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Implementing Community-Scale PV Systems as a Sustainable and Governable Urban Common

Shared solar photovoltaic (PV) resources are projected to be an essential avenue to increase the adoption of renewable energy in urban areas. In particular, **community-scale PV** shows excellent potential in neighborhoods with mixed building typologies and in regions with multi-tenant buildings and rented property. However, rapid supply of renewable energy sources alone will not bring us to future energy goals such as the *2000-watt society* and the *Swiss Energy Strategy 2050*. In fact, an oversupply of electricity from distributed PV can have adverse side-effects such as grid instability and may not produce the initially intended benefits. Therefore, it is critical to use **on-site energy generation** from distributed renewable energy sources "intelligently".

I propose a **community-centered bottom-up approach** to help address this challenge. In this approach, electricity produced from community-scale PV systems is treated and managed as a **common pool resource (CPR)**.

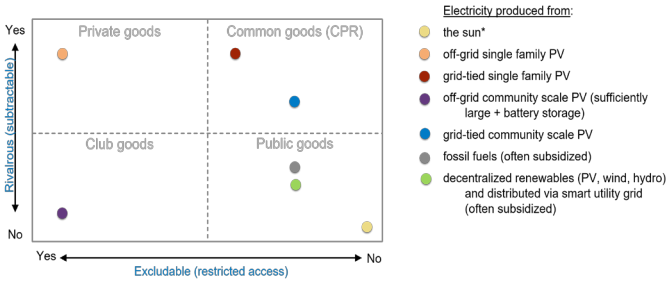
The current CPR theory shows great potential if developed for distributed energy systems, especially for community-scale PV. When considering community-scale PV systems as a CPR, sustained cooperation can be achieved through intelligent **consumption behavior** when shared between multiple users with appropriate measurement and accountability strategies. CPRs are characterized as being both scarce and renewable, used by relatively small groups of people, from those who live in close proximity, and who depend on the rates of return produced from the CPR.

A corresponding list of **CPR design principles** are directly extended to community-scale PV as the initial step in this research and includes a mixture of **technical and social based criteria.** The social criteria are tested through a series of interviews from ten case studies throughout Zürich Switzerland. The technical criteria are then tested through an energy performance analysis of the select case studies which includes instantaneous rates of **self-consumption, self-sufficiency** and **solar-fraction.**

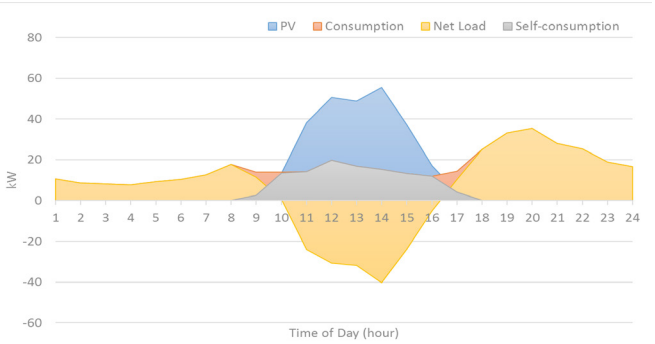
This work culminates with an **urban scalability study** to show the potential benefits if implemented at a broader scale. The essential inputs for this analysis are **user-behavior schedules for electric loads** from the select case studies.

The outcomes of this proposed PhD research are:

(i) Refined CPR theory and associated design principles specific for community-scale solar PV systems.



(ii) An associated energy analysis applied to select case studies in Zürich, Switzerland.



(iii) Scalability study of community-scale PV systems using urban energy models and density based grouping techniques.