

Towards a Design Model for local Smart Grid systems: Connecting Ostrom's IAD-Framework to Institutional Legal Theory.

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Abstract

This paper proposes an analytical framework towards a design-model connecting Ostrom's IAD-Framework with Institutional Legal Theory (ILT), applicable to legal-settings for local Smart-Grid systems. This connection contributes to achieving the legal innovations necessary to the (fit of) public-private arrangements of such local systems.

A two-step analytical approach is used. The first step is to frame the institutional connection between IAD and ILT. Ostrom's 'rules-in-use' are connected to legal 'rules-in-form'. This institutional rule-perspective is then aligned with Action Situations at Ostrom's three analytical levels, considering that different legal institutions are relevant to the content of Action Situation rules.

In the second step, the institutional rule-perspective is placed in the specific legal setting of an example in a Dutch municipality. We demonstrate how the abstract IAD/ILT-frame provides a lens to identify legal aspects (e.g. gaps and conflicts) of establishing and maintaining particular local Smart-Grid systems – to provide insight for future design challenges.

WORK IN PROGRESS – DO NOT CITE WITHOUT PRIOR AUTHOR APPROVAL!

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1. Introduction

In the field of energy, changes in the institutional setting and in the technical domain are taking place simultaneously. The energy market was liberalized in the European Union in the 1990s, supporting renewable energy gained in political importance, decentralized (renewable) energy production is increasing and (local) renewable energy initiatives have been and are occurring across Europe. In the future, distributed generation of electricity from intermittent renewable energy sources (i.e. PV panels, wind, biomass, geothermal heat), and rising local demand (i.e. electric vehicles, heat pumps) are believed to present a challenge to the current electricity grid (Clement-Nyns, Haesen, & Driesen, 2010; Eising, van Onna, & Alkemade, 2014; Grond, Schepers, Veldman, Sloomweg, & Gibescu, 2011; Järventausta, Repo, Rautiainen, & Partanen, 2010; Nykamp, Bosman, Molderink, Hurink, & Smit, 2013). This problem is aggravated by the fact that the timing of local energy demand does not match the timing of local production of electricity by renewable resources. Solar PV panels, for instance, produce their maximum output at times when residential demand is (mostly) low. Instead of using more gas turbines to meet peak demand and to place additional cables and transformers to reinforce the distribution grid, smart grid technology can be used to balance the electricity load by increasing the flexibility of the electricity grid (Appelrath, Kagermann, & Mayer, 2012; Blumsack & Fernandez, 2012; Clement-Nyns et al., 2010; Muench, Thuss, & Guenther, 2014; PBL, 2009). A smart grid adds an ICT layer to the conventional electricity grid, which enables real-time remote control (e.g. of smart appliances and electric vehicles) and can balance supply of electricity from renewable sources with the demand for electricity. This balancing is especially useful for membership-based cooperatives, as the smart grid enables “(self-) provisioning to the members of the cooperative, instead of feeding the electricity into the grid [...]” (Naus, Spaargaren, van Vliet, & van der Horst, 2014, p. 441). Therefore, from a sustainability and self-reliance point of view, smart grid technology is urgently needed.

However, in an EU member state such as the Netherlands, currently only smart grid pilot projects exist – which benefit from legal exemptions – as to rely solely on the market is believed to offer insufficient incentives to implement smart grids (IEA, 2011). This not only calls for governmental support (IEA, 2011; ten Heuvelhof & Weijnen, 2013), but also for legal innovations. This paper focuses particularly on the latter issue, in respect of local level initiatives, where smart grid technology could and should be integrated into the current planning process on local energy infrastructures. Currently this planning process is faced with a changing institutional and technical environment, while smart grid technology is still perceived as complex and also subject to continued innovation. Due to this, stakeholders involved in local planning processes seem to lack reference and guidance for integrating this technology in decision-making on local construction and renovation of residential areas.

The paper is about providing a backbone to providing design guidelines for stakeholders involved in local planning towards establishing new and integrated smart grid projects. Its leading question is how to connect the empirical institutional analysis of such planning with the normative analysis of relevant legal aspects? We believe that a framework that

combines Elinor Ostrom's Institutional Analysis and Development (IAD) Framework with Institutional Legal Theory (ILT) (MacCormick and Weinberger 1986; Ruiters, 1993) can provide such a connection, upon which design guidelines may, at a later stage, be formulated. This IAD-ILT connection is useful as establishing and maintaining local smart grid systems calls for legal innovations in general public and private and public-private arrangements, while retaining a proper fit with existing general legal regimes for energy-provision. Conditions for successfully establishing and maintaining smart grids depend strongly upon empowering, permitting and constraining legal rules (such as in relevant to regulated energy markets, the functioning of public authorities and of private law relations). The abstract IAD-ILT frame provides a lens to identify legal aspects of establishing and maintaining particular local smart grid systems. The usefulness of the IAD-ILT Framework is exemplified in a case study of the municipality of Enschede, the Netherlands.

The paper is organized as follows. First the case study of the municipality of Enschede will be introduced (section 2.). Secondly, the IAD Framework is explained in relation to the case study (section 3.), which is followed by the third and most innovative part of the paper: the development of an analytical IAD/ILT framework (sections 4.). Fourthly (in section 5.), the IAD/ILT Framework is applied to the case of the municipality of Enschede. The paper ends with a brief conclusion (in section 6.) on the most relevant findings and related future design challenges for the establishment and maintenance of local smart grid systems.

2. An Exemplary Case

A case study was undertaken in order to explore and demonstrate how the IAD-ILT framework developed in this paper can be applied to the specific legal setting of a local smart grid project. The case is outlined in this section, to be revisited in section 5., after having discussed how connecting IAD and ILT can yield a heuristic tool for analytical description and prescriptive design (in sections 3 and 4).

2.1 - Exploratory Case Study

For this exploratory research, a single case study of a typical, exemplary case was chosen (Gerring, 2012). In the municipality of Enschede, the Netherlands, decision-making and planning currently take place about the implementation of smart grid technology in the neighborhood Bothoven-Noord. This planning process¹ can be considered a typical case when it comes to smart grid implementation outside of pilot projects in the Netherlands, and was therefore chosen as unit of analysis. The units of observation in this case study are the stakeholders involved in the local planning process, i.e. the project group. For the data collection, triangulation took place: one of the researchers took part in six meetings of the project group (moderate participant observation), semi-structured interviews were conducted with all six project group members and written documents like project plans were analyzed. The data collected was analyzed with the qualitative data analysis and research software Atlas.ti (version 7.5.4.).

¹ To be precise, the planning process refers to the decision-making of stakeholders about a change to the energy infrastructure

2.2 - Introducing the case: Enschede, Bothoven-Noord

The municipality of Enschede, located in the East of the Netherlands, has the ambitious goal to make the neighborhood Bothoven-Noord energy-neutral² by 2040. The municipality hereby considers the implementation of smart grid technology as a means to achieve this goal and hopes that this implementation as well will lead to other benefits like job creation. The initiative for a smart grid in Bothoven-Noord was taken by a project manager from the municipality of Enschede, together with an employee from housing corporation Domijn and an employee from housing corporation de Woonplaats. This group in turn invited three other stakeholders to join the project group: an employee from the distribution system operator (DSO) Enexis, an employee from the DSO Cogas, and a member of the building association Pioneering. Besides this main project group, several of the stakeholders meet in sub-groups to discuss other, related aspect of the smart grid Bothoven-Noord project, e.g. the municipality and Domijn meet with EnNatuurlijk to talk about the district heating grid. The social network analysis in Figure 1 shows how all stakeholders are connected, when it comes to (an aspect of the) Bothoven-Noord project³.

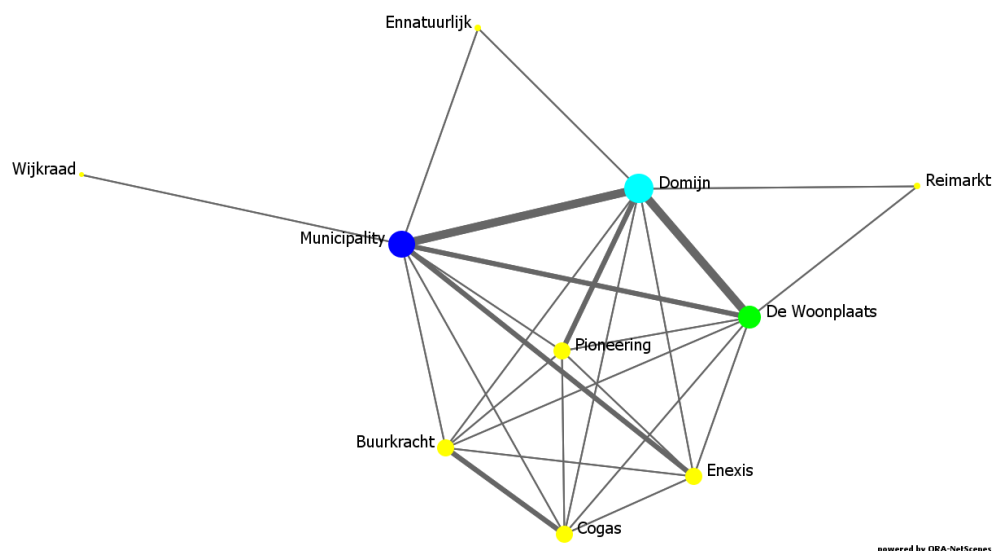


Figure 1: Social network analysis of stakeholders discussing the Bothoven-Noord project (as of May 2015)

The project group defined several project activities and is currently deciding on how to execute these activities. The planned activities are as follows:

- 1.) Distributed generation via solar PV panels and solar thermal collectors on the roof of the old factory building (Performance Factory) owned by Domijn;
- 2.) Installation of smart meters in all 2000 houses;

² According to the municipality this signifies not only that demand in Bothoven-Noord is met by renewable energy produced in the neighborhood, but also that renewable energy is supplied to other neighborhoods.

³ The width of the ties is proportional to the tie weight. The nodes of the stakeholders are sized by their degree centrality (sum of ties). The colors denote the betweenness centrality, whereby blue means the node is a higher gatekeeper, and yellow means the node is less of a gatekeeper.

- 3.) Development of a smart meter app (for electricity and heat);
- 4.) Initiatives for residents to save energy;
- 5.) Monitoring of the effect of the changes made.

Besides these five activities, the project group wants to make the district-heating grid that is located in Bothoven-Noord part of the smart grid, by supplying the heating grid from the solar thermal collectors of the Performance Factory. While Bothoven-Noord consists of several different areas with a total of 2000 houses – social housing as well as privately owned houses – the district heating grid that is (partially) located in Bothoven-Noord consists of 570 connections (Koop, van den Boogaard, Luning, & Thissen, 2011). All 300 social houses of de Woonplaats receive heat from this district-heating grid (until 2020), but have a gas connection for cooking as well. Besides this, several privately owned houses and an apartment building (located outside of Bothoven-Noord) are connected to the district-heating grid. This grid is fed by combined heat and power (CHP) from a district-heating power plant. The company EnNatuurlijk is responsible for the production, distribution and supply of heat to all connected households⁴.

The planning process about Bothoven-Noord is currently ongoing, and the project group will probably uncover by trial and error what is empirically feasible in terms of implementation and maintenance of a smart grid. This paper tries to facilitate this planning process, by developing building blocks for an optimal legal-design. This is believed to decrease complexity, facilitate the planning process, as well as make it more efficient.

