 kW_p PV with 8 kWh battery storage
  - 8 kW_p PV with 5 kWh battery storage

The economic evaluation at hourly resolution follows the opportunity cost of electricity and heat energy.

Sequential use of electricity from PV generation



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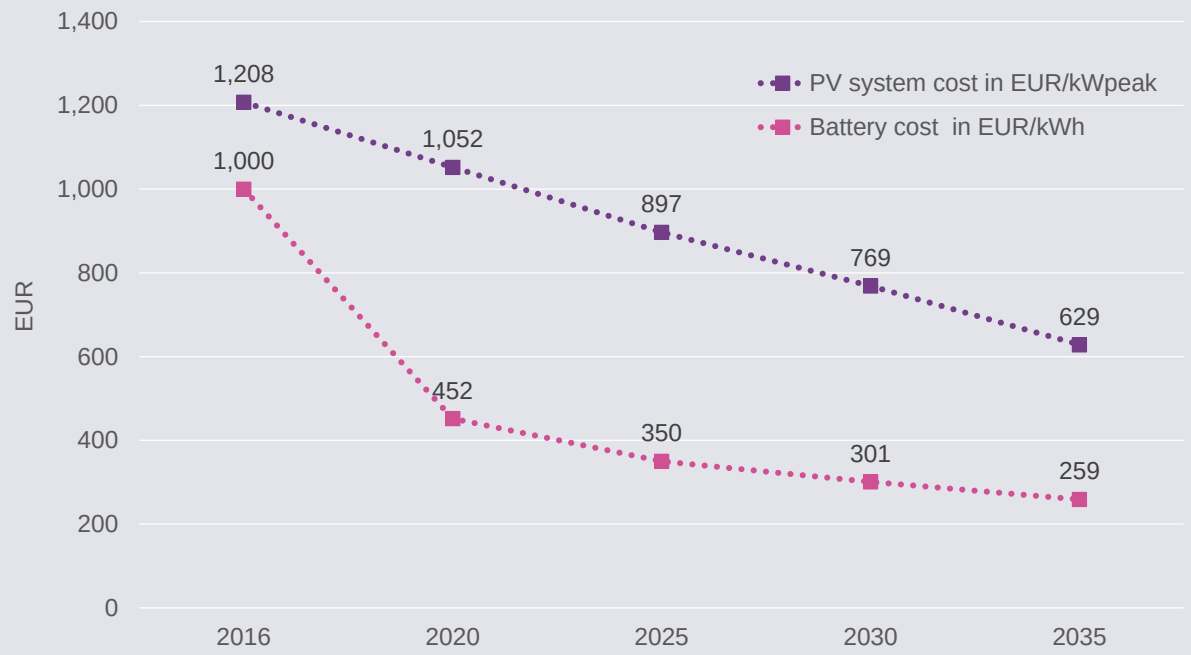
- The calculation is based on profiles for household demand and PV generation.
- Whenever there is surplus electricity that cannot be used at a given level, the surplus is used at the next level.

The economic dimensioning of a system for self-consumption depends on the assumed technology cost for PV and battery storage systems.

