Comparing regulatory innovations in climate change policies

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ABSTRACT

Climate change policies ask for unprecedented rates of radical technological innovation. At the same time, they ask for deep transformations of regulatory frameworks. It is usually believed that both technological and regulatory innovation shall proceed together for large scale deployment of green technologies to become possible. However, how to manage these parallel dynamics is still debated. This paper proposes to apply a comparative diagnostic approach to describe the main institutional factors which affect the regulation of green technologies. The diagnostic approach is applied to one prominent example of green innovation, that is the transition to smart grids in the electricity sector. The US and EU regulatory frameworks for smart grids are compared. The analysis shows that regulatory innovations do happen, but there are several important differences between the two systems. Transnational networks may foster convergence in the near future, but it is equally likely that different standards and rules will coexist.

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1. Introduction: regulating green technologies

This paper explains how the United States and the European Union are trying to adapt their regulatory frameworks to green innovation, that is the kind of technologies which should drive the transition towards a low-carbon economy.[1] Requirements for such a transition are daunting: clean technologies already available today should be deployed on a large scale at reasonable costs and new clean technologies should find their way to the market in a short timeframe.[2] In the last few years green innovation has become a central concern for both developed and developing countries. This despite the fact that, as shown by the slow pace of international negotiations on climate change, not all countries are equally committed to curbing greenhouse gas (GHG) emissions with the sense of urgency transmitted by climate scientists. The adoption of comprehensive climate policies with binding targets is just one driver of green innovation. After the 2008 economic crisis, investments in clean tech were perceived as one of the best available options to escape from a long period of economic stagnation.[3] Moreover, green innovation promises high returns for several different economic sectors: those directly affected by climate change policies (energy, transport, residential and commercial building), as well as connected sectors like information and communications technologies. The trend already visible today is toward global markets of clean tech in which the struggle for primacy can be expected to be particularly harsh. For example, R&D investments in energy technology are higher in the emerging economies than in Western industrialized countries. China is the world leader in the manufacturing of several clean technologies.[4]

This frenzied race to green innovation may be good news from the point of view of environmental sustainability. Though, we already know that technological transitions usually

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[1] There is debate on the exact meaning of green innovation. In Europe eco-innovation, including all innovations with environmental benefits, has become the preferred word of art, both in the literature (e.g. R. Kemp, Eco-Innovation: Definition, Measurement, and Open Research Issues, 27 (3) Economia Politica 397 (2010)) and in the European Commission's initiatives (see the communication Innovation for a Sustainable Future – The Eco-Innovation Action Plan, COM (2011) 899 fin. of 15 December 2011). For the purposes of this paper, green innovation is any technological innovation which can help achieve the goals of climate change policies.

[2] See, e.g., IEA, Energy Technology Perspectives 2010, OECD/IEA, 49: "A portfolio of low-carbon technologies, with costs of up to USD 175/tCO2 when fully commercialised, will be necessary to halve CO2 emissions by 2050. No one technology or small group of technologies can deliver the magnitude of change required."

[3] See, e.g., UNEP, A Global Green New Deal, Final Report, February 2009; OECD, Towards Green Growth, 2011.

[4] See M.A. Levi et al., Energy Innovation: Driving Technology Competition and Cooperation Among the United States, China, India and Brazil, Council on Foreign Relations, 2010; L.D. Anandon et al., Transforming U.S. Energy Innovation, Belfer Center for Science and International Affairs, November 2011, 273ff..

take more than a decade. Moreover, they are not linear processes, but gradual transformations fraught with a lot of uncertainty about the final outcomes. The literature on innovation systems suggests what is probably the most important reason for the difficulties confronting any attempt to engineer large-scale transformations. Innovative activities take place within a dense web of relationships, at different levels, and among several different organizations and institutions. Not only those relationships shall be built over time. Each component of an innovation system shall also play a distinctive role and coordinate with the other components. A sustained rate of innovation will only be possible when these demanding conditions (the right kind of relationships and the right level of coordination) have been fulfilled. Otherwise, lock-in to legacy technological systems will be the unavoidable outcome.[5] Recent assessments suggest that, despite a potential for significant fuel savings, the deployment of green technologies is far from approaching the level needed for the transition to a low-carbon economy.[6]

The focus of this paper is on the interplay between the distinct trajectories of technological and regulatory innovation. Their mutual influences have already been acknowledged by the literature on environmental regulation.[7] Sometimes a technological innovation may prompt a revision of regulation. In other cases more stringent regulations will lead to technological innovation. An often-heard criticism is that regulation is ineffective in fostering technological innovation or unduly constrains economic activity. Hence, the interplay between technology and regulation may have a positive, negative or neutral character.

While traditional environmental regulation aims at avoiding local negative externalities, climate change policies aim at transforming the most important sectors of the economy. The scale of this task immediately prompts questions about the changes that the regulatory system itself should undertake: are traditional environmental and energy authorities able to adapt their decisionmaking processes to problems which involve systemic change ? How should

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[5] See B.-A. Lundvall, National Innovation Systems – Analytical Concept and Development Tool, 14(1) Industry and Innovation 95 (2007); F.W. Geels et al., The Dynamics of Sustainable Innovation Journeys, 20 (5) Tech. Analysis and Strat. Mgmt 521 (2008); B.D. Solomon and K. Krishna, The Coming Sustainable Energy Transition: History, Strategy, and Outlook, 39 Energy Pol. 7422 (2011).

[6] See IEA, Energy Technology Perspectives 2012, OECD/IEA, June 2012, Executive Summary, 1-2 (additional investments of $36 trillion are required by 2050, with fuel savings amounting to more than $100 trillion, but key technologies for energy and GHG savings are lagging behind and the share of public investments in RD&D has fallen by two-thirds since the 1980s).

[7] See the review by D. Popp et al., Energy, the Environment, and Technological Change, in B.H. Hall and D. Rosenberg (eds.), Handbook of the Economics of Innovation, North Holland, 2010, vol. 2, …

such authorities coordinate with other policymakers at national, subnational and international level ? Are the tools they employ effective or should they be replaced with newer ones ?