3. The IAD-Framework & Smart Grid Development

As said, this paper proposes to address smart grid cases like the one in Bothoven by applying an analytical and design framework that connects Elinor Ostrom's Institutional Analysis and Development (IAD) Framework with elements of Institutional Legal Theory (ILT). In this section we will outline the main IAD-aspects relevant to our case.

3.1 - Issue-Typology: Smart Grid Action Arenas

Given that renewable energy available in a smart grid can be defined as a common pool resource (CPR), its establishment and maintenance requires collective action. Ostrom (2005, pp. 23-24) explains that CPRs are goods (or services) that “yield benefits where beneficiaries are hard to exclude [low excludability] but each person's use of a resource system subtracts units of that resource from a finite total amount available for harvesting [high subtractability]”. Wolsink (2012) argues that the energy produced inside a smart grid qualifies as a CPR, given that microgrids establish a common property that generates a common good.

To avoid free-riding as regards the CPR, agreements about implementation, as well as maintenance of smart grids are needed to properly govern the withdrawal of resource units.

⁴ EnNatuurlijk has a monopoly position.

Ostrom (2005, p. 220) states that “collective action is required to establish and enforce rules limiting the appropriation of [...] resource products”. For the analysis, as well as the development of such rules, the Institutional Analysis and Development Framework (see Figure 2⁵) is beneficial. Ostrom et al. (1994, p. 43) actually describe this framework as a “conceptual tool for inquiry about how rules affect a given situation”.

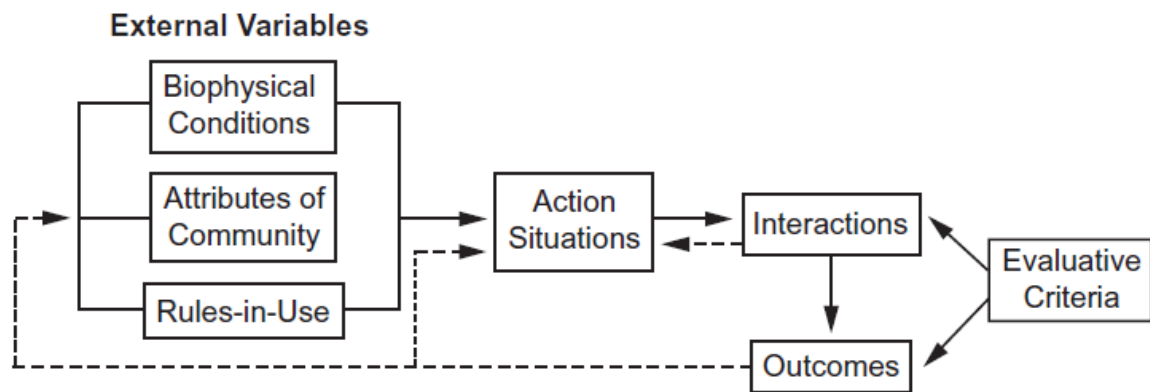


Figure 2: The Institutional Analysis and Development Framework

Source: (Ostrom, 2011)

Ostrom distinguishes between two types of rules: rules-in-use⁶ and rules-in-form. Rules-in-use are those rules to which participants would refer if they had to explain and justify their behavior to other participants in the Action Situation^{7,8} (Ostrom, 2011). In the case study of Bothoven-Noord, the Action Situation of interest is the local energy planning process (at the Collective Choice level, see below) in which decisions about the implementation of a neighborhood smart grid are taken by a project group. Seven different rules-in-use are part of the IAD Framework (see Figure 3)⁹. These rules-in-use do not necessary have to exist in any written document.

According to Ostrom (2007), rules-in-form are written statements, resulting from formal legal procedures and some rules-in-use might be contrary to these rules-in-form. In the IAD Framework only rules-in-use are – together with biophysical conditions and attributes of community – treated as exogenous variable¹⁰. In the next chapter, where the IAD and ILT Framework will be combined, the relation between rules-in-use and rules-in-form is discussed more extensively.

⁵ During the years, Ostrom modified the IAD Framework slightly. For older versions see Ostrom, Gardner, and Walker (1994) or Ostrom (2005)⁵. In the past, she spoke of an action arena, which consists of an Action Situation and participants. In this paper we work with Ostrom’s latest version (see Figure 2) in which Ostrom (2011) only identifies one single Action Situation (of which participants are a part). In this IAD Framework, several feedback loops exist. These feedback loops will not be elaborated here and during the analysis of a given Action Situation be treated as fixed.

⁶ Rules-in-use are also called working-rules by Ostrom.

⁷ An Action Situation is “an analytic concept that enables an analyst to isolate the immediate structure affecting a process of interest to the analyst for the purpose of explaining regularities in human actions and results, and potentially to reform them” (Ostrom, 2011, p. 11).

⁸ The rules-in-use determine the possible behavioral options of the stakeholders in the Action Situation, i.e. for all meetings about the Bothoven-Noord project, while the interaction describes the behavior of certain individuals during a specific meeting.

⁹ Boundary rules are by Ostrom also referred to as entry- and exit rules, and choice rules are also called authority rules in her work.

¹⁰ During the analysis of a local planning process, these exogenous variables are to be treated as fixed (Ostrom, 2005).

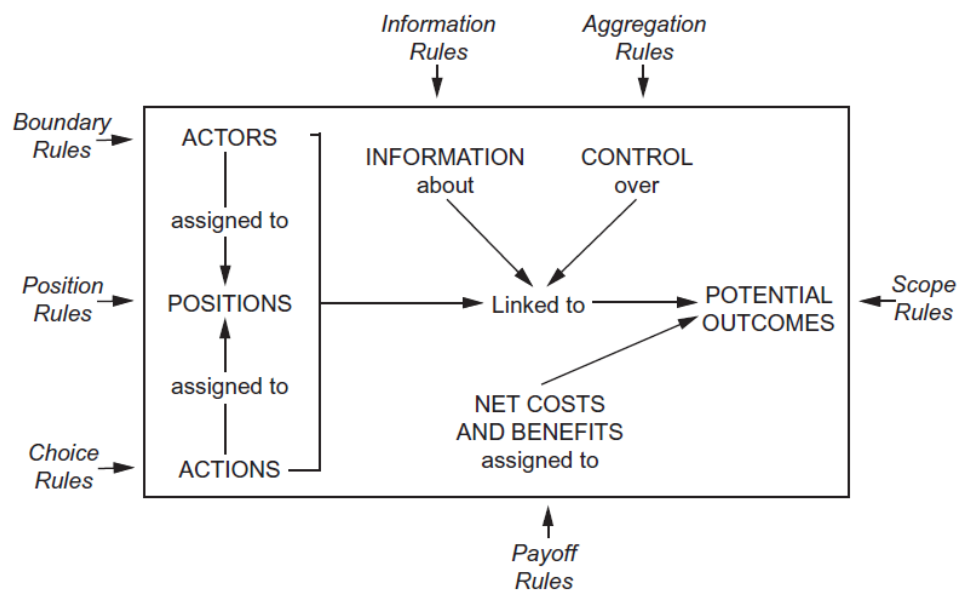


Figure 3: Effect of rules-in-use on the internal structure of the Action Situation

Source: (Ostrom, 2011)

The focus of the IAD Framework on rules makes it possible to determine how relationships between stakeholders are ordered, to trace changes in rule structures, as well as to analyze the general composition of institutional arrangements (Imperial, 1999). It hence allows to pinpoint which rules-in-use stand in the way of the development of certain new institutional smart grid arrangements that currently do not fit with the normative scope of possibilities. Based on this, researchers are enabled to make predictions and suggestions about the governance design of (different types of) smart grid Action Situations.

3.2 - Action Situations & Multiple Levels of Analysis

“Most of social reality is composed of multiple [Action Situations] linked sequentially or simultaneously” (Ostrom et al., 1994, p. 45). As regards the simultaneous linkage of Action Situations, a thematic delineation was chosen for this paper: the Action Situation in which the implementation of the smart grid is discussed (which includes the district-heating grid). We understand this sequence as the chronology of distinct (thematic) Action Situations which are mainly¹¹ located at different analytical levels.

Ostrom (2005, 2007) speaks of multiple levels/situations of analysis: Operational, Collective Choice, Constitutional and Metaconstitutional. The rules-in-use are determined at each prior level: Constitutional-choice rules are defined at the Metaconstitutional level, Collective Choice rules are determined at the Constitutional choice level (making ‘making grids’ possible) and operational choice rules derive from the options and limits set out at the Collective Choice level (‘making grid’). These operational rules in turn influence the Action

¹¹ Only when no external variables (especially rules-in-use) change, can Action Situations be linked sequentially at the same analytical level.

Situation at the Operational Situation level ('operating grid'). All these rules are hence crafted at a deeper level, and always exogenous to the higher level.

In the case study, the planning process of the project group (Action Situation) takes place at the Collective Choice Situation level and decisions (operational rules) are made at this level about the implementation and maintenance of Smart Grid technology in the neighborhood Bothoven-Noord, the Operational Situation level. The rules-in-use that affect the behavior of the stakeholders in the project group are defined at a deeper level, the (meta-) Constitutional choice level. Actors that are part of an Action Situation often have the ability to change those rules that affect their own (action) situation. In order to do so, actors have to move to a deeper *analytical* level, e.g. from the Operational Situation level to the Collective Choice Situation level where they can decide to adopt new operational rules that (re)define their room to maneuver at the Operational Situation level. The emphasis hereby lies on analytical level, as actors can undertake such a move verbally and mentally, while physically still sitting at the same table¹². As regards movements between these levels over time - in the Bothoven-Noord case between the Collective Choice level and the Operational level - such sequence continues until no more changes in the rules are demanded and a Smart Grid gets established, or until a steady state of maintenance of the Smart Grid is achieved.

To sum up, for the implementation of a Smart Grid, the essential question is which rules at the Collective Choice level facilitate the establishment and maintenance a specific type of Smart Grid at the Operational choice level.

4. Applying ILT to IAD for Smart Grids

In this section we explore how the legal aspects of smart grid Action Situations can be combined with the IAD-Framework. The exploration will begin with connecting Rules-in-Use to Rules-in-Form (i.e. legal rules) and will then move on to better understand types of legal rules and institutional regimes of legal rules as heuristic tools for descriptive analysis and prescriptive design of smart grid Action Situations.

4.1 - Connecting Rules-in-Use and Rules-in-Form

Institutional statements describe opportunities and constraints that create expectations about human behavior. According to Ostrom (Ostrom 2005, 137-139) there are three (main) types of such statements, each with its own syntax (Crawford & Ostrom 1995, 581-583):

- *Strategies* are about 'institutions-as-equilibria', and rationally arise from mutually understood actor preferences, that contain three key components: an 'Attribute' (i.e. the depiction of the characteristic that designates the particular participant to whom the

¹² Rules that are made by the same set of participants (at a deeper analytical level) to which they apply (at a higher analytical level), can be described as intrinsic. When participants at the deeper level are not the same as on the higher level – but a smaller, a larger or a wholly or partially different group (whereby one could not say that participants at the higher level are – intrinsically – self-organizing at the deeper level), these rules can be called 'extrinsic'.

statement is relevant) an 'a/m' (i.e. the depiction of the particular action and/or outcome in an Action Situation) and 'Conditions' (i.e. the depiction of circumstances – as when and where – under which an action or outcome should (not) be pursued), which together can be summarized as AIC;

- *Norms* are about 'institutions-as-norms', and follow from shared perceptions between participants about proper and improper behavior, and contain all AIC-components but also a 'Deontic'-component (as a direction of ought, such as 'shall' or 'may'), which together makes ADIC;
- *Rules* are about institutions-as-rules', and follow from shared understandings of regulated and sanctioned statements of ought, and contain all ADIC-components but also an 'Or else'-component (as a possibility of being sanctioned in case of non-adherence), which together makes 'ADICO'.