PV system cost in EUR_{2015}/kWh and battery cost in EUR_{2015}/kWh *



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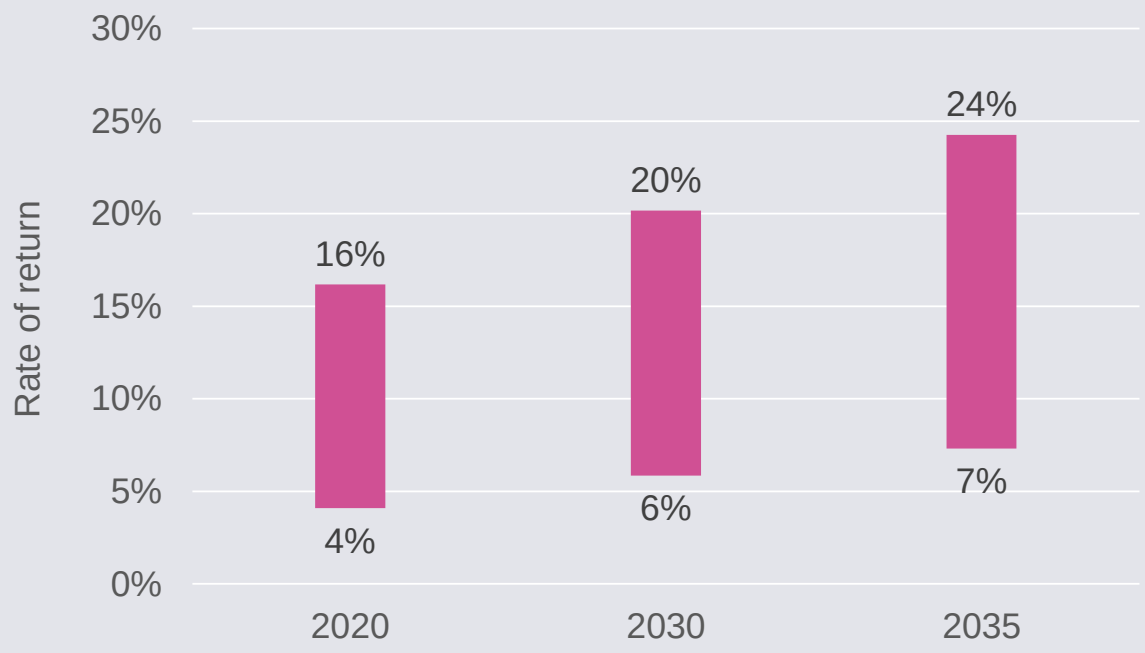
** including value added tax*

- → The **development of PV cost** follows a path described in “Current and future cost of PV” (Fh-ISE 2015)
- → The **development of storage cost** starts from current retail prices described in the “Speichermonitoring” (ISEA/RWTH Aachen 2016) and is inspired by further recent publications from ISEA/RWTH.

Self-consumption with PV and PV energy storage systems for single- and two-family homes will become economically feasible in the coming years.

Rate of return ranges for self-consumption



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- The **highest rates of return** can be expected for PV energy systems *without* storage.
- That is, even when factoring in large price drops for batteries, PV energy storage systems, do not make more economic sense.
- But battery storage would increase your **self-consumption ratio**. And it is not clear whether households will base their decisions solely on profitability.

Absolute project surpluses from PV systems with and without storage range from 6,000 to 22,000 EUR.