What seems already clear is that green innovation will be directly dependent on the type of regulatory framework each country or region will be able to set up. Much less clear, however, is whether regulatory innovation will keep pace with technological innovation. The idea of mutual influence seems plausible, but the literature on environmental regulation already shows that the right incentives at the right time will only be available in some (perhaps few) cases. Institutional change has its own internal logic. Even though technological change plays the role of an external shock which alerts policymakers to the need for reform, whether it is actually undertaken, its features and its final outcome are determined by the combination of several different variables within each regulatory system. What can be expected is that some countries will score higher on green innovation because they will be able to manage the interplay between technological and institutional change, while other countries will have poorer performances.

Of course, policymakers are primarily interested in understanding how they can reach the highest ranks. Global efforts in the implementation of climate change policies provide a natural experiment with unique features. A lot of information is available worldwide on local experiences, pilot programs, resistance to change, successes and failures. Unfortunately, such information cannot be immediately translated in operative solutions ready to be implemented everywhere. In each context, the interplay between technology and regulation must be unpacked and the elements affecting the final outcome identified. This kind of analysis can benefit from a comparative perspective. Carefully assessing the reform paths followed in different countries or regions should provide the kind of contextual, operational knowledge policymakers need.

Of course, comparative descriptions that list regulatory measures, however successful they are in a specific place, will not be enough. Much more useful are analyses that identify the most crucial aspects to be managed when adapting the regulatory framework to technological innovation. Given the systemic character of such innovation, the number of aspects with a potential impact is probably high. The difficulty of the analysis is compounded by the fact that different disciplines carry out the comparative inquiry of regulatory frameworks for green innovation from their own perspective and with their vocabulary. Therefore, a comparative analysis should fulfil at least two conditions: a) identify those aspects of the regulatory framework with the heavier impact on technological innovation; b) provide a common language which can bridge contributions from different disciplines.

The institutional diagnostics approach comes close to fulfilling both conditions. It has been applied to several different policy problems, from the management of complex eco-systems to economic development. It does not promise to give policymakers easy-to-implement blueprints for regulatory reform. But it does provide a framework for analyzing the interaction among the different elements of a regulatory system in a multi-level setting. Moreover, it was worked out with the specific aim to supply a common language for different disciplines. Hence, it could supply interesting answers to the two methodological problems (selective focus and different disciplinary perspectives) usually encountered in comparing regulatory frameworks for green innovation.

A comparative analysis along the lines of the diagnostics approach goes further than the recommendations usually provided by many international organizations, climate change bureaucracies or transnational networks. These bodies rightly suggest that major changes to national regulatory frameworks are needed to implement large scale transformation of high-carbon sectors. However, the reforms they propose suffer from two opposite drawbacks. In some cases, they are formulated at too high a level of generality, hence they lack clear guidance for national policymakers.[8] In other cases, the proposed reforms are drawn from some successful national experience, but do not provide the contextual evidence which helps to adapt them to a different national setting. The limits of such recommendations can be better understood by pointing out to a tripartite distinction about the contents of policies. The latter are usually made of: 1) very abstract general aims, 2) less abstract operationalizable policy objectives and 3) specific on-the-ground measures.[9] International organizations usually focus on 1) and 2), while 3) is left unaddressed.[10]

Comparative diagnostics is also relevant for an assessment of the overall direction each country or region takes toward sustainability goals. When adapting the regulatory framework

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[8] For example, UNEP, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, 2011, devotes a chapter to the enabling conditions to promote the transition to the green economy. One of the conditions is establishing sound regulatory frameworks. The problem is deciding what "sound" means and how such frameworks can be obtained.

[9] This tripartite distinction applies both to policy goals and policy means: see M. Howlett, Designing Public Policies, Routledge, 2011, 16f..

[10] One important reason why international organizations cannot provide recommendations about policy objectives and specific measures is that these contents are usually controlled by insiders to the regulatory system and a limited number of core actors. See Howlett, above note …, 36-38. Moreover, the adoption of specific solutions entails a distribution of costs among agents. Hence, strategic behaviour and fewer incentives to reveal information and share knowledge can be expected: see E. Brousseau et al., Knowledge Matters: Institutional Frameworks to Govern the Provision of Global Public Goods, in E. Brousseau et al. (eds), Reflexive Governance for Global Public Goods, MIT Pr., 2012, 243, 256, 268f., 271 (IPCC and UNEP are examples of bodies which only provide descriptions of possible policy instruments).

to green innovation, it is possible to pursue a weak or strong ecological modernization.[11] The former tries to find technological solutions to environmental problems, the latter tries to achieve broad-ranging changes to society and the economic system. A diagnostic approach should not only provide evidence about the chosen path, but also about the channels employed to go down it and their effectiveness.

The paper is organized as follows. Section two describes the comparative diagnostics approach and explains how it could be applied to the regulation of green innovation. Sections three and four apply the diagnostics approach to US and EU policies in the field of smart grids. Section five describes the role played by transnational networks in the development of a global market for smart grids. Section six discusses the patterns of techno-regulation which can be identified in this case study. Section seven provides concluding remarks.

2. Comparative diagnostics for techno-regulation

According to a widely cited definition, there are at least three different types of regulatory innovations. First-order innovations refer to modifications of minor aspects of the regulatory framework, for example a change in the price cap formula or in the level of permitted emissions. They cannot be considered 'real' innovations. Second-order innovations refer to modifications in techniques or processes, for example a shift from soft law to hard law, from legal rules to economic incentives, or the creation of new regulatory agencies. Third-order innovations entail significant transformations of the regulatory framework arising from radically changed cognitive and normative structures. Examples are re-nationalization, or a shift from command-and-control to market-based mechanisms. Third-order innovations may be accompanied by first-order and second-order ones.[12]

Climate change policies ask for the kind of systemic transformation that requires third-order innovations in the regulatory framework. But how exactly such transformation should be accomplished is still an unanswered question. Third-order innovations do happen, but they may be prompted by different mechanisms, impact on different components of the regulatory framework and spread unevenly across countries.[13]

Compounding the difficulties in assessing regulatory dynamics, technological change displays its own non-linear trajectories and interacts in several different ways with the

[11] For this distinction see J.S. Dryzek, The Politics of the Earth, 2nd ed., Oxford UP, 2005, 173-176.
[12] See J. Black, What is Regulatory Innovation ?, in J. Black et al. (eds.), Regulatory Innovation: A Comparative Analysis, Elgar, 2005, 8-11.
[13] See, e.g., J. Black and M. Lodge, Conclusions, in J. Black et al., above note …, 181-197.

regulatory framework.[14] Climate change policies try to use regulation to push green innovation, but the record so far is much less than satisfactory. Therefore, the main research problem is how to identify the institutional factors which guide the choices about the regulation of green technologies. At the same time, the sheer variety of regulatory frameworks and technologies advises against searching for the 'optimal' regulatory regime. One-size-fits-all solutions tend to single out a few institutional factors and pay scant attention to interdependencies. What is needed instead is an approach that takes into account all contextual factors and explores their interaction.