Norms and Strategies are attributes of the community (Ostrom 2005, 138). We will not address these, but note that at any time they may be 'upgraded' by participants in some Action Situation to (also) be accepted as rules-in-use (by adding an 'Or else' and, only as regards strategies, a Deontic, expressing a normative position).

For legal academics the 'ADICO-terminology' may be somewhat confusing as they are (more) accustomed to (in 'ADICO-sequence'): norm-subjects, norm-operators, norm-objects, norm-conditions, and norm-sanctions. To (probably) most members of this same group the 'Or else'/sanction component is not considered vital to the normative authority of a norm. We will use this component in the more general sense of expressing a bindingness that authorizes (social) criticism upon infringement and immunizes adherence from (such) critique.

4.1.1 Normative Institutions

We already explained that there are two types of rules: rules-in-form and rules-in-use. Rules-in-form are defined by Ostrom in a, understandably, rather formal way, as rules that are known (upon being documented) and that result from applying some legal procedure (Ostrom 2005, 138). Rules-in-use are defined in more substantive terms, as rules applied in a social practice of collective action and used to justify behavior.

Rules-in-form can relate to Rules-in-use in (at least) two ways:

- in terms of an empirico-causal relationship, by which existence of an instance of the one rule-type causes introduction, alteration or termination of a rule of the other type – as by presenting an incentive or justification (e.g. good social practice is put into law, bad social practice is abolished because it infringes upon a rule-in-form).
- in terms of a normative relationship, whereby (patterns of) social practice that display rules-in-use are found to be adhering to or infringing upon rules-in-form, which, in legal terms, would qualify these practices as lawful or unlawful.

Henceforth, rules-in-form are discussed as legal rules. This decision follows from our objective of determining what legal planning aspects are relevant to collective action efforts to establish smart grids. Two clarifications are in order:

- possible other subtypes of rules-in-form, such as policies, are ignored (unless explicitly

referred to).

- unwritten law is included; that is to say: valid legal norms established without following a legal procedure and/or without a written form, such as customary law and oral contracts.

From this broad characterization of types of rules it follows that legal rules-in-form are understood as prescriptive institutional statements/facts about a normative state of affairs, and rules-in-use as descriptive institutional statements/facts about an empirically observable state of affairs. Both rule-types cannot be reduced to one another (Ruiter 1994, 100; Ruiter 1997, 361-3), because:

- rules-in-use represent *ex post* (to some social practice) descriptions, with predictions about future practice, falsifiable by empirical observation (i.e. a ‘word-to-world direction of fit’).
- legal rules-in-form represent *ex ante* (to some social practice) prescriptions, validated by the existence of a legal system (i.e. a legal validity generating framework that is socially accepted), which are not falsifiable upon empirical observation (i.e. presenting a ‘world-to-word direction of fit’).

The above is summarized in the following table (no 1).

Table 1. Connecting rules-in-form to rules-in-use		
Rule-in-form - result of legal procedure - written form	→	Operating in an Action Situation:
Rules with normative validity following a legal system		- as causal response (process) - as normative order (relation)
	→	Rule-in-use known to participants - affecting participants’ behavior - Empirically observable rules following interaction in practice

4.1.2 Analyzing Normative Correspondence

Our first challenge is to determine the normative correspondence in context of Action Situations, given that rules-in-use structure Action Situations (see figure 3 above) and may, aside from perhaps causally resulting from legal rules, be lawful or unlawful. We assume here that in establishing and in operating smart grids participants will want to act lawfully (as regards legal norms and legally effective as regards available legal instruments – more about which later at 4.2.1) and not risk sanctions (and failure). In other words, we look for the match between rules-in-use that establish Action Situations as a ‘social space’ (Ostrom 2005, 14) and the ‘legal space’ (Lindahl, 1972) available for interactions within that Action Situation.

Normative correspondence can be studied by first defining a particular AIC (i.e. a conjunction of a norm-subject, a norm-object and norm-conditions – not as ‘strategy’, but as basic action-perspective to a rule), that exists or may exist within an existing or possible Action Situation, for example: users of a smart grid, not charging car batteries, between 6 and 9 AM. Next, the Action Situation may be studied for existing legal rules and rules-in-use regarding this particular AIC, and upon identifying a corresponding pair (both addressing the same AIC), both rule-types can be compared to see if their Deontic/norm-operator matches. (The same can be done as regards their Or else/norm-sanction, but we leave this aside

here.) This approach in search for corresponding rules and matching Deontic/operator yields the following possible general outcomes:

1.) *multilateral absence*, when none of either types of rules addresses the predefined AIC. This may point at the Action Situation being merely incidental and novel, so no legal rules are as yet prescribed nor have rules been formed by practice (e.g. dealing with a disaster of a new kind) or even virtual, as one that may yet come about (e.g. considering a possible future Action Situation with artificially intelligent robots).

2.) *unilateral absence/occurrence*, when there is either an applicable legal rule or a rule-in-use, but not a corresponding rule(-in use or legal rule). A situation of this type calls for reflection on the meaning of absence of rules. Absence of rules-in-use is understood to mean a lack of constraints (which creates a 'freedom from'/liberty) and a lack of opportunities (which possibly impedes 'freedom to'/ability). Again, this may result from no practice having developed (in the analyzed Action Situation) for the particular AIC. Absence of legal rules is taken to present a situation of 'weak permission', as a matter of participants not being under any obligation and that being 'free' to take any action they desire and, simultaneously, to refrain from such action. (Ostrom, 2010; Von Wright 1963, 85-). Thus we can conclude for the two possible situations of unilateral absence/occurrence that:

- if there are only rules-in-use, then the normative state of affairs is that social interactions are weakly permitted as there are no legal constraints (actions *sine lege*) but neither is there legal support for any kind of action.
- if there are only legal rules, then the normative state of affairs differs dependent on the relevant Deontic/operator – if this entails obligations, such as a command to perform certain action, then absence of such practice is unlawful. If the Deontic/operator is permissive this allows for lawful AIC-performance.

3.) *bilateral occurrence* also leads us to distinguish two situations

- when both rules have the same Deontic/operator, then a lawful state of correspondence exists.
- when corresponding rules have a different Deontic/operator then there may be conflicts that amount to unlawful practices. Relations between different Deontics/operators become clear if we look at the possible 'normative positions'.

In doing so, it becomes clear that in legal theory four normative positions are distinguished: prohibition, command, permission, dispensation. One more position than listed by Ostrom, as she does not explicate that permission can refer to an action (doing) and to refraining from an action (not doing). A distinction (in four) helps in:

- understanding opposite normative positions: prohibition and command are contrary norms; prohibition and permission are contradictory norms, as are command and dispensation; prohibition and command are subaltern norms, and so are prohibition and dispensation; permission and dispensation are subcontrary norms. In the addendum we have an overview of how these logical relations work out in case of corresponding legal rules and rules-in-use, with different Deontics/operators, which leads to 12 variations, 6 of which present a lawful state of affairs and 6 of which are unlawful.

- Understanding normative opposites can be translated into basic legal relations that follow from obligations and permissions (each of different types) and have been labeled by Hohfeld (Hohfeld 1964) as 1st order rights relations (i.e. ‘duty – claim’ and ‘privilege – no-claim’), which, according to Lindahl (Lindahl 1972), determine the legal liberty space available for actions between a right-holder (i.e. ‘bearer permissive’) and a counterparty (i.e. ‘counterparty-obligatory’). The below table summarizes these relations and (relative) liberties.

The below table (no. 2) also shows a fifth normative position, which we already discussed, that of absence of a legal norm, not constituting a legal relation upon legal rights or obligations, but a weak permission as both permission and dispensation by mere absence of legal obligations.

Table 2. Elaborated Square of Normative Positions: settings of liberty space			
Actor perspective (X ⁽ⁿ⁾ or Y ⁽ⁿ⁾) ↓	Relational perspective →	Counterparty obligative - a.(i.) or a.(ii.)	Bearer Permissive (b.(i.) or b.(ii.) -
Right-holder (X ⁽ⁿ⁾)		CLAIM (‘X ⁽ⁿ⁾ ’s right to have an act of type A (not) done)	PRIVILEGE (‘X ⁽ⁿ⁾ ’ may (refrain from) perform(ing) act-type A’)
Counterparty (Y ⁽ⁿ⁾)		(‘Y ⁽ⁿ⁾ ’s obligation to (not) perform an act of act-type A’) DUTY	(‘Y ⁽ⁿ⁾ ’s lack of a right/claim to have A (not) perform an act of act-type A’) NO CLAIM
Absent norm →		No legal relation: Permission & Dispensation (‘may do & not do’) as mere ‘freedom’	

In summary, there are four main normative states of affairs as regards correspondence between legal rules and rules-in-use pertaining to the same AIC relevant to one particular Action Situation. For each state of affairs we can, on the basis of afore findings determine lawfulness. Only for no. 2 and 4 states of affairs lawfulness is given; in states no. 1 and 3 a more precise analysis is required with different possible outcomes. In performing our analysis (see table no. 3) we separate between the causal and normative interpretation of this relation, focusing on the latter, and we distinguish between five instead of only three normative positions (by also including dispensation and weak permission). These outcomes we have summarized in the following table (no 1).

Table 3. Normative correspondence between (and matching of) legal rules and rules-in-use		
legal rule (=rule-in-form)	(1) legal rule without matching rule-in-use ‘sine praxis’	rule-in-use (existing in practice)
	(2) legal rule =consistent= rules-in-use ‘lawful praxis!’	
	(3) legal rule >inconsistent< rules-in-use ‘unlawful praxis?’	
	(4) rule-in-use without matching legal rule ‘praxis sine lege’	

4.2. Institutional Change and Rules-of-Power: the Missing Link

Thus far we considered rules as (not) being given for a particular Action Situation. Clearly though, rules that structure Action Situations can change and participants to Action Situations may indeed want to change rules of their Action Situation, or indeed of some

other Action Situation – as in establishing rules for establishing or operating a smart grid.

4.2.1 Secondary Rules-of-Change

To introduce, alter or terminate rules is not a matter of applying legal rules/rules-in-use about prohibitions, commands, permissions or dispensations regarding the performance of factual acts. Such rules, as discussed in the above, are ‘rules of conduct’, which determine ‘legal liberty space’, and even if these are indeed performed at a deeper level of social interaction (levels discussed in the above), such actions do not lead to a change in legal rules. What is needed are ‘rules of power’, which constitute a ‘legal ability space’ (Lindahl 1972).

Ruiter has explained that legal systems generate validity through combination of ‘rule-establishing decisions’ and ‘decision-constituting-rules’ (Ruiter 1994, 106). The legal system holds the latter type of rules, as conferring power to certain norm-subjects, to enable them, as norm-authorities, to perform valid ‘rule-establishing decisions’, in the form of legal acts which come with intended legal effects that amount to a change in rules of conduct, and possibly also in other rules of power.

