ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
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Laboratory on Human-Environmet Relations in Urban Systems
Swiss Mobiliar Chair in urban ecology and sustainable living

Conceptualising Urban Energy Supply Systems as Socio-Ecological Technical Systems in Transition

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Motivation

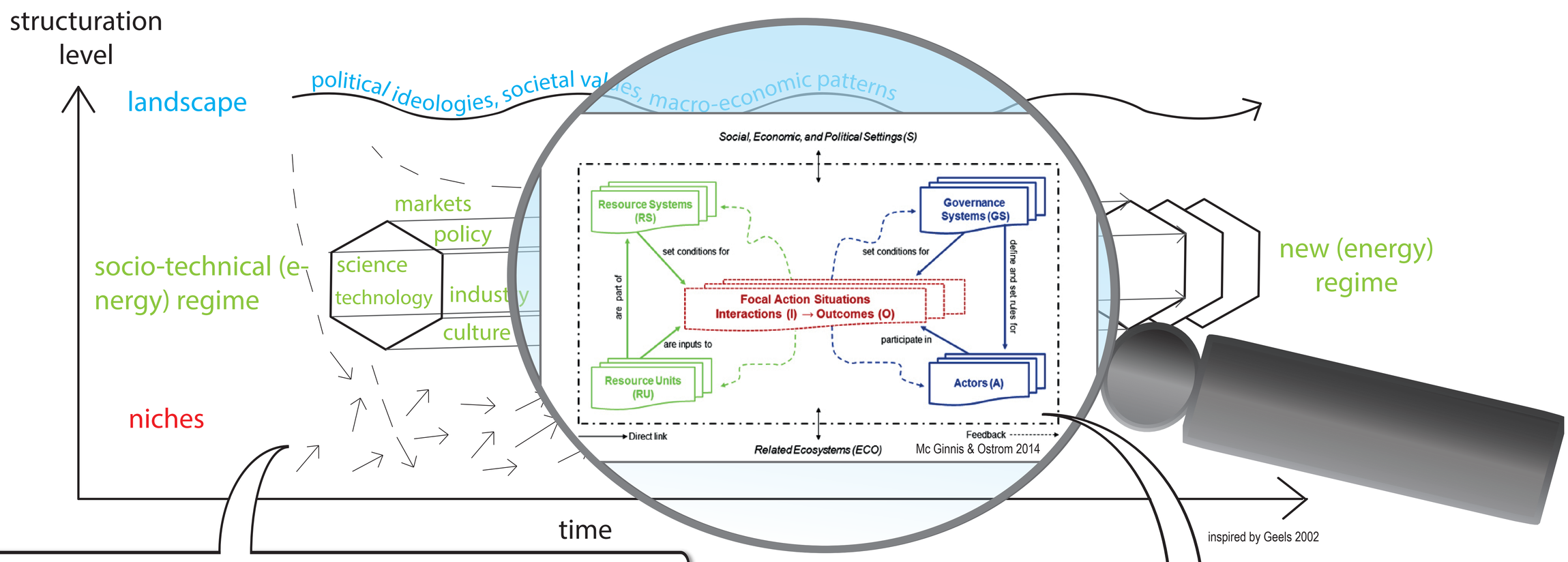
The analysis of energy system transitions is mainly affected by a **socio-technical system (STS) understanding**, focussing on the co-evolvement of societal and technical changes.

However, energy systems are highly dependent on and characterised by **ecological ressources**, which are not explicitely considered in the STS approaches.

Concept

Integration of the **multi-level-perspective (MLP)** (Geels 2002) as an analytical approach **on STS** and the **socio-ecological systems framework (SESF)** (Ostrom 2009).

Conceptualisation of energy systems as integrated **socio-ecological technical systems in transition** towards sustainability - considering technical & ecological aspects.



The Multi-Level Perspective (MLP)

The MLP analyses the drivers of societal transitions (e.g. the energy transition) on **three strucutration levels**:

- **niches**: low strucutration level, high innovative potential (photovoltaic cells)
- **regime**: structured systemic patterns (used technology, e.g. nuclear power)
- **landscape**: high strucuturation level (societal values in energy use)

Regimes change through pressure from the landscape (e.g. changing societal norm on nuclear power) & open a **window of opportunity** through which niches enter the regime.

The MLP is based on the concept of **actor-rules-system interaction** which **constitute a socio-technical system.**

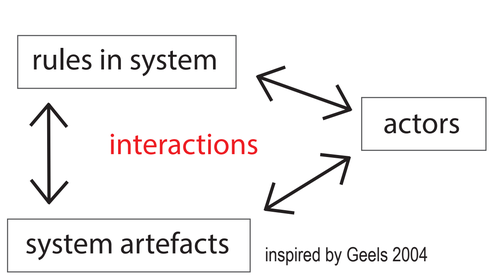
The Socio-ecological Systems Framework (SESF)

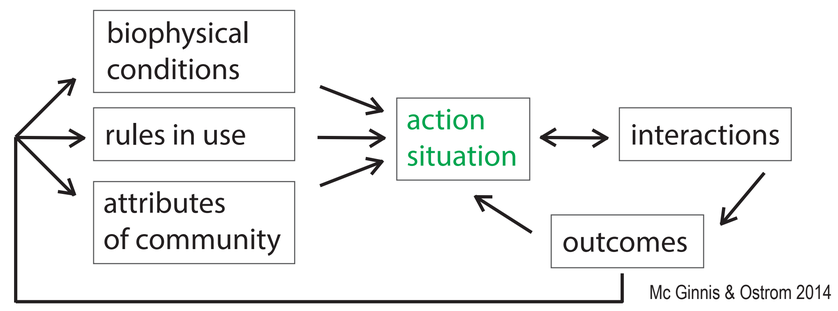
The SESF analyse the **human-environment interactions** in SES, i.e. the **governance structures** which allow for a **sustainable utilisation of ecological resources**.

The SESF considers **four subsystems**:
- the **resource units** (energy resources), the **resource system** (e.g. the grid)
- the **governance system** (e.g. resource property rights, policy) and the **actors.**

The four subsystems are linked through the **focal action situation** in which the actors use the resources, produce and sell energy etc.

The actor-rules-system interactions (in focal action situations) in STS and SES





Actor-rules-system (ARS) interaction constitute a STS: actors (e.g. energy companies) carry rules (e.g. policies) & influence them, actors & rules are influenced by artefacts (e.g. grids) etc.

Action situations are influenced by biophysical conditions (**system artefacts**), **rules** & attributes of the community (**actors**).The output of action situations feedbacks on all input factors (**interaction**).

Outcomes

- ★ The **STS & the SES perspective** share a **similar understanding on the consitution of a system** through the **interaction of system artefacts, rules & the actors (SRA).**
- ★ The MLP contributes the **technical system aspects, the dynamic transition perspective** and has frequently been **applied to energy systems** in transition.
- ★ The SESF delivers the **ecological system aspects, the preservation of system functionality** and an **inidcatorset for empirical analysis.**
- ★ The **integration of the MLP and the SESF** provides the **basis for the conceptualisation** of energy systems as **SETS** based on the **interaction of SRA.**
- ★ The conceptualisation allows for the **analysis** of the **role of actors** for systemic transitions **considering technical and ecological aspects.**

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