In the balance of this section a comparative diagnostic approach is presented that goes a long way toward addressing these research problems. Comparative diagnostics relies explicitly on analogies to the medical sciences, biology, architecture and engineering. The basic idea is to identify the set of variables which affect a specific policy problem and list the main patterns of interaction. The diagnostic approach does not provide ready-made solutions and rejects attempts to supply universal answers. Its main strength lies in the guide it can provide to policymakers dealing with complex governance issues. Most importantly for the purposes of this paper, the variables to take into account are identified inductively on the basis of the comparison of a large number of situations in different parts of the world.

An additional advantage of the diagnostic approach is that it has been developed by several scholars in different fields. Examples can be found in political science, environmental studies, economics, and innovation studies. Even when an explicit reference to diagnostics cannot be found, several theoretical frameworks in different disciplines appear compatible with its logic. This means that the diagnostic approach can provide a common framework and language for interdisciplinary dialogue. In what follows, I will provide a synthetic review of some studies devoted to the development of the diagnostic approach. Drawing on those studies, I will then single out the three steps to be accomplished to identify the dynamics of regulatory frameworks.

One of the most sustained attempts at developing a diagnostic approach was carried out by political scientist Elinor Ostrom (1933-2012). Her best known contributions relate to the governance regimes for common-pool resources. However, those studies should be seen as specific applications of a much broader conceptual framework for the analysis of a large

[14] For discussions of the law-technology interaction from different perspectives see, e.g., J.B. Wiener, The Regulation of Technology, and the Technology of Regulation, 26 Tech. in Society 483 (2004); L.B. Moses, Recurring Dilemmas: The Law's Race to Keep Up with Technological Change, 2007 Ill. J. Law, Tech & Policy, no.2, 239; G.E. Marchant, Sustainable Energy Technologies: Ten Lessons from the History of Technology Regulation, 18 Widener L.J. 831 (2009).

number of institutional settings. The Institutional Analysis and Development (IAD) framework was first proposed in the eighties and then further refined and expanded over the years. The diagnostic approach builds on those early efforts.

The main goal of Ostrom's approach is to provide a metatheoretical framework which encompasses all situations where humans interact. The high number of variables and their possible combinations lead each discipline to develop its own language and to focus on different aspects. The IAD framework performs the function of a conceptual map which, much like geographical maps, guides scholars from different disciplines toward a common understanding of the impact that institutions have on individuals' and organizations' behaviour. From families to markets to legislatures and government agencies, all settings are amenable to the same type of analysis along the lines suggested by the IAD framework.[15]

According to Ostrom, the starting point should always be the action situation, that is the specific interaction involving two or more individuals with diverse preferences who act jointly to exchange goods and services, solve problems, dominate one another, or fight. They can be buyers and sellers, legislators, users of common-pool resources and so on. A common set of variables can be used to describe and analyze the action situation:

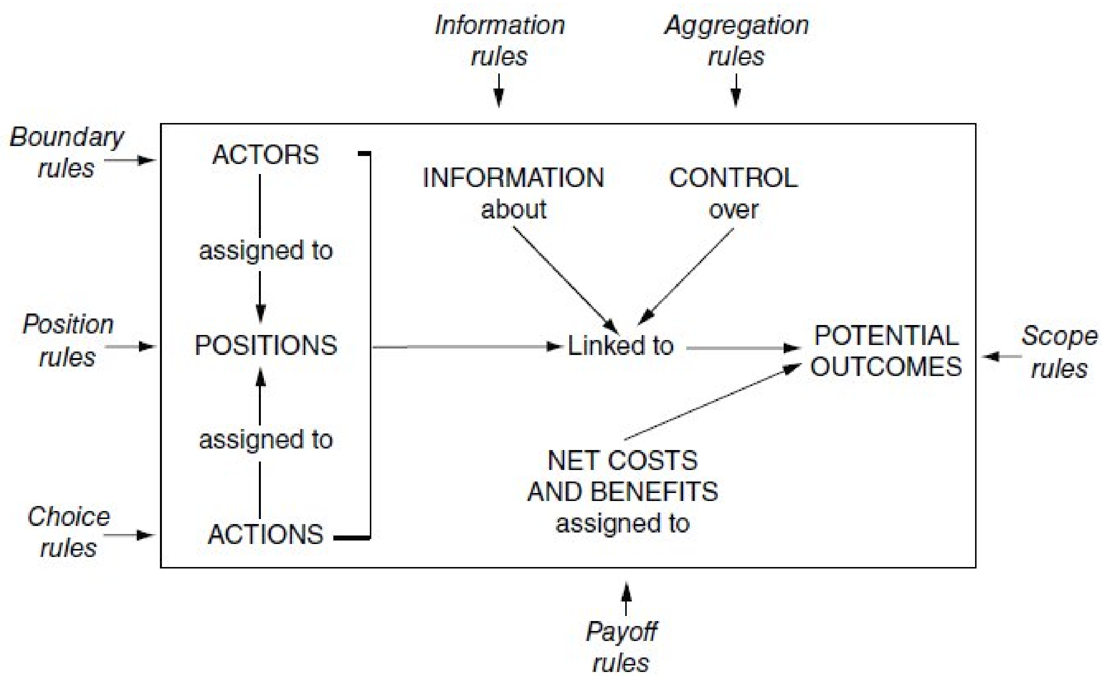
1) the set of participants and their attributes;
2) the positions allowing participants to take specific actions;
3) the potential outcomes of the interaction;
4) the set of allowable actions;
5) the control an individual has on the outcomes;
6) the information available to participants;
7) the costs and benefits (serving as incentives and deterrents) assigned to actions and outcomes.[16]