It was Herbert Hart (Hart 1961, 91-99) who made the distinction between primary rules (of factual conduct) and secondary rules (about rules). Of the latter there are three kinds: rules of recognition (What upholds the legal system and when is a rule legally valid?), rules of power (Who is authorized to perform which legal acts?), and rules of adjudication (Who decides what the law says and how it should be applied?). Although, unfortunately, the distinction was not picked up by Ostrom for application in the IAD Framework, we believe it can be integrated nonetheless; upon the distinction made in the above between legal rules and rules-in-use. A key point in integrating especially rules of power (Ruiter 1994, 112-3) is to understand that, whilst it also has an ADICO-structure, it has its own particular Deontic, ‘can’, to denote legal ability of performing legal acts.

4.2.2 Legal Space: Liberty & Ability

From this difference in Deontic follow different normative positions, and from these follow different Hohfeld relations (i.e. power – liability; immunity – no-power) and subsequently a distinct (relative) legal space, which Lindahl names ‘legal ability space’, available for the performance of legal acts between participants in Action Situations: of a right holder (i.e. bearer-ability) and a counterparty (i.e. counterparty disability). The below table (no. 4.) summarizes these relations and (relative) abilities.

Table 4. Elaborated Square of Normative Positions: settings of liberty space			
Actor perspective ($X^{(n)}$ or $Y^{(n)}$) ↓	Relational perspective →	Bearer-ability (- a.)	Counterparty-disability (b. -)
Right-holder ($X^{(n)}$)		POWER (‘ $X^{(n)}$ ’s power versus $Y^{(n)}$ to bring about legal position P)	IMMUNITY (‘ $X^{(n)}$ ’s immunity versus $Y^{(n)}$ as regards $Y^{(n)}$ bringing about legal position P)
Counterparty ($Y^{(n)}$)		(‘ $Y^{(n)}$ ’s liability versus $X^{(n)}$ bringing about legal position P)	(‘ $Y^{(n)}$ ’s disability versus $X^{(n)}$ to bring about legal position P)

	LIABILITY	NO-POWER
Note that absence of (a rule of) power (= absence of a legal 'can') constitutes a no-power ⇔ immunity relationship		

From this it should be clear that legal powers are not about cancelling a (contradictory) prohibition, but about capacitating (opposite to incapacity – prohibitions only come-in when there is a capacity). This is why the Deontic/operator reads 'can' and not 'may'.

The relevance of this analysis to the legal aspects of the IAD-framework is:

- that aside from lawfulness as adherence/following rules of conduct, there is lawfulness as validly performing legal acts and thus changing rules and existing legal relations, rights and obligations, liberties and abilities.
- that, as will be demonstrated, legal powers put a new perspective on understanding relations between institutional levels, because interactions on deeper levels can only change legal rules for higher levels if there are rules of power available upon these deeper levels.
- that legal powers are crucial for legal design, to outline introduction of new, and alteration and termination of existing legal rules pertaining to Action Situations

4.2.3 Playing-the-Game & Rules-of-the-Game: Powers & Institutional Levels

The available liberty and ability space together form the legal space available for 'playing the game' according to prescribed legal 'rules of the game', which latter rules may be changed by legal rule-making, -change and –termination upon rules of power embedded in the legal system.

So what to think of the scenario, described by Ostrom, of participants changing their own practices by deciding to change their rules-in-use? The mere analytical separation between levels, by which the rule-change is seen as outcome of an Action Situation at a deeper level does, from a legal point of view, not suffice. The image of a deeper level is not problematic (although the notion of a higher level is more customary), but the essential point is that (wherever rule-change is taking place) the given deeper or higher level comes equipped with rules of power, granting the participants (at that level) the ability to make legal changes.

Assuming that this condition is fulfilled, different sets of participants may be involved in rule-making. Following the distinction between regulatory relations, sometimes regulators and regulatees are the same (i.e. 1st party regulation: regulator = regulatee), sometimes their positions are separate (i.e. 2nd,party regulation: regulator regulatee) and sometimes their positions are separate, while a third party is added to fulfill as specific regulatory task, such as a standardization, certification or enforcement agency – (i.e. 3rd party regulation: regulator – 3rd party – regulatee). Participants in a given Action Situation, may be placed in any position of any of these relations, as well as in hybrid forms, such as co-regulation (placed in between 1st and 2nd party regulation (Levi-Faur 2011, 7-9; Heldeweg 2013, 128-35)).

Furthermore, the ability to change rules may lead to introduction, change and termination of rules of conduct (across levels) as well as of rules of power. Ultimately rule change only works if rules of power (and thus rules of conduct) are supported by the rule of recognition, which upholds the legal system (as the validity generating framework) – that ultimately rests upon presumed social acceptance (by at least most people, most of the time) that is of a

non/proto-legal, empirically testable (and falsifiable) nature.

If we take these findings together, we can integrate rules of power/ability space, next to rules of conduct/liberty space into the image of levels of social interaction – as demonstrated by the next table (no. 5).

Table 5. Levels as Action Arenas where rule-establishing-decisions (legal acts) are taken upon decision-constituting-rules		
Level of Action Arena	Interaction	Rules structuring the AS (for Interaction)
Operational Situation (OS)	Performance of factual activities, e.g.: <ul style="list-style-type: none"> • establish smart grid • manage a neighborhood cooperative 	OS-RiUs following RoCs with ‘deeper origin’ about: <ul style="list-style-type: none"> • prohibitions, commands, permissions & dispensations
↑ CCS-made OS-RoCs ↑		
Collective Choice Situation (CCS)	Introducing, altering, terminating (<i>only</i>) RoCs, e.g.: <ul style="list-style-type: none"> • contracting between OS-participants (1st party regulation) • permitting/subsidizing by non-OS-participants (2nd party) • co-regulating formal or substantive standards for OS interactions 	CCS-RiUs following CS-made RoPs (with positions and conditions) about: <ul style="list-style-type: none"> • how to make/change RoCs at CCS, for OS-RiUs
↑ CS-made CCS-RoPs and OS-RoCs ↑		
Constitutional Situations (CS)	Making, altering, terminating RiF, e.g.: <ul style="list-style-type: none"> • (RoP for CCS) Civil Law Code; Electricity act • (RoC for OS) Competition Law Act; meta-regulation for products/services 	CS-RiUs following MCS-made RoPs (with positions and conditions) about: <ul style="list-style-type: none"> - how to make/change RoPs at CS, for RiUs at CCS - how to make/change RoCs as CS, for RiUs at OS
↑ MS-made CS-RoPs and OS-RoCs ↑		
Metaconstitutional Situations (MS)	Making, altering, terminating RiF, e.g. <ul style="list-style-type: none"> • constitutions & bills of rights • conventions, custom 	MS-RiU following RoR when to make RiF to change AS-CS, follow BW and/or AoC
AS=Action Situation; RiU=rules-in-use; RoC=rules-of-conduct; RoP=rules-of-power; RiF=rules-in-form (RoC and/or RoP); RoR=Rule of Recognition		

Three remarks are in place as regards the nature of this scheme of levels.

Firstly, the scheme suggests an (upside down) hierarchy. Actions in the upper levels are impossible without the lower levels being in place. While this may be said to hold true for the relationship between (different) rules of power and (different) rules of conduct, this is not to say that it is true between participants at different levels, given the possibility of 1st party regulation.

Secondly, the scheme provides a framework for social analysis. Ostrom herself has compared it to (what she names a broadly) similar scheme of Oliver Williamson (Ostrom 2015, 291 ft 7; Williamson 2000, 596-600). Whilst Williamson’s scheme is also about (levels of) social analysis, his approach is more absolute, as he uses scales to indicate the time-span of establishing institutional settings at various levels (L): L1 (Embeddedness: 100-1000 years), L2 Institutional Environments: 10-100 years), L3 (Governance Structures: 1-10 years), L4 (resource allocation: 0-1 year). It seems awkward to depict Ostrom’s example of ((Ostrom 2005, 18-9) workers changing their modus operandi by switching from L4 to L3, whilst the change is made ‘as they speak’. In the above scheme it is logical to not place the exercise of powers at the Operational Situations level, as suggests the possibility of a change of rules at that level – without moving to the Collective Choice level. In Williamson’s scheme

there is room for exercising powers at L4, albeit only for ‘executed legal acts’ (immediately followed by factual implementation and without intent of changing institutional settings: e.g. buying a cup of coffee, being fined and paying), while executory legal acts (where acting upon newly established, changed or terminated relations/rights follows later).

Thirdly, taking together the first remark about a hierarchy of norms (not necessarily of persons) and the second remark about Williamson’s approach leads to use Williamson’s notion of *alignment* between levels established legal acts, but with a normative twist. Between levels (bottom-up in Ostrom, top-down in Williamson; ‘O’ and ‘W’) there needs to be *normative alignment* in that rules at the ‘O-upper’/‘W-lower’ levels need to be consistent with ‘O-lower’/‘W-upper’ levels. If not, then rules of conduct may be unlawful for a conflict with O-deeper/W-higher rules of conduct, while rules of conduct and/or of power at ‘O-lower’/‘W-upper’ levels may prove to be invalid and hence not binding/applicable at their ‘O-higher’/‘W-lower’ level – so ultimately the legal space at Operational Situations level/L4 the legal would be built on quicksand.

4.3 - Legal Institutions as Heuristic Tool

Beyond understanding the typology of rules (i.e. legal rules-in-form v. rules-in-use; rules of conduct v. rules of power) and relations between types, also across levels, there lies the issue of the complexity of social practices, with each pattern of behavior connecting various participants, concerning various interactions, relating to seven types of rules-in-use. After all, our focus lies with collective social action within Action Situations of which the structure is determined by these rules-in-use concerning participants interacting and interaction producing outcomes.

How does one determine – other than through traditional piecemeal, case-based and problem-driven, legal analysis – what makes for a legal regime fitting rules-in-use that structure an Action Situation to set-up or operate a smart grid?

We believe the best option is to put the (desired or existing) patterns of social practice first and study types of legal regimes that (aim to) connect more broadly to such practices, similar to how the seven IAD rules-in-use are ideally configured coherently (Ostrom 2005, 191), to constitute prescribed practices suitable for application in practice: legal institutions. As such, the regimes of legal institutions project a prescriptive pattern of behavior, that configure relevant legal rules of conduct and of power, and that is realizable in interactions that take place in the social space of the relevant Action Situation.

4.3.1 Legal Institutions: A Very Short Introduction

So, our point of departure is a socio-technical functionality (*in casu*: smart grids), which is empirically observable (both in technical and social aspects), and which we match with a normative conceptualization through one or more types of institutional legal regimes. Well-known examples are: contracts, marriage, ownership, permits, legal persons/organizations, and states. Legal Institutions are about regime types that cluster single legal rules, firstly by *recognition*, in a word-to-world direction of fit, of a legal pattern that is descriptive of an existing or designed/possible pattern of social practice, and next by *realization*, in a world-

to-word direction of fit, of the legal concept of social behavior being put into practice according to the legal rules of that concept (Ruiter 1994, 361-363). This conjunction of recognition and realization builds upon a conjunction of four types of rules (MacCormick and Weinberger 1986, 52-3; Ruiter 1997, 359-61):

- *constitutive* rules, which provide basic recognition of an institutional concept (such as marriage) within the legal order.
- *institative* rules, which prescribe how an instance of such an institutional legal concept can be brought about (by factual and/or legal acts – performing a wedding).
- *consequential* rules, which prescribe what rules are applicable upon instantiations (a token of legal institution: the available ability and/or liberty space (such as to the marriage of Bill and John).
- *terminative* rules, which describe how an instance of a legal institution can be ended (such as the divorce of the marriage between Olivia and Rachel).