Absolute project surplus ranges in EUR

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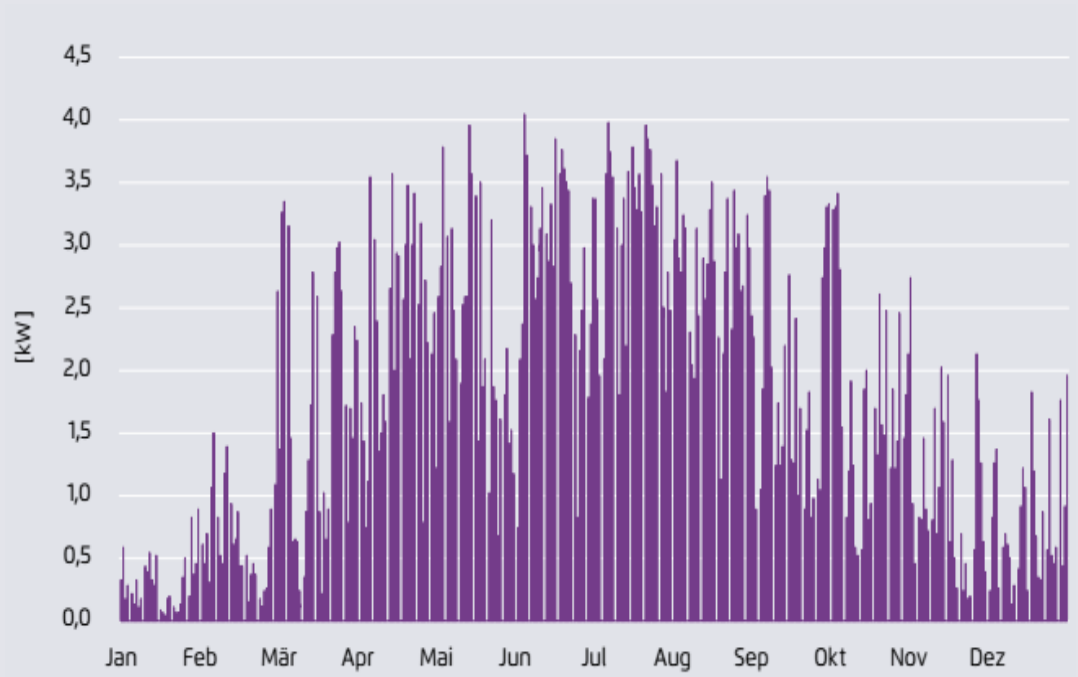
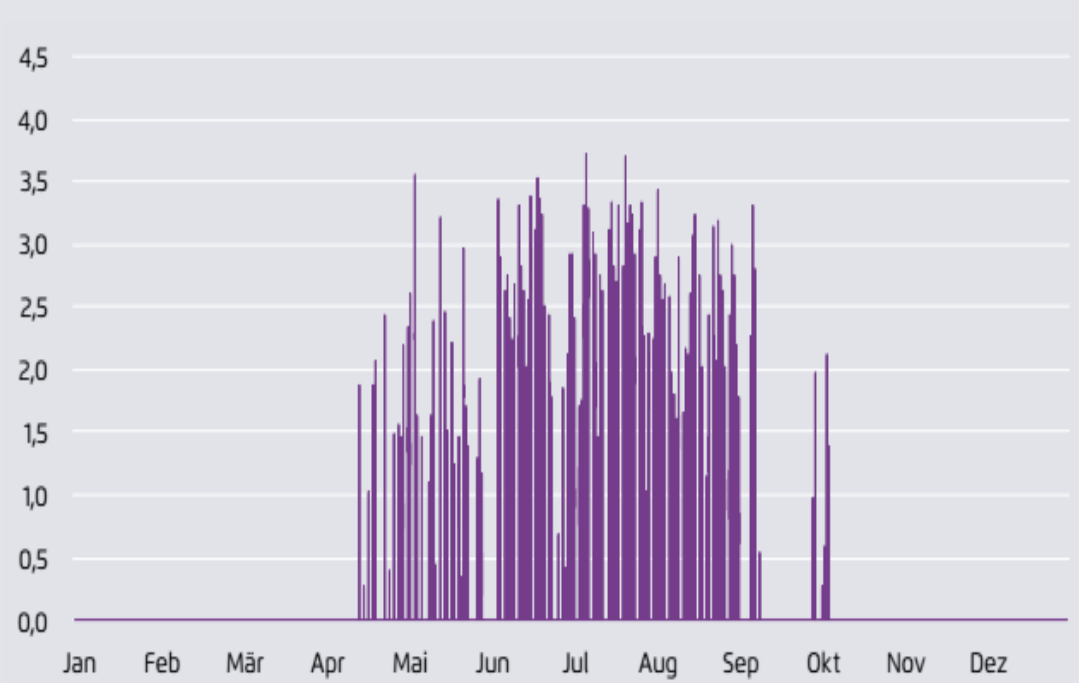
- The **greater absolute surplus** from PV energy storage relative to systems without storage might encourage homeowners to purchase battery-based systems.
- But homeowners' **desire to be independent** of utility companies may also play a role in their decisions and this cannot be monetized here.

The feed-in from PV into the grid *with* self-consumption yields a market value that will remain about 10 percentage points below the one from PV generation *without* self-consumption.*