Figure 1 gives a graphical description of the working parts in the action situation and their relationships. The main advantage of this set of variables is to provide the researcher with a preliminary list of queries to answer before going on with a more detailed analysis. In her studies on common-pool resources, Ostrom focused on the types of rules which operate as

[15] See E. Ostrom, *Understanding Institutional Diversity* (Princeton University Press, 2005), 14f., 32; E. Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems', (2010) 100 *American Economic Review* 641. Also see M.D. McGinnis, 'An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework', (2011) 39 *Policy Studies Journal* 169.
[16] See Ostrom, *Understanding*, n … *supra*, 32-55.

external variables and affect each individual working part of the action situation. The next step is to use the empirical evidence on a large number of real action situations to identify the broader institutional regularities, or design principles, associated with systems which survive for long periods of time.

Figure 1. Elements of the Action Situation and the rules affecting them.



Source: E. Ostrom, above note …, 651.

A more ambitious framework has been recently proposed. It includes a larger set of variables and broaden the analysis to many other kinds of relationships between the action situation and other tiers. The main idea is that the highest-tier variables (depicted in Figure 2) can be further decomposed in second-tier and third-tier variables. The goal is to provide researchers and policymakers with a better understanding of how different combinations of microsituational and broader contextual variables affect decisions made by individuals. This is the core of the diagnostic approach.[17]

What value could the IAD and SES frameworks add to comparative research on regulatory systems? Two broad lessons are worth considering. Firstly, those frameworks can provide the starting point for designing a comparative study. The action situation provides each researcher with a starting point to organize empirical data. It should make it easier to communicate them to both researchers from other disciplines and policymakers. Hopefully, large-scale adoption of the framework might lead to a reduction of the resources policymakers need to absorb and process comparative information.

Secondly, both the IAD and SES frameworks leave scholars free to pursue any type of theoretical approach and to give priority to different aspects of the institutional context. Depending on methodological premises, a smaller or a larger number of variables could be included in the comparative study. Any factors affecting the regulatory decision-making process, from interpretation of authoritative texts to the structure of institutions, legal communities and their patterns of thought can be included in the analysis.[18] The reference to a common framework is only intended to ease the assessment of the strengths and weaknesses inherent to each methodology, as well as their usefulness for policymaking purposes. In no way it replaces other methodologies. For example, the Ostrom's frameworks do not provide any guide on the causal links among the parts of the action situation. This is the realm of theories and models.[19]

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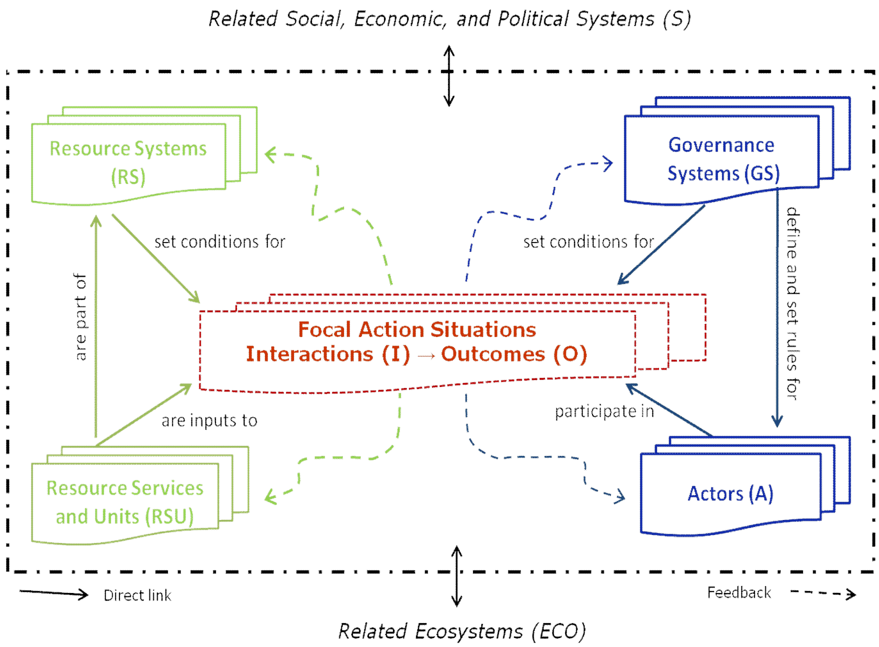
[17] E. Ostrom, 'A Diagnostic Approach for Going Beyond Panaceas', (2007) 104(39) *Proceedings of the National Academy of Sciences USA* 15181; E. Ostrom, 'A General Framework for Analyzing Sustainability of Social-Ecological Systems', (2009) 325 *Science* 419; A.R. Poteete e al., *Working Together: Collective Action, the Commons, and Multiple Methods in Practice* (Princeton UP, 2010), 234-245; M.D. McGinnis, 'Building a Program for Institutional Analysis of Social-Ecological Systems: A Review of Revisions to the SES Framework', working paper, 23 July 2010; M.D. McGinnis and E. Ostrom, 'SES Framework: Initial Changes and Continuing Challenges', forthcoming in Special Issue of *Ecology and Society*, draft version 10 July 2011.

[18] On these aspects see Gerber, 'System Dynamics', n … *supra*, 728-733; D.J. Gerber, 'Globalization and Legal Knowledge: Implications for Comparative Law', (2001) 75 *Tulane Law Review* 949, 959-963.

[19] According to Ostrom, 'Beyond Markets and States', n … *supra*, 646, a specific theory (e.g. game theory or transaction cost theory) "is used … to specify which working parts of the framework are considered useful to explain diverse outcomes and how they relate to one another ... *Models* make precise assumptions about a

Figure 2. Revised SES Framework with Multiple First-Tier Components



Source: M.D. McGinnis and E. Ostrom, 'SES Framework: Initial Changes and Continuing Challenges', forthcoming in Special Issue of *Ecology and Society*, draft version 10 July 2011, 20.

limited number of variables in a theory that scholars use to examine the formal consequences of these specific assumptions about the motivation of actors and the structure of the situation they face."