The connection, through ‘recognition’ and ‘realization’, between Legal Institutions and Social Practice we have summarized in the below table (no. 6.)

Table 6. Fitting Legal Institutions to Social Practice		
Legal/normative institutional setting	Socio-technical functionality ← (Optimal) Fit? →	social/empirical institutional setting
Recognition/Design	Word-to-world direction of fit →	Pattern of social behavior
Pattern of prescribed behavior	← World-to-word direction of fit	Realization

From this we can look for legal institutions prescriptive of the social practice of establishing and/or operating a smart grid. If those practices would, as such, be recognized as a desirable pattern of social practice, then indeed a legal institution of a fitting regime-type could be constituted, to next be realized by repeated instantiations in cases of such social practices being pursued. Alternatively, establishing and operating smart grids may be understood as conjunctions of social practices for which legal institutions are recognized and realized, such as through ensembles of ownership, contracts and permits.

As legal institutions for smart grid seem not to exist *per se*, we look for the basic types of legal institutions that together form the legal ensemble relevant to our case.

Ruiter has done important work in systematically identifying abstract types of legal institutions (Ruiter 1993 and 2001), looking at single facts about individual entities in the sense of subjects or objects (of which only the former can perform acts), which have particular attributes, either as properties or as relations between them. On that basis he has developed a classification of “... seven fundamental categories of representations of particular phenomena” (Ruiter 1997, 364-). Their bare minimum has been summarized in the next table (no. 7).

Table 7. Seven categories of fundamental legal institutions		
Legal order Legal Institution Various types of regimes	Fit Recognition → ← Realization	Social practice Patterns of behavior Various types rules-in-use
Legal quality e.g. ‘minority age’	attribute of a person	Behavior according to some person’s attribute being the case. (e.g. not to be contracted with)
Legal status		Behavior according to some object’s

e.g. 'res nullius'	attribute of an object	attribute being the case. (e.g. free to appropriate)
Personal legal relation e.g. 'marriage'	Relation between persons (‘P2P’)	Behavior according to some person to person relation being the case. (e.g. treat as social unit)
Objective legal relation e.g. 'ownership'	Relation between person(s) and object(s) (‘P2O’)	Behavior according to some person to object relation being the case. (e.g. not take object away from owner)
Legal configuration e.g. 'easement'	Relation between objects (‘O2O’)	Behavior according to some relation between objects being the case. (e.g. respect a right of way)
Legal entity e.g. 'foundations'	Personification of relations	Behavior according to some form of legal organization being the case. (e.g. contracting with a firm)
Legal object e.g. 'tradable rights'	Objectification of relations	Behavior according to some possibility of legal transactions being the case. (e.g. legal transfer of CO ₂ rights)

The details of the named categories may be found, especially, in work done by Ruiters, and will not be discussed here (Ruiters 1993, 1997, 2001). The next step here is to relate types of the named legal institutions to Action Situations concerning smart grids, and, finally, to relate them to the seven IAD-categories of rules-in-use.

4.3.2 Legal Institutions @ Operational Situation Level

We now look for a match between these fundamental legal institutions to the context of an existing simple smart grid, which (by the help of smart metering) couples and coordinates use of electricity of several households (whether domestic or business/industrial), with or without its own electricity generation and or storage, but still with a (back-up) connection to the main grid. The Action Situation is that of the users and others relevant to the continued operations of the grid as participants. The main elements are named in the below table (no. 8).

Table 8. Seven categories of fundamental legal institutions & smart grids	
Legal order Legal Institution Various types of regimes	Possible prescription of social practice relating to smart grids
1. Legal quality <i>attribute of a person</i> e.g. 'adulthood/public authority'	Involved natural persons would need to be adults to be owners or contracting parties. When legal persons are involved (see 6.), then qualities of these (e.g. public authority, TSO) may have special legal meaning, but also qualities of persons within legal persons (mayor&aldermen, CEO's).
2. Legal status <i>attribute of an object</i> e.g. 'common pool'	A particular legal status of a smart grid could be that, within a legal order it is regarded as a particular type of common pool and that this would have legal consequences (e.g. a duty of care; restrictions of use).
3. Personal legal relation <i>Relation between persons</i> (‘P2P’) e.g. 'service contract', 'permits', 'subsidies' & 'taxes'	The aspects of smart grids in perhaps jointly producing energy, allocation energy between users and a main grid energy back-up will involve contracts between users, TSO, energy providers and perhaps housing corporations, ESCO's and the like. At the same time relations with public authorities may well be relevant, such as concerning permits, obligatory certificates, subsidies, taxes. These issues are typically unilateral (decided top-down by government). A possible exception could be a Public-Private Partnership arrangement concerning the establishment but perhaps also the operations and maintenance of the smart grid.
4. Objective legal relation <i>Relation between person(s) an object(s)</i>	Ownership of the grid installation, and of energy generated by or stored within the smart grid is a crucial issue. Important firstly because this is about a relation of a person and an object versus all other persons. Secondly, ownership involves first

(‘P2O’) e.g. ‘ownership’	order rights (of access, and of withdrawal/fruits), and second order rights (of management, of exclusion and of alienation) – all these matters need to be settled.
5. Legal configuration <i>Relation between objects</i> (‘O2O’) e.g. ‘easement’	The possibility of object to objects relations which remain despite a change in persons as respective owners or persons with user rights. Further study is required to see if relations between the technical facility of a smart grid and the households concerned could somehow relate to this effect.
And next, through operations of personification or reification performed upon no. 3-5 institutional legal relations,	
6. Legal entity <i>Personification of relations</i> e.g. ‘foundations’	Is the Action Situation that of one legal person, whereby the internal settings of that person determine the rules-in-use, or is or are legal persons involved as participants? Distinction between three basic types (across public and private domains): associations (personified alliances/membership, communities/citizenship), corporations (personified partnerships/shareholding) and foundations (personified funds/objective purpose). Cooperatives are examples of hybrids (between association and corporation). Smart grids could be managed by legal persons (e.g. cooperatives) but surely legal persons such as TSOs, energy providers and public bodies.
7. Legal object <i>Objectification of relations</i> e.g. ‘ownership transfer’ and ‘tradable rights’	The mere fact that ownership rights P2O include the right of alienation – see no. 4 – are testimony to the relevance of objectified relations being transferred, but likewise could public rights (such as possible permits, relevant to maintaining a smart grid).

We regard legal institutions no’s 1-5 as 1st order legal institutions, and no’s 6 and 7 as 2nd order institutions, seeing that they exist following operations (personification or objectification/reification) performed upon 1st order no’s 3-5.

Furthermore, again we see how rules of conduct and rules of power are jointly relevant; both in instantiation of a legal institution (often by use of legal powers, e.g. use of ownership, contractual or of regulatory power, sometimes by factual activity, e.g. ‘management of business’), and in consequential rules (the legal space once a legal institution is in place may involve both ability and liberty).

A remaining question is whether a legal institutions analysis of smart grids is limited to determining possible ensembles of 1st and 2nd order legal institutions or if there are relevant higher order legal institutions, perhaps specified to a type of collective action of which smart grids (in operation or as project to be established) is a subtype/token. Ruiters describes 2nd order legal institutions as “... valid presentations of a property of valid presentations.”, and speaks of the possibility, especially in “modern legal orders” of “.. legal institutions of still higher orders.” (Ruiters 1997, 369). He names “major social institutions, such as governments, legislative bodies, organizations of private enterprise, (and) social security systems” as possible examples (Ibid.)

4.3.3 Legal Institutions @ Collective Choice and (Meta)Constitutional Levels

The above analysis focuses on the Operational Situation level. Already there were hints of the relevance of 1st and 2nd order legal institutions to the Collective Choice and Constitutional Situation levels, such as the conception of ownership, and the instantiation of legal persons (respectively). If we approach the issue of establishing smart grids at Collective Choice level from the perspective of deeper levels, Constitutional and indeed Metaconstitutional, we come across institutional patterns of social behavior of a broader nature, which, after Williamson, we name ‘Institutional Environments’. These patterns have roots in the Metaconstitutional level/L1 (Embeddeness – which in itself is mostly about

informal practices), but are formally established foremost at the Constitutional level/L2, to influence interactions at the Collective Choice and Operational Situation level.

We believe these institutional environments can also be regarded as social practices suitable for recognition as regimes that prescribe a mode of behavior that may be instantiated and applied repeatedly. In the relevant academic discourse, three types of institutional environments are broadly recognized as distinct social practices, each with their own characteristic coordinative mechanism (and accompanying structures and processes) as a mode of governance guiding social (and economic) transactions (Powell 1990; Van Heffen & Klok 2000; Thompson, Frances, Levačić & Mitchell 1991).¹³ We name them: *public hierarchy* (with government and citizens as dominant actor-types, coordinating interactions through command by government), *civil (society) networks* (with NGO's and societal enterprises as dominant actors engaged in cooperative interaction), and *competitive markets* (featuring businesses and consumers engaged in B2B and B2C exchange transactions).

In the next table (no. 9) the key elements of this trichotomy of ideal-type institutional environments is summarized, by displaying how these 3rd order legal institutions are about an operation whereby a contextual setting is created by relating transactional relations (listed in column 2) to an overarching (contextual) relation (listed in column 3), with an underpinning normative legitimacy (listed in column 4). Each environment comes with a particular interest orientation and accompanying mode of coordinating interactions that together set the institutional scenery, décor or landscape – which one can regard as if empirically observable – presenting opportunities and constraints to participation, interaction and outcomes.

Table 9. Three types of Institutional Environments			
Relation → Environment ↓	Transactional	Contextual (interest)	Legitimacy
Public hierarchy	Hierarchy/command Gov2Cit	Public interest Cit2Cit / Gov2Gov	'Voice' (democracy), separation of power & rule of law
Competitive market	Market/exchange B2C / B2B	Competitive self interest Buss v Buss / Cons v Cons	'Exit', fair competition, consumer protection, ownership & contracts
Civil network	Network/cooperation Member2Member	Civil community interest All (member & -member)	'Inclusiveness', stakeholder involvement, voluntarism
Gov=Government; Cit=Citizen; Buss=Business; Cons=Consumer; B2C=Business-to-Consumer; B2B=Business-to-business			

This representation is not to suggest that there are no hybrids. *Regulated markets*, such as many energy markets that combine liberalization of energy services with safeguards concerning public values (such as universal service, reliability, affordability, and sustainability), present an important example with relevance to smart grids. While these regulated markets combine a competitive market with a public hierarchy environment, similarly could one find hybrids between public hierarchy and civil networks (e.g. public housing and health care sectors), and between civil networks and competitive markets (e.g.

¹³ These references merely refer to similar distinctions as the ones that are presented next (in the main text). The main difference between this study and the studies referred to is that this focuses on normative distinctions and the others on empirical distinctions, which sometimes also explains differences in labeling (e.g. Van Heffen & Klok refer to Markets, Hierarchies and Networks, primarily in terms of multi-, uni- and pluri-centric types of coordination, which fits the empirical patterns, but is less useful to a normative categorization, where the use of certain adjectives (respectively: competition, command and cooperation) makes more sense.

(trans/inter/supra)national standard setting). We cannot elaborate here, upon these hybrids nor on the ideal-type forms, but we did include an addendum at the end of this paper for those who are interested in the operation of relating or contextualizing relations.

