Self-Awareness in Self-Organising Institutions for Autonomic Power Systems Management

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The Problem: conflicting goals

**Government**
Implement carbon emission regulations
(i.e. by renewable energy sources)

**Consumers**
Power when needed and at an affordable cost
Saving of energy only done when convenient

**Generators / Distributors**
Satisfy instantaneous demand (i.e. by excess assets)
Obey regulatory targets by the government
Make profit
The Problem: conflicting goals

**macro-level vs. micro-level**

meeting global carbon emissions vs. comfort/utility of an individual

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**Example: energy consumption during peak-hours**

- peak demand to be met from conventional and renewable resources
- resources provided by consumers (i.e. ‘prosumers’)
- capacity of renewable resources unpredictable
- need: incentives for consumers to lower or ‘flatten’ their consumption

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Source - Western Power 2009
Proposed Solution

- view APS as a Common Pool Resource with exogenous and endogenous resource provision
- regularisation of the system through institutions as described by Elinor Ostrom
- self-governing agents ensure responsible handling of the resource
- institutional rules: conventionally agreed by affected agents, mutually understood, monitored and enforced, mutable and nested within higher-order rules
- contribution / demand / allocation / appropriation → account for individual needs
**Proposed approach**

*Sociologically-inspired computing*

- Norm-governed system specification for Multiagent Systems
  - Physical power, institutionalised power, and permission
  - Obligations, and other complex normative relations
  - Sanctions and penalties
  - Roles and actions (communication language)
- Protocol stack: object-/meta-/meta-meta-/etc. level protocols
- Specification space (DoFs)
- Axiomatisation in the Event Calculus
  - general purpose action language for representing events, and for reasoning about effects of events
identify and react on nature of population

manage times when there are not plenty of resources, avoid times of excess and identify times of crisis
### How can we ensure the agents act the way we would like them to? Appeal on or influence ...

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Private Self-Awareness</strong></td>
<td>representation of self-aspects, system’s macro-goal → agents’ private goal</td>
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<tr>
<td><strong>Persistent Self-Awareness</strong></td>
<td>reflection over time, learn from previous experience</td>
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<tr>
<td><strong>Predictive Self-Awareness</strong></td>
<td>simulate future environmental states, trade-off alternatives</td>
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<tr>
<td><strong>Meta Self-Awareness</strong></td>
<td>incentivise change of (private) goal, revise incentivising mechanisms</td>
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Thank you!