It is important to note that the multi-tier framework developed by Ostrom and colleagues is strongly related to the idea of polycentric governance, another major tenet in this literature. Explicitly introduced as an alternative to centralized authority, polycentric governance assumes that decision-making authority is dispersed among many different levels, with the most local ones given priority, at least until patent failures of self-governance are documented. No clear jurisdictional boundaries are assumed among levels. Each of them has some authority to develop rules and address specific problems. Advantages are claimed to be the exploitation of local knowledge, the building of trust-based relationships, better adapted rules, lower enforcement costs, reduced probability of failure because of the establishment of parallel and independent systems of rule making, interpretation and enforcement. At the same time, highly decentralized systems display some limits: inertia or failure of self-organizing efforts, local tyrannies and discrimination, stagnation, limited access to scientific information by local groups, conflicts within a group, inability to cope with large-scale resources.[20]

Ostrom was not the only scholar interested in institutional diagnostics. Political scientist Oran Young was probably the first author to explicitly delineate a diagnostic approach to institutional problems. Working in the field of environmental governance, Young first critically assessed the design principles proposed by Ostrom for the successful management of common-pool resources. He then suggested to identify elements of a problem which are relevant for solving it and to associate each element to a recommendation on design features. In its latest version, the same diagnostic approach is presented as a list of queries representing priority issues. The queries are grouped under four headings: 1) problems (e.g. cumulative or systemic, nonlinear and irreversible changes, impact of pre-existing institutional arrangements); 2) politics (e.g. dispersed or concentrated power, negotiation or conflicting interests); 3) players (e.g. rational behaviour or not, dimensions of the group, homogeneity); 4) practices (e.g. legally binding or informal agreements, stand-alone or embedded governance system).[21]

The priorities identified by Young are clearly influenced by the global environmental problems he has in mind. Other aspects could be relevant in different institutional settings. But the general procedure to add new queries should always follow the logic of disaggregating specific elements of the problem and finding their design implications. Like in

[20] See Ostrom, *Understanding*, n … *supra*, 281-286; E. Ostrom, ‘Beyond Markets and States’, n … *supra*, 643f. .

[21] See O.R. Young, *The Institutional Dimensions of Environmental Change* (MIT Press, 2002), 176-190; O.R. Young, Building Regimes for Socioecological Systems: Institutional Diagnostics, in O.R. Young et al. (eds.), Institutions and Environmental Change, MIT Press, 2008, 119-134.

Ostrom's framework, the most difficult issue is to manage complex combinations of elements. From this point of view, the theme of horizontal and vertical institutional interplay, developed by Young and other authors, displays many analogies to Ostrom's polycentric perspective. Here the main issue is to identify the causal mechanisms leading one institution to influence another one.[22]

In the field of economics, Dani Rodrik and his colleagues at Harvard University have proposed a growth diagnostics approach out of dissatisfaction with current theories on economic growth.[23] The latter are unable to explain why some countries grow and others not, why there are different growth speeds, why we observe economic miracles and collapses in different places at around the same time. Building on the observation that the broad variety of institutional solutions is the rule for growth strategies, Rodrik and his colleagues propose a diagnostic approach in three steps:

1) identify the most binding constraint on growth for a specific country;
2) try to remove that constraint with a policy measure as close as possible to the cause of the distortion;
3) try to devise institutions which can sustain growth over the long run.

As far as the first step is concerned, it clearly avoids the major pitfall of the Washington Consensus approach, that is the attempt to direct reforms to all possible targets. The growth diagnostics approach tries instead to find out those areas where reforms will yield the greatest return. To this end, diagnostic signals are sought for to identify the most important binding constraints in each economy. Sometimes co-variation of related variables shows which problems should be given priority. In other cases, the attempts of the private sector to escape from binding constraints provide evidence about their negative impact. In comparing different countries, the type of economic agents thriving or doing poorly in different sectors can help to establish the intensity of the constraint.

For the purposes of this paper, it is interesting to note that Rodrik's diagnostics has been taken up by the OECD in the Green Growth strategy. Two categories of constraints to

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[22] See Young, *The Institutional Dimensions*, n … *supra*, ch. 4 and 5; T. Gehring and S. Oberthür, 'Interplay: Exploring Institutional Interaction', in Young et al., *Institutions*, n … *supra*, 187-223; S. Oberthür and O.S. Stokke (eds), *Managing Institutional Complexity* (The MIT Press, 2011).

[23] D. Rodrik, *One Economics Many Recipes: Globalization, Institutions, and Economic Growth* (Princeton University Press, 2007), 56-95; D. Rodrik, 'Diagnostics Before Prescription', (Summer 2010) 24 (3) *Journal of Economic Perspectives* 33; R. Hausman et al., 'Doing Growth Diagnostics in Practice: A "Mindbook"', Center for International Development, Harvard University, Working Paper no. 177, September 2008, 22.

green growth are identified: a) low economic returns, encompassing factors which create inertia in economic systems, and b) low appropriability of returns, including market and government failures which prevent people from capturing the full value of improved environmental outcomes and efficiency of resource use. Several indicators, coupled with country-specific information, should help identify the key constraints and the environmental country-level priorities. Strategies to implement the least-costly policy options should then be implemented.[24]

Other diagnostics proposals can be found in the field of innovation studies. For example, Charles Edquist develops a diagnostic analysis which focuses on measuring the performance of innovation systems and on identifying the causal relationship between the performance and the main activities carried out in each system.[25] More generally, several theoretical frameworks in innovation studies can be loosely associated with a diagnostic approach. Attempts at identifying the main elements and activities of innovation systems clearly point to the need to trace the dominant influences across technological domains, actors and levels.[26] Integration of such frameworks is still to be accomplished. Moreover, their relationship with other disciplines is an underexplored subject. But a diagnostic approach seems able to supply the kind of meta-framework which exploits the potential of each theory while at the same time fostering the dialogue among different disciplines.

As far as the diagnostics of regulatory frameworks for green innovation is concerned, the challenge lies in connecting the approaches described above to the analysis of the legal dimension. The main research problem is to identify the institutional factors which impact (positively or negatively) on innovation processes. At the same time, the analysis should provide information which allows meaningful comparisons across regulatory systems.