The importance of institutional environments as 3rd order legal institutions lies with how conception (by constitutive rules), instantiations (following institutive rules) and operations (following consequential rules) work across institutional situations levels and also influence the use of 1st and 2nd order legal institutions.

The next table (no. 10.) displays the basic aspects of conception, instantiations and operations of 3rd order legal institutions across institutional (analysis) levels.

Table 10. Connecting legal institutionalization to social action levels*		
Conception	Setting constitutive, institutive, consequential and terminative rules	At MCL: of 3 rd At CL: of 1 st & 2 nd At CCL: n.a. At OSL: n.a.
Instantiations (conceptualization)	Establishing instances of legal institutions by exercising power/performing factual acts (conceptualization)	At MCL: n.a. At CL: of 1 st & 2 nd At CCL: of 1 st & 2 nd At OSL: n.a.
Operations	Participants using the available ability and liberty space (being put into action)	At MCL: n.a. At CL: of 2 nd & 3 rd At CCL: of 1 st & 2 nd At OSL: of all
* Metaconstitutional level (MCL), Constitutional Level (CL), Collective Choice level (CCL) and Operational Situations level (OSL)		

While these findings tell us ‘which institutional facts take place where’, it does not show how these facts relate to and influence each other across institutional levels – whether as a descriptive issue of analysis or in the course of design(ing change). At this point we can return to our earlier representation of legal institutionalization across institutional levels and specify our above findings to show the institutional normative alignment (table no. 11).

Table 11. Legal Institutionalization across Institutional Levels		
Level	Actions & Outcomes concerning Legal Institutions (Conception, Instantiation, Operation)	Type characteristics (e.g. ‘legally significant activity’)
Operational Situation Level (OSL)	Operating according to legal space determined by consequential rules (Possible inclusion of executed legal powers)	<i>Public hierarchy</i> Factual acts within public law
		<i>Competitive markets</i> Factual acts upon contract and ownership
		<i>Civil networks</i> Factual cooperation
	↑ Written Consequential rules Occurrences of 1 st , 2 nd and 3 rd order legal institutions ↑	
Collective Choice Level (CCL)	Setting Governance Structures <ul style="list-style-type: none"> within context of occurring 3rd order Institutional Environments 1st and 2nd order legal institutions (long term relations: e.g. ownership, contracts, public law regulation, legal persons (e.g. private corporations and cooperatives; public bodies public regulators) Instantiating 3 rd order legal institutions (for OSL practice: e.g. - private (e.g. corporations, cooperatives))	<i>Public hierarchy</i> Establish public bodies; long term permissions/finance
		<i>Competitive markets</i> Establish firms & ownership; long term contracting
		<i>Civil networks</i> Establish legal persons; organize cooperation
	↑ Written Institutive, Consequential and Terminative rules;	

Occurrences of 1 st , 2 nd and 3 rd order legal institutions ↑		
Constitutional Level (CL)	Setting Institutional Environments	<i>Public hierarchy</i> Constitutional/legislative frameworks
	<ul style="list-style-type: none"> Operating as public hierarchy, competitive markets or civil (society) networks (+ hybrids) Further conception, instantiation, and elaboration of 1st, 2nd and 3rd order legal institutions 	<i>Competitive markets</i> Civil law code; Corporate governance
		<i>Civil networks</i> Community building
↑ Conventions & Constitutions concerning legal institutions ↑		
Metaconstitutional Level (ML)	(Proto-)Legal conception of 1 st , 2 nd and 3 rd order legal institutions No instantiation of or practice within legal institutions (except constitutional change)	No institutional environments as legal institutions

We now see that while legal institutions of all types may be fathered/recognized at Metaconstitutional level, their formal conception is likely to follow at Constitutional level, with some immediate instantiations, certainly as regards 3rd order institutions, but with further elaboration, but especially instantiations and operations at Collective Choice and Operation levels. While moving to higher levels, not only do 2nd order legal institutions concern operations upon 1st order legal relations, but also do 3rd order institutions influence conception, instantiations and operations of 1st and 2nd order institutions.

4.4 - Connecting Legal Institutions & IAD Rules-in-Use

As a final step we want to determine how both 1st and 2nd, and 3rd order legal institutions relate to the seven types of IAD rules-in-use (at and across various levels – as referred to in section 3.1).¹⁴ Again our paper does not allow a full discussion, but we have summarized some of our modeling work into the next two tables.

4.4.1 Legal Institutions Described as IAD Rules-in-Use

The first of those two represents the relations between 1st and 2nd order legal institutions and the IAD rules-in-use (table no. 12). The descriptions in each box aim to provide a key characterization only. As descriptions do not distinguish between the context of institutional environments, they cannot be very specific and sometimes are restricted to declaring dependency to the specifics of instantiations of institutions.

Table 12. IAD-rule to 1 st & 2 nd order Legal Institution fit							
Legal Institution →	Legal personality	Legal quality (subject)	Legal status (object)	P2P	P2O	O2O	Legal object
Position rules	As Action Situation As participant	Capacity & orientation: e.g. adult, authority	Common pool resource, Public good or service (?)	Positions at both ends (possible multiple holders, especially when in rem) Concerning relative ability and liberty space			Transferable relations regarding grid
Boundary rules	To positions within; type	Qualifications for standing	Requirements for	Always following legal powers; restrictive with public unilateral powers;			More restrictive

¹⁴ We cannot elaborate here on the aspect of coherence between these rules, which has overall importance (of Action Situation coherence – which is also why we use the institutional legal approach), but also between particular rules, such as the position and boundary rule and the choice and scope rule.

	specific rules	or power	'stewardship'	unrestrictive with private multilateral	when 3 rd party impacts
Choice rules	Restrictive when public; facilitative when private	Enabling and facilitative, poss. spec. duty of care	By nature of or interest served by object	Legal ability rules.. - broadly set in private relations - narrowly defined in public relations	Powers tailored to object of transfer
Aggregation rules	For setting up – public and private	For decision to... By nature of quality	Tailored to type of object	Legal ability rules.. - multilateral in private relations - unilateral in public relations	Procedures tailored to object of transfer
Information rules	Type specific; difference internal external	Tailored to nature of quality	Ditto (see above)	Legal ability rules.. - symmetry/reciprocity in private relations - accountability in public relations	(...) Ditto (see above)
Payoff Rules	Type specific and by internal decisions	Ditto (see above)	Ditto (see above)	Legal ability rules.. - following exchange in private relations - government prerogative in public relations, but within boundaries	(...) Ditto (see above)
Scope rules	Objective or jurisdiction of the type	Ditto (see above)	Ditto (see above)	Legal ability rules.. - own/collective interest in private relations - power restrictions in public relations	(...) Ditto (see above)

The descriptions that we have thus established tie together IAD-rules relevant to 1st and 2nd order legal institutions. This is expected to have heuristic merit to analytical and design efforts with descriptive and prescriptive aspirations respectively, but these merits remain underdetermined as descriptions are still quite rough, as they lack specification to 3rd order legal institutions.

To improve on this, the second of both tables (table no. 13) is about the relationship between 3rd order legal institutions and IAD-rules (Van Heffen & Klok 2000).¹⁵

Table 13. IAD-rule to 3 rd order Legal Institution/Institutional Environment fit			
Institutional environment →	Public hierarchy	Civil society	Competitive market
Position rules	Government/Citizen upon Statutory provisions (for organizations)	Members/non-members Governance codes for sectors/networks/organizations	Business/consumer as owners and contracting parties (also Standardization/certification)
Boundary rules	Public authority restricted by power rules. Citizen: non-restrictive (actio popularis; standing)	Membership: rather unrestrictive, but with possible specific requirements Non-members: unrestricted	Consumer: non restrictive Business: rather unrestrictive (proper registration/solvability)
Choice rules	Specifications especially for unilateral powers, with gen. principles. (discretion) Citizens: non restrictive	Broad/unrestrictive powers Poss. restrictive to members acting on behalf of... non-member rights of participation	Broad/unrestricting multilateral powers, plus ownership rights. Many weak permissions to factual acts
Aggregation rules	Constitutional and legislative rules; collegial decisions (majority/veto)	Collective decision making tailored to network; stakeholder consultation	Multilateral procedures of contracting (supply&demand); unilateral in ownership rights
Information rules	Political accountability; legal oblig. to motivate and general openness	Reciprocal openness, specifically dependent on network. Separating (non) members	Business 'truthful specification' in contracting. Consumer unrestricted
Payoff Rules	Set by government, but legal principles (equality, speciality) restrict	By collective member decisions; cooperation calls for contribution. Non member freedom	Payment as obligation following contracting.

¹⁵ The work done by Van Heffen & Klok (2000), was most helpful to this ordering.

Scope rules	Set by power rules (jurisdiction; conditions; norm-object). Hum. Rights. Burdensome is allowed	Boundary of network objective and collective decisions; privacy	Broad freedom; boundary of public (dis)order; morality
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4.4.2 3rd Order Matching IAD Rules-in-Use to 1st & 2nd Order Legal Institutions

As it is important for Action Situations that there is overall coherence between all seven IAD rules-in-use (Ostrom 2005, 191), it will be clear that such coherence also requires that rules fit with the contextual orientation of a particular institutional environment. It would, for example, not fit to mix restrictive position rules under public hierarchy with loose boundary rules of civil society or competitive markets, as in public hierarchy we are most careful about who's in public power. Similarly, under choice rules, multilateral regulation (fitting competitive markets), would not fit public hierarchy because those would make each decision meant to serve the public interest dependent of the consent of (all) citizens.

From this it follows that coherence is also needed with respect to how various 1st and 2nd order legal institutions relate to 3rd order institutions and how this translates into IAD rules-in-use. To name one example: the legal person subtype of an association may be well suited for public hierarchy (as public community, say a municipality), or to a civil network (as an NGO that supports nature conservation), but probably less to run a company in a dynamic competitive market. If a corporation is chosen as legal form of a company, of course specific rules relevant to its internal operations and relations with others need to also fit together to enable the type of coherent functioning that allows success in its competitive market endeavors – which requires a different position than as that of a corporation that is intended to function as a public enterprise (such as of a monopolist in public energy provision).

To demonstrate relevance of a proper (3rd order) contextual fit of 1st and 2nd order legal institutions, with accompanying (institutive and) consequential rules that structure a relevant (general type) Action Situation (such as operating a common pool resource, such as certain smart grids), the next step is to join findings of the afore two tables and put them into 3 ideal-type/pure and 3 hybrid contexts, so to arrive at a full picture. Those pictures would still require tailoring (by selection and elaboration) to the specific collective action challenge (e.g. of establishing a smart grid). Clearly the scope rules relevant to this paper do not allow for all of those next steps. Instead, we present an impression of the cross section of 3rd order public hierarchy, with fitting 1st and 2nd order institutions and IAD rules to demonstrate the above argumentation (see table no. 14). Then, after some concluding remarks about the relevance of legal theory to IAD, the next section will present a revisit to the Bothoven-case (see section 5) to demonstrate how the use of an 'institutional legal mix' has heuristic value to analysis/description and to design/prescription, while focusing (to avoid drowning in details) on P2P relations at Collective Choice level.

The example of public hierarchy is chosen for its relative simplicity (being a pure form) and recognized operations (when depicted in its most traditional 'command & control' form).