Feed-in from PV system without storage in kW



Feed-in from PV system with battery storage and heat pump in kW



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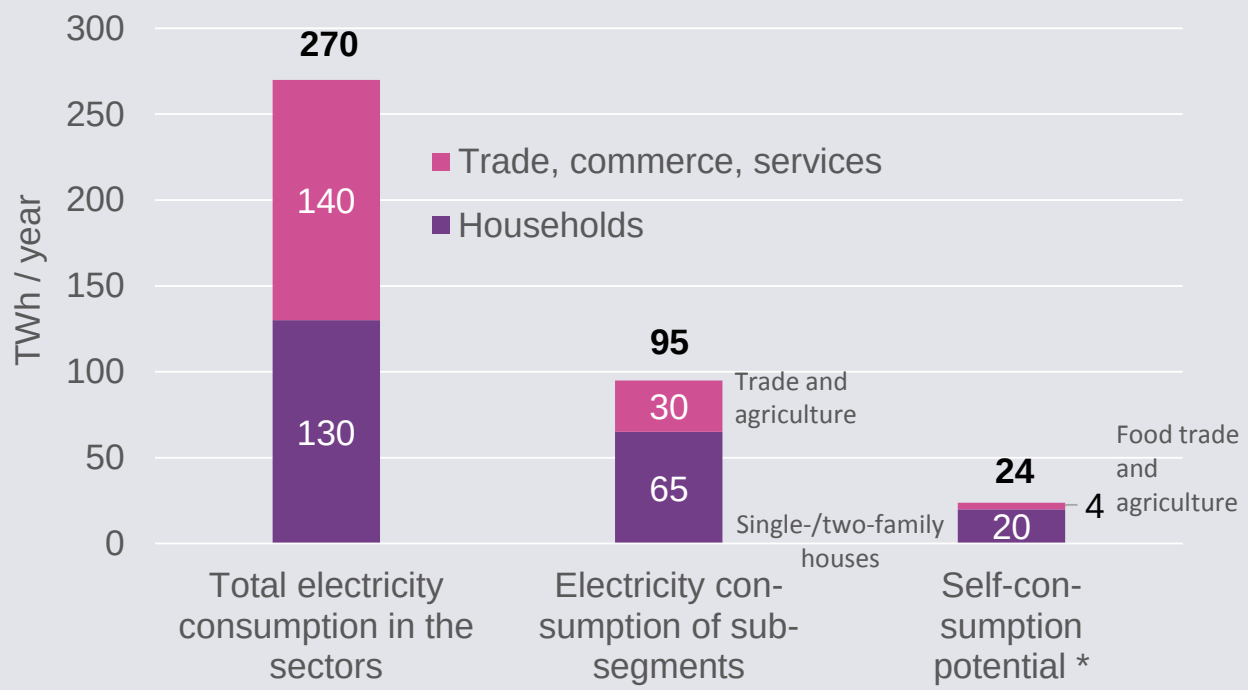
* Assuming a PV expansion to 60 to 80 GW by 2035.

Pros and cons of self-consumption

Pros	Cons
→ Increasing the **diversity of actors**, thereby limiting the market power of individual actors → Triggering an increase in **energy efficiency** and load management → Rising the **acceptance** of the energy transition → Enhancing **security of supply** by providing the possibility to supply oneself at least temporarily	→ Negative effect on **distribution of levies** (EEG levy, CHP levy etc) and network charges with increasing levels for those not engaging in self-consumption → **Higher total energy system cost**, as prosumers tend to optimize self-consumption, rather than following central scarcity signals in electricity markets. → Trend towards **underdimensioning of PV** systems relative to the available rooftop space since self-consumption tends to produce smaller systems.

The potentials for self-consumption with PV energy storage systems in single- and two-family homes, in agriculture and in the food trade are relatively low.

Electricity consumption in two sectors and self-consumption potential in TWh/year



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* with reduced energy use from the grid

- Self-consumption will reach **at most 44 TWh** until 2035.
- But this includes self-consumption for new heat applications so that the estimate of **reduced energy use from the grid is around 20 TWh** hours per year (single-/two family-homes 20 TWh; food trade and agriculture 4 TWh).
- This represents about 5 % of today‘s net electricity consumption.
- If the potential was achieved in the short term, Germany’s **EEG surcharge** would rise by around 0.5 cent per kilowatt hour.

Conclusions

- **From today's perspective, self-consumption poses no risk of quickly eroding the funding base** of Germany's EEG surcharge or network charges. The potentials determined in this study are relatively low, and, even if the price of photovoltaic energy storage systems continues its rapid fall, market growth will remain gradual.
- **Politicians must take swift action to provide a stable framework for self-consumption and on-site solar generation** on rented properties such as apartment buildings ("Mieterstrom") if solar power business models are to have a firm basis.
- **For this, the proper structuring of levies and fees – the EEG surcharge and network charges in particular – is crucial.** A forward-looking system of levies and fees would have to include owners of private property and their tenants in the overall costs of the system; and it would need to ensure that future changes in legislation do not retroactively devalue investments in on-site solar power.

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Questions or Comments? Feel free to contact me:

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