The following two sections use the policies adopted in the US and the EU to foster the digital transformation of the electricity grids as a case study for exploring the viability of the diagnostic approach. Smart grids (SGs) represent a systemic transformation for the electricity

[24] OECD, Towards Green Growth, 2011, 125-131.

[25] C. Edquist, Design of Innovation Policy Through Diagnostic Analysis: Identification of Systemic Problems (or Failures), 20(6) Ind. & Corp. Change 1725 (2011).

[26] For example, K. Hillman et al., Fostering Sustainable Technologies: A Framework for Analysing the Governance of Innovation Systems, 38(5) Sci. & Pub. Policy 403 (2011), provide a three-fold distinction for the governance of innovation systems along the following analytical dimensions: who governs, how to govern, and what to govern. They then suggest that the functionality of innovation systems will be influenced by governance choices on each dimension. For reviews of the main systemic approached to innovation and proposals for their integration see J. Markard and B. Truffer, Technological Innovation Systems and the Multi-level Perspective: Towards an Integrated Framework, 37 Res. Policy 596 (2008); L. Coenen and F.J.Díaz López, Comparing Systems Approaches to Innovation and Technological Change for Sustainable and Competitive Economies: An Explorative Study into Conceptual Commonalities, Differences, and Complementarities, 18 J. Cleaner Prod. 1149 (2010).

sector. The large-scale implementation of a wide collection of technologies should completely change the management of each segment of the electricity supply chain, from generation to final consumption. Many different types of hardware, software, application and communications technologies are involved, with varying levels of maturity and development speeds. There is a wide agreement on the gradualism of this technological transformation, which could span decades.[27] At the same time, much uncertainty surrounds the paths to be taken and the future equilibria of electricity markets.

Judging from market trends forecasts, bright scenarios are at hand: in Europe the SG market will be worth $9,1 billion by 2020, with a cumulative value of over $80 billion in the next 10 years; the US market could grow to $56 billion in 2016. [28] Large public investment programs have already been undertaken in developed and developing countries. The many benefits stemming from SGs seem to suggest that such private and public investments are fully justified. SGs will reduce GHG emissions, ease integration of renewable sources, optimize grid operations, and provide innovative services for consumers.

Though, a closer reading reveals that SG benefits are hard to quantify and depend to a large extent on significant changes in business models, consumer behaviour and regulatory frameworks.[29] Moreover, no one seems to believe that the same solutions for these three issues will be adopted in all countries.[30] Even within the same country, some degree of variation is expected.

Besides economic factors, the pace and direction of SG implementation seems deeply affected by several institutional factors: national or regional energy policies, structure of the standardization process, jurisdictional boundaries, extent of international cooperation, strength of traditional legal concepts. Hence, both the central role played by SGs in climate change policies and the uncertainty surrounding the regulatory innovations aimed at supporting their large-scale deployment suggest that this subject lends itself to a diagnostic analysis. At the same time, a comparative perspective is needed because the global dimension

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[27] For a roadmap to 2050 see, e.g., IEA, Technology Roadmap – Smart Grids, OECD/IEA, April 2011, which also provides (p. 17-20) an overview of SG technologies.

[28] See, respectively, Pike Research, Smart Grids in Europe – Executive Summary, 2011, 4, available at www.pikeresearch.com (last visited …); Lucintel, Global Opportunities in Global Smart Grid Market 2011-2016: Trends, Forecast, and Market Share Analysis, December 2011, available at … (last visited …).

[29] See, e.g., P.L. Joskow, Creating a Smarter U.S. Electricity Grid, 26 (1) J. Econ. Persp. 29 (2012) (concluding that "there is a lot of uncertainty about the size of costs and benefits, and this costs and benefits vary across distribution feeders as well as customers and regions"); L.J. Makovich, The Smart Grid Separating Perception from Reality, Issues in Science and Technology, Spring 2011 (arguing that "the direct benefits of smart grid investments have not yet proven certain or significant enough to fully offset the costs of implementation").

[30] World Economic Forum, Accelerating Smart Grid Investments, 2009, 12-17 (SG architecture will depend on the legacy characteristics of the power grid and the primary drivers for implementation).

of the SG market increases interest in international cooperation and in regulatory convergence.

Following the comparative diagnostics approach presented in the previous section, the analysis will focus on:

1) indentifying the focal action situation. For SG policies, this means asking how the large-scale deployment of smart grid technologies is framed as a regulatory problem;
2) position rules for access to innovation processes;
3) information rules on communication channels;
4) the relationships among local, national and international regulatory levels.

As far as the focal action situation is concerned, several competing frames for SG implementation can be detected:

a) the climate change frame;
b) the green innovation frame;
c) the cybersecurity frame
d) the Single Market frame

Each frame can coexist with the others. But their relative importance varies in different countries or regions. Framing processes have been widely discussed in policy studies.[31] The choice of the frame is influenced by several elements of the institutional context. But It is clear that how a technological innovation is perceived and defined affects the response provided by regulators. Hence, differences in framing processes lead to divergences in regulatory options.

Position rules and information rules are but two of the seven external variables employed in Ostrom's framework. A more extended analysis requires an in-depth exploration of each variable. In this preliminary inquiry, a focus on two categories of rules most relevant for technological innovation will suffice. Position rules define the role held by each actor and

[31] For reviews of the literature see F. Polletta and M.K. Ho, 'Frames and Their Consequences', in R.E. Goodin and C. Tilly (eds), *The Oxford Handbook of Contextual Political Analysis* (Oxford University Press, 2006), 187; M. Hajer and D. Laws, 'Ordering Through Discourse', in M. Moran et al. (eds), *Oxford Handbook of Public Policy* (Oxford University Press, 2006), 251, 256-259; M. Rein, 'Reframing Public Policy', *ibid*, 389, H. Wagenaar, Meaning in Action: Interpretation and Dialogue in Policy Analysis, Sharpe, 2011, 81-90.