Table 14. 3 rd Order Public Hierarchy and matched IAD-rule to 1 st 2 nd order Legal Institutions	
(3 rd order)	

Institutional environment →	Public hierarchy						
1 st & 2 nd order legal institutions →	Legal personality	Legal quality (subject)	Legal status (object)	P2P	P2O	O2O	Legal object
Position rules	Action Situation: positions within gov't Participant: Gov2Cit'zen	Gov't: Public authority / task. Cit.: interested party	Owner of public property; Manager / steward of common property	Government-Citizen Legislator-legislate; Regulator-regulatee Enforcement agency-Offender 1 st -2 nd -3 rd party regulatory positions (hybrid: 1 st -2 nd co-regulating positions) P2O/O2O: govt-owner v. all others; private owner v. government			Gov't owner Govt. licensor Gov't market manager
Boundary rules	Constit. Statutory appoint. within, alloc of tasks	Access to power; elect, appoint	Selection tailored to nature of the object (compuls.)	Taking positions follows from power rules (mostly compulsory) or actual legal positions (being owner; being norm-subject to rule of conduct)			eligible to transfer permissions, ownership rights
Choice rules	Power allocation within and to publ. bodies	Prime / secondary legislator Enforcem. agency	Actions relevant to nature of the object (compuls.)	Especially unilateral P2P regulation Special rules regarding public property and public burden on private property			Power of transfer of rights (e.g. CO ₂ market)
Aggregation rules	Collective decision making. Ext. representation	Public auth. basic public law rules	Procedures fitting interests in object	Individual or collective decision making with pub.authority. Unilateral, but perhaps advisory, participatory supervisory procedures			Contractual relations; poss. L'sor approval
Information rules	Openness for accountability	Publ.auth gen. princ. openness & explain	Fit to nature of / interests in object	Provide explanation to unilateral acts Proper specification in multilateral acts			Proper specification
Payoff Rules	Internal budget; external resp.	Tax.office Enforce agency	Depending properties object/acts	Burdensome or beneficial decisions (incl tax & sanctions). Principles: proportional/equality/égalité/purpose			Payment as contracted (poss fees)
Scope rules	Pers. Purpose jurisdiction	Public task Publ.law levels	Legal use /realm of object	Only within jurisdiction + other conditions			Ownership title; range of relation

4.5 - All Rules & Legal Institutions (Re)Considered

The legal theory approach to IAD- relevant as we look at the local planning process regarding the establishment of smart grids, which will inevitably involve legal rules - has provided us with various insights. In a very concise way, these insights may be summarized as follows:

1. there is a fundamental difference between the empirical/descriptive nature of IAD rules-in-use and the normative/prescriptive nature of legal rules;
2. legal rules may be relevant to rules-in-use in fundamentally different ways: as a matter of causality and of lawfulness;
3. there exists a fourth type of norm in respect of rules of conduct (differentiating between permission and dispensation), and all four together relate in a logically (opposite) way that also leads to distinguish relations between rights and obligations following from normative positions as legal liberty space, alongside the normative relevance of absence of rules;

4. that from the afore it follows that there are various states of normative correspondence between legal rules and rules-in-use (i.e. sine praxis, consistent practice, inconsistent praxis, sine lege – with (in)consistent deontics/norm-operators);
5. that legal rules of power play a crucial role that rules of conduct cannot fulfill (not even at other levels) and which accounts for different rights and obligations relations that add up to a legal ability space, which is relevant especially to design and change of rules (of conduct and of power – by a combination of rule establishing decisions, decision constituting rules);
6. that rules of power provide an underpinning basis for understanding the relations between/working of levels (in 1st, 2nd and 3rd party regulation), and the importance of normative alignment;
7. that the use of legal institutions has heuristic merit in determining the normative match to empirically observable patterns of social practice, as they provide (more) coherent regimes (instead of/by functionally clustering single rules) to, upon instantiation, be prescribed and applied in that social practice;
8. the existence of 1st, 2nd and 3rd order legal institutions from their relationship as valid presentations of states of affairs (1st order) and, upon the operation of personification or reification, or of contextualization, as valid presentations of states of affairs about valid states of affairs (2nd and 3rd order), within a given legal order, underpinned by constitutive, institutive, consequential and terminative rules (about their conception, instantiations and operations);
9. the possibility of applying 3rd to 1st and 2nd order legal institutions, with reference to related IAD rules-in-use (at a given Action Situation Level at a given Level);
10. the relevance of the above insights to descriptive analysis of a given Action Situation, as well as to prescriptive design of new Action Situations or changes in them or their termination.

5. Revisiting the Bothoven-Case

At this point we revisit the Bothoven-case (from section 2.2) as a case-in-point for the type of descriptive analysis and prescriptive design that we believe can be improved by tying together IAD and aspects of (institutional) legal theory. To combine description and design, we will firstly present the status quo as it exists presently, to then look into two possible scenarios for future development. As this discussion is, at this point, merely to demonstrate how the above approach holds a heuristic promise, we will only consider a limited number of factual and legal aspects.

5.1 - The Status Quo

At the Operational Situation Level, provision, production, distribution, appropriation, assignment and consumption take place (Ostrom, 2007): the tenants of de Woonplaats receive their heat from EnNatuurlijk and in turn compensate EnNatuurlijk for this (as well as pay rent to de Woonplaats).

At the Constitutional Situation Level, next to the Dutch Constitution and the Housing Act¹⁶ (Dutch: Woningwet), the Heat Act (Dutch: Warmtewet¹⁷) mainly determine the first, second and third order relations as regards the district heating grid in Bothoven-Noord. The Heat Act provides the Dutch Authority for Consumers and Market (ACM) to annually establish maximum tariffs that can be charged for heating¹⁸. This 3rd order legal institution of a regulated market influences the instantiation of relevant 1st and 2nd order legal institutions. While all stakeholders have a broad legal ability space available for contracting and use of ownership, the predetermined maximum tariffs for rent and heat are consequential rules that unilaterally limit this legal ability space particularly for de Woonplaats and EnNatuurlijk.

As regards first order legal institutions, at the Collective Choice level three personal legal relations (P2P) are instantiated and subsequently in operation¹⁹:

- a. *Contract EnNatuurlijk and de Woonplaats*: Until 2020 EnNatuurlijk has the duty to deliver heat to de Woonplaats' tenants/claimants (Vrins, 2013). Before 2020, any changes to the production and infrastructure of the heating grid that have negative financial consequences for EnNatuurlijk, have to be compensated to EnNatuurlijk (immunity to change, unless payment).
- b. *Contract de Woonplaats and tenants*: rental contract (claim/tenants-duty/Woonplaats), including reciprocal obligation of tenants to take heat from EnNatuurlijk (duty/tenants-claim/EnNatuurlijk)
- c. *Contract EnNatuurlijk and tenants*: about the provision of and payment for district heat (claim-duty)

All of these applied consequential rules, agreed at the Collective Choice level, influence the liberty space at the Operational Situation level.

5.2 – Two Scenarios

To demonstrate the usefulness of legal institutions as a heuristic approach, next to the status quo that was described above, two scenarios were developed, based on the plans of housing corporation Domijn. Domijn will install solar PV panels and solar thermal collectors on the roof of its building named the 'Performance Factory'. With these solar thermal collectors it wants to supply the district-heating grid in Tattersall. This is supported by De Woonplaats – and by the project group in general – as it will make the district-heating grid in Tattersall more sustainable. The first scenario is about such a change to the district-heating grid before the year 2020, the second scenario for after 2020. The Constitutional level is treated as fixed in all three situations²⁰ and the focus lies on the Collective Choice level. The

¹⁶ The Housing Act (Wet van 29 augustus 1991 tot herziening van de Woningwet) regulates the increases in the amount of rent that a housing corporation can charge its tenants.

¹⁷ Wet van 17 juni 2013, houdende regels omtrent de levering van warmte aan verbruikers (Warmtewet).

¹⁸ In Dutch: "Besluit van de Autoriteit Consument en Markt op grond van artikel 5, eerste lid, artikel 6, eerste lid en artikel 8, vijfde lid, van de Warmtewet". These prices are based on the average price for gas each year so that households connected to a district heating grid are not paying more for heat than they would otherwise pay for gas (in Dutch referred to as 'Niet meer dan anders-principe').

¹⁹ The objective legal relations are not focused on here.

²⁰ Domijn, a housing corporation similar to de Woonplaats, is subject to the same rules made at the Constitutional level as de Woonplaats.

actual empirical decisions that actors take in this action situation (e.g. whether to contract or not) are focused on by other parts of the IAF Framework (actors' preferences, interaction, and outcomes) and will therefore not be addressed here.

5.2.1 Scenario 1: Before 2020

We assume that EnNatuurlijk will suffer negative financial consequences once Domijn supplies the district heating grid from its solar thermal collectors. At the Operational Situation Level compensation has hence to be paid to EnNatuurlijk. At the Collective Choice level two new personal legal relations would come into existence (while the previous P2P relations of the status quo remain the same):

- a. *Contract Domijn and de Woonplaats*: contract that specifies that until 2020 Domijn has the duty to compensate either EnNatuurlijk directly, or to compensate de Woonplaats, so that de Woonplaats in turn can compensate EnNatuurlijk (for else it has no-power to engage in the contract with Domijn).
- b. *Contract Domijn and EnNatuurlijk*: contract until 2020 about the supply of and payment for heat from Domijn's solar thermal collectors, and perhaps as regards the direct financial compensation from Domijn to EnNatuurlijk.

5.2.2 Scenario 2: After 2020

In 2020 the contract between de Woonplaats and EnNatuurlijk ends, but we assume that both parties will want to extend this contract²¹. Thus de Woonplaats – being an important customer of the local heating grid and having the alternative of gas supply to its tenants - has the bargaining power to demand different contractual relations from EnNatuurlijk, e.g. to supply the heating grid with renewable energy (from Domijn). At the Operational Situation Level Domijn would thus deliver heat to EnNatuurlijk, which in turn it supplies to de Woonplaats' tenants. At the Collective Choice Situation Level all personal legal relations, except the one between the tenants in Tattersall and de Woonplaats, will change:

1. *Contract EnNatuurlijk & de Woonplaats*: stating that de Woonplaats' tenants will continue to take heat from the district heating grid.
2. *Contract tenants Tattersall & EnNatuurlijk*: regarding the supply of and payment for heat. In this respect, EnNatuurlijk is legally bound (under supervision by the ACM) to a maximum tariff that it can charge for heat.
3. *Contract EnNatuurlijk & Domijn*: specifying supply of and payment for heat (claim-duty).

5.3 - IAD Rules-in-Use Applied at Collective Choice Level

Given this limited case-setting (Current status quo; Scenario 1. future state before 2020; Scenario 2. future state after 2020) and these premises (3rd order regulated market, focus on Collective Choice level for change of P2P-institutional legal relations), we can now demonstrate how these changes work as regards six types of IAD rules-in-use, of which we

²¹ Even though de Woonplaats could install individual gas boilers in its houses, we believe that it is unlikely to choose for this option, as it is expensive and not sustainable. For EnNatuurlijk the tenants of de Woonplaats are important customers to the small district-heating grid.

cluster for two).²² Again, limitations follow from our ambition to illustrate how our previous findings do indeed help in respect of both descriptive analysis and possible prescriptive design - and hence to avoid over-detailing.

5.3.1 Position & Boundary Rules

As regards position and boundary rules private law contractual relations between De Woonplaats, EnNatuurlijk and the local residents exist, as defined above. De Woonplaats and EnNatuurlijk are legal persons of different types (i.e. societal enterprise and a limited corporation); the residents are natural persons. All are endowed with the power to contract on housing and on energy services and possess specific legal qualities²³.