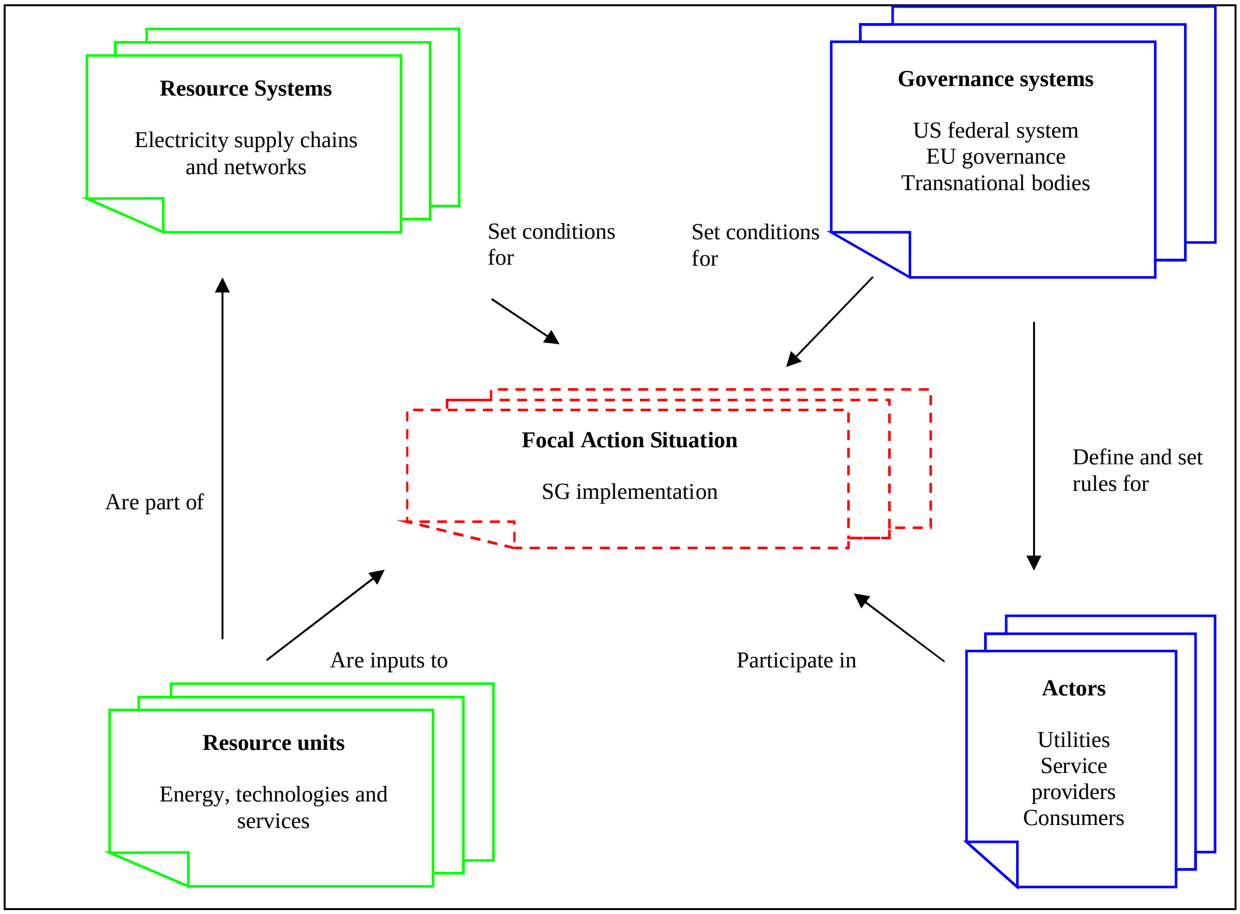
the actions she is entitled to take. In innovation systems, position rules can establish conditions for participating to standardization processes, regulatory proceedings or self-regulation. They can also provide (or prevent) access to different regulatory levels. Information rules define channels of communication among actors and the kind of knowledge they share. Considering the central role of learning processes in any innovation system, how communication channels are designed will determine both the rate and direction of technological innovation. With regard to SG policies, the analysis will focus on the regulation of customers' personal data collection and distribution which is made possible by the digitalization of the grid. How the huge amount of personal data can be used by utilities and other service providers affects not only the choice of business models, but also the balance among competing interests in the energy sector.

The relationships among regulatory levels are one of the most distinctive traits in any national or supranational legal system. Such relationships are usually embedded in long-standing traditions, hence not amenable to quick changes. Moreover, many aspects of technological innovation, from standardisation processes to information flows, are directly affected by the distribution of decision powers among levels. Hence, a multi-level analysis is needed to understand prospects for regulatory convergence or divergence.

The interaction of these three institutional components goes a long way towards explaining similarities and differences in the regulation of green technologies across countries. To be sure, this kind of comparative inquiry only provides policymakers a simplified picture of a regulatory system. But it avoids the pitfalls of de-contextualized information usually supplied by reports of best practices. The goal of the diagnostic approach is not to identify optimal solutions, but to shed light on the dynamics of regulatory systems and suggest the elements which are amenable to change.

Figure 3 presents the overall diagnostic framework for SG implementation. The following three sections apply the diagnostic approach to the governance tier in US, EU and at transnational level. The main goal is to understand how the broader institutional context affects the choice of regulatory tools. This kind of analysis may also provide useful insights for exploring the other tiers of the diagnostic frameworks and their relationships with the governance tier.

Figure 3. Diagnostic framework for SG implementation.



Source: adapted from M.D. McGinnis and E. Ostrom, 'SES Framework: Initial Changes and Continuing Challenges', forthcoming in Special Issue of *Ecology and Society*, draft version 10 July 2011, 20.

3. Smart grid policies in the US

We can start with a discussion of dominant frames. Research on SGs was already ongoing on both sides of the Atlantic in the early years of the twenty-first century. However, it was driven by different visions of future grids. In the US priority was given to increasing security for a largely centralized power grid. In the EU the main issue was integrating several national networks with large amounts of distributed generation and renewable energy.[32] This

[32] See D. Coll-Mayor et al., Future Intelligent Power Grids: Analysis of the Vision in the European Union and the United States, 35 Energy Pol'y 2453 (2007).

is not to say that points of convergence could not be found. Common interests in developing SG technologies have led to several transatlantic collaborations. As we shall see in section 5, these collaborations also cover regulatory aspects. But the many institutional factors affecting SG implementation in the US and the EU can hardly be overlooked.