In the change from the status quo to scenarios 1 or 2, the most striking point is that a new player enters stage upon invitation of de Woonplaats (invitational boundary rule): Domijn. For Domijn, as explained in section 2.2, taking a contractual position is unrestricted, albeit that of course it 'takes two to tango' (see aggregation rules). To enter stage by taking the position of contracting party in a P2P-relation with De Woonplaats and EnNatuurlijk (we are assuming there will be no contracts with residents)²⁴ the most elementary boundary rule is that these participants need to be willing to contract (open boundary rule).

There may, however, be difference between the status quo and scenario 1 as EnNatuurlijk cannot reject the offer of a contract about Domijn plugging its energy into EnNatuurlijk's grid – given that by being compensated it does not suffer any disadvantage (no immunity). If such a provision exists then boundary rules hold that EnNatuurlijk has less power to not contract (and thus stop this scenario from taking place). In scenario 2 EnNatuurlijk has full power to decide.

5.3.1 Choice & Scope Rules

As regards choice and scope rules again the default setting is that institutive and consequential rules of power and of conduct only put very few constraints on contracting itself and on the obligations that contractual parties take on – again setting aside the legal qualities of De Woonplaats as housing corporation and EnNatuurlijk as energy provider.²⁵ As discussed above, we assume that in scenario 1 EnNatuurlijk has to accept Domijn's offer, provided that sufficient compensation is paid, and has no power to change this contract until 2020. Domijn on the other hand has no obligation to contract.

Next to this, in the change from the status quo to scenarios 1, and especially to 2, we find that the contextual institutional fact of P2P-relations take place within a regulated market has a constraining influence on the power to contract, as the Heat Act puts constraints on prices. Again this leads to a different perspective when we compare scenario 1 with that of

²² We decided that applicable Information rules would be too detailed in respect of explaining the scenarios.

²³ Beyond the scope of position/boundary rules one may assume that De Woonplaats and EnNatuurlijk are contractual parties with a specific legal quality (e.g. having a task in public housing, within the context of a hybrid regulated civil network), and a permit requirement to provide energy services, combined with public value conditions for contracting, given that the energy market is a regulated market, but this we will leave aside.

²⁴ In terms of boundary rules there may be limitations in the right of private person of renting a house with a housing corporation, which in turn impacts whether a tenant will contract with EnNatuurlijk.

²⁵ See previous footnote.

2. In scenario 1 this constraint need not have effect as EnNatuurlijk gets compensated and is not in need to charge residents for the possible relative surplus costs that follow from the solar feed-in. In scenario 2, there is no possibility of such (buffering by) compensation, and certainly no obligation on EnNatuurlijk to contract.

5.3.3 Payoff Rules

As regards Payoff rules we have already painted the main picture as regards compensation. As a preliminary remark, however, we reiterate that in this particular Regulatory Market context payoff rules are basically decided freely by contractual parties, but that there may be public value conditions to contractual powers (such as regarding universal service, affordability, reliability, distributive justice and sustainability) which create boundaries – both as regards the energy market (also relating to scenarios 1 and 2 regarding the price restriction of the Heat Act) and the public housing market.

If we consider the change from the status quo to scenario 1, clearly the compensation provision in the contract between De Woonplaats and EnNatuurlijk is relevant to costs and benefits, in ways explained in the above. As Domijn has the (indirect) duty to compensate EnNatuurlijk, it will likely face more costs than benefits in the period before 2020. Under scenario 2 the compensation provision does not exist. But, as EnNatuurlijk is limited by the ACM in the tariffs it can charge to its customers, the company can only compensate for potential financial losses by paying Domijn accordingly (less).

5.3.4 Aggregation Rules

As regards Aggregation rules the point of departure, already alluded to in the above, is that in contracting all parties need to agree, so the modus of aggregation is that of mutual consent and mutual expression (through offer and acceptance) of the willingness to contract. In the change from the status quo to scenarios 1 or 2, we find that in scenario 1 it follows from the initial contract that compensation needs to be offered and possibly that EnNatuurlijk must agree to contracting with Domijn; this does not alter the basic aggregation rule, but does paint the picture of how this contractual obligations come about. In scenario 2 these obligations (to compensate or to contract) do not exist and so the default rules apply²⁶.

5.4 - Analysis & Design

From the brief overview of the institutional legal ramifications of (no more than a minor) change in the Bothoven case, we are faced with the interconnectedness of IAD rule-types (as mentioned by Ostrom 2005), even if restricted to one type of legal institution at one level of analysis, under one particular type of 3rd order institutional environment. As we pull-in more legal aspects, such as P2O (ownership relations), legal quality and legal objects, it will undoubtedly picture an even more joined-up institutional configuration of rules. Complex as

²⁶ Of course it may be possible that government legislation, relating to regulated markets considerations, comes with government powers of approval or permission, which would then influence the pallet of aggregation rules.

this may be, for purposes of analysis and legal design, we believe our institutional legal approach demonstrates that to use legal institutions as a heuristic approach does enable to more quickly see and understand patterns of social interaction – instead of a seemingly endless going through possibly relevant single rules, whereby one 'cannot see the forest for the trees'. Furthermore, we believe the use of legal institutions is useful to prescriptive design. When particular scenarios are contemplated as new or changes in social practices, to approach these in terms of legal institutional immediately provides a picture of prescribed behavior as tied together by such institutions, including consequential aspects that may not as yet have been considered and may impact behavior in a relevant way – either desirable or not. At the same time the approach through legal institutions can support design by suggesting alternatives (such as switching from P2P to P2O and O2O-relations) on a level that allows understanding as alternative social praxis. Last but not least, the use of legal institutions is helpful to (especially explanatory) descriptive analysis and (especially critical) prescriptive design²⁷ as it relates to the aspect of normative alignment between prescriptive social practices at various institutional levels. Clearly this approach also favors chances of coherence between rules, also in terms of seven IAD rules-in-use, as the perspective is always guided by (existing, new or changing) patterns of social practice.

6. Concluding Remarks

In our Introduction we stated that this paper is “... about providing a backbone to providing design guidelines for stakeholders involved in local planning towards establishing new and integrated smart grid projects.” To that end we asked, as a leading question, “how to connect the empirical institutional analysis of such planning with the normative analysis of relevant legal aspects?”

While the research presented here has an exploratory character, we believe that it does indeed make a case for connecting Elinor Ostrom’s Institutional Analysis and Development (IAD) Framework with Institutional Legal Theory (ILT) in a way that can provide an underpinning for the formulation of design guidelines for collective action challenges such as in establishing and operating smart grid projects.

In connecting empirical and normative analysis, this paper’s emphasis has been on the normative aspect, setting aside a connection that focuses on the causal relationship between rules-in-use and legal rules. As regards the normative connection, we have summarized the key theoretical elements that ILT can add to IAD in section 4.5. by pointing at: (1.) the fundamental difference between rules-in-use and legal rules; (2.) the above mentioned distinction between their causal and their normative connection; (3.) the need to differentiate our understanding of rules of conduct (also including dispensation and non-regulation); (4.) the four basic states of normative correspondence between rules-in-use and legal rules (relevant to lawful and valid performance); (5.) the crucial role of rules of power in legal change; (6.) the role of these rules in the build-up of levels of social

²⁷ Which relates to normative legal science (Smits 2012): legal design from a perspective of what ‘law ought to say’.

action/situations; (7.) the heuristic relevance of legal institutions to IAD; (8.) the existence of 3rd orders of legal institutions; (9.) the connection between IAD rules-in-use and legal institutions (across levels); (10.) the relevance of these finding both in descriptive analysis and prescriptive design. The latter point we have demonstrated by revisiting the Bothoven-case – albeit while taking assumptions and limiting the scope both in situation level and in relevant rules-in-use – with a ‘positive’ conclusion (in section 5.4).

We believe that our findings hold a promise for a further elaboration and indeed a next step of improved analysis and scenario development. For example by a further analysis of connections amongst legal institutions of different orders and between legal institutions and IAD rules-in-use, and by exploring a legal design approach that can yield design-guidelines that assist smart grid endeavors – aside from relevant work in the field of the causal connection between rules-in-use and legal rules, in the context of Action Situations (such as of smart grids). Meanwhile we welcome criticism and hope it comes with the kind of constructive comments that may further the quest.

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Addenda

Relating to section 4.1.2

There are four possible relations in situation of non-matching operators: contrary, contradictory, subaltern and subcontrary related operators, leads to 6 possible states of correspondence, with 12 variations:

Determining states of correspondence for bilateral occurrence, with different Deontic/norm-operator					
Correspondence	Logical relation	Legal Rule	Rule-in-use	Lawfulness Rule-in-use	... Because
1	Contrary	Prohibition	Command	Unlawful	Shall not do!
		Command	Prohibition	Unlawful	Shall do!
2	Contradictory 1	Prohibition	Permission	Unlawful	Shall not do!
		Permission	Prohibition	Unlawful	May do!
3	Contradictory 2	Command	Dispensation	Unlawful	Shall do!
		Dispensation	Command	Unlawful	May refrain!
4	Subaltern 1	Prohibitive	Dispensation	Lawful	Poss. implicated
		Dispensation	Prohibitive	Lawful	Sine lege
5	Subaltern 2	Command	Permission	Lawful	Poss. implicated
		Permission	Command	Lawful	Sine lege
6	Subcontrary	Permission	Dispensation	Lawful	May do...
		Dispensation	Permission	Lawful	May refrain..

Note IIb only Legal Rule, no RiU: when obligating legal rule, then risk of unlawfulness

Relating to section 4.3.3

To explain the operation of relating or contextualizing relations, to form institutional environments as legal institutions, the technical operation is explained in the below.

Each of the 1st order legal relation types P2P or P2O or O2O could be regarded as a square (N^2 - henceforth ΩN)²⁸ operator that represents and projects a normative relational or contextual orientation towards:

1. P2P-based interest in collective personal control (P2P²/ΩP2P), coordinating through *cooperation* or inclusive reciprocity (all involved serving mutual interests in agreed obligations) for ΩP2P, projecting *civil (society) networks*.
2. P2O-based interest in exclusive personal control (over commodities (P2O²/ΩP2O), coordinating through *competition* or excluding reciprocity (all involved serving their own interests in competitive commodity transfers) for ΩP2O: projecting *competitive markets*.
3. O2O-based interest in objective purpose (the public interest) beyond personal interests (O2O²/ ΩP2P) coordinating through *command* or exclusive sovereignty (interests of all involved are subordinate to a public interest in an objective purpose) for ΩO2O, projecting *public hierarchy*.

Theoretical operation generating 3 rd order legal institutions			
Relational operator	Institutional relation	Legal space orientation - towards	Institutional environment Ideal type operators
ΩP2P	P2P	cooperation as a community – for collective interest	Civil (Society) Networks Voluntary networks, community action (e.g. NGO)
	P2O	cooperation by common goods – for collective use	
	O2O	cooperation by internalization – for servient purpose	
ΩP2O	P2P	competition as efficient exchange – for private interest	Competitive Markets Suppliers and consumers Firms
	P2O	competition as - for private sovereignty	
	O2O	competition as externalization – for optimal use	
ΩO2O	P2P	commanding as regulating – for public interest	Public Hierarchies Governments and citizens
	P2O	commanding as dominium eminens – for utilitarian use	
	O2O	commanding as public goods – for public good	

²⁸ Suggestive of this relational operator establishing a particular square ‘topos’ in which relations are positioned.