When the Congress enacted the Energy Independence and Security Act (EISA) in 2007, the opening section of the title devoted to SG (sec. 1301) referred to the goal of maintaining "a reliable and secure electricity infrastructure that can meet future demand growth". The shadow of the 2003 blackout is clearly visible there. The list of more specific objectives following the policy statement clearly points to support for advanced technological solutions. Hence, security and innovation were the main driving factors.[33] A third factor can be identified in the restructuring process of electricity markets. While the impulse of the Federal Energy Regulatory Commission (FERC) has led to a substantial transformation of the wholesale segment, state programs for introducing competition in the retail electricity markets have been implemented unevenly.[34] SG technologies enabling consumers to actively manage their electricity consumption and to buy innovative services could change the relationship with traditional utilities and open new business opportunities for other categories of players. From this point of view, SGs can be perceived as the missing link for completing the restructuring of US electricity markets.

Not surprisingly for a country without a federal legislation on climate change, other benefits related to the reduction of GHG emissions were not mentioned. The most recent policy statement on SGs by the Obama administration does not propose any significant changes of direction. Even though it makes several references to the integration of clean energy sources and the improvement of energy efficiency, the four main pillars identified in the report are: 1) enabling cost-effective smart grid investments; 2) unlocking the potential for innovation in the electric sector; 3) empowering consumers and enabling them to make informed decisions; 4) securing the grid.[35]

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[33] See, in the same vein, N. Foster, To Begin the World Anew: Smart Grids and the Need for a Comprehensive U.S. Energy Policy, in D. Korany (ed.), Transatlantic Energy Futures, Center for Transatlantic Relations, Washington, DC, 2011, 104f., available at http://transatlantic.sais-jhu.edu (last visited …). According to A.C. Graab, The Smart Grid: A Smart Solution to a Complicated Problem, 52 Wm. & Mary L. Rev. 2051 (2011), EISA should be interpreted as putting on the same plane the two goals of grid reliability and reduction of US oil dependence.

[34] Updated data on electricity state restructuring

[35] National Science and Technology Council, A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future, June 2011.

Of course, policy statements are attempts to frame problems in ways that allow the deployment of the needed resources and to obtain the desired outcomes.[36] But they also define the direction of both technological innovation and regulatory intervention. To the largest possible extent, incentives for public and private R&D investments will be granted in those same areas which the policy statements consider of primary importance. Similarly, regulators will be pressed to dismantle barriers to the chosen goals.

This kind of top-down process will not always work smoothly. In some cases it will meet strong resistance to change. For example, the transformation of public utilities from suppliers of electricity to suppliers of services will not be easy to accomplish. In other cases, bottom-up pressures from the industry or the regulators will affect the pace and direction of change. While a similar clash of conflicting interests may be expected in every regulatory system, the interesting question is how the American institutional context affects the final outcome. Two aspects of SG implementation could provide some hints on this issue. The first one is the approval process of the SG interoperability standards. The second one is the role played by the notions of cybersecurity and consumer privacy. The balance of this section shows that the solutions being adopted for both challenges are tightly linked to deep-seated features of the US regulatory system.

Let's begin with the standardization process. Traditionally, the American standardization system follows a market-based approach. Standards are developed by a multiplicity of private organizations and then freely adopted by producers and users. The main advantage of such an approach is the strong incentive to develop innovative products that can outperform competing ones. The main disadvantage is the duplication of standardization efforts and a low level of interoperability.[37] The federal government has never tried to change the market-based approach. The National Technology Transfer and Advancement Act of 1995 directed federal agencies to use technical standards developed by voluntary consensus standard bodies. Federal agencies have also contributed to the standardization processes, but within public-private partnerships.[38]

[36] On framing climate change see D. Jamieson, The Nature of the Problem, in J.S. Dryzek et al. (eds.), The Oxford Handbook of Climate Change and Society, Oxford UP, 2011, 38.
[37] See T. Büthe and W. Mattli, The New Global Rulers, Princeton UP, 2011, 148-151. The authors' main thesis is that the fragmentation of the US standardization system put US firms at a disadvantage in international standard-setting bodies.
[38] See National Science and Technology Council, Subcommittee on Standards, Federal Engagement in Standards Activities to Address National Priorities: Background and Proposed Policy Recommendations, October 2011, available at … (last visited …).

When the fragmentation of the US standardization system became a problem for global competition, more coordination was sought, but little has changed so far.[39] Only in a few strategic sectors the federal government took on a leadership role. Even in these cases, the government's role was to coordinate different categories of stakeholders and to accelerate the process.[40] There seems to be a clear perception that any attempt to introduce stronger centralization or mandatory standards would be doomed to failure.

SG interoperability standards are one sector in which the US government took on a leadership role. Sec. 1305 EISA directed the National Institute of Standards and Technology (NIST), a non-regulatory federal agency within the US Department of Commerce, to coordinate the development of a framework to achieve interoperability of SG devices and systems. When a sufficient consensus has been reached, the FERC shall "adopt" NIST standards for interstate transmission and wholesale markets under its jurisdiction.

Supported by significant appropriations in the federal budget, in a short time NIST was able to gain a prominent place in SG implementation. In November 2009 it launched the Smart Grid Interoperability Panel (SGIP), the main coordination forum for the development of standards.[41] An initial set of standards was published in January 2010, followed in February 2012 by an expanded and updated release.

While NIST was charged with the task of coordinating hundreds of stakeholders, the standardization process it designed was nevertheless constrained by the fragmentation of the US system. The broadest participation of different categories of industry representatives, standard-setting and standard-developing organizations, as well as local and state regulators, was actively sought. Moreover, in an attempt to influence international standardization efforts, NIST opened its process to representatives of foreign countries. The complexity of the whole process leads to a significant increase of the informational and financial resources each stakeholder has to invest to make a meaningful contribution to the standardization process. It turns out that only some categories are able to make the needed investments. This is reflected in an imbalance of the SGIP voting system. Utilities, together with state and local regulators, only represent 10% of SGIP membership, while vendor and vendor-related categories represent 50% of SGIP membership. The majority threshold (50% or 75%) required in the

[39] See Büthe and Mattli, above note …, 218f.. See also ANSI, United States Standards Strategy, December 2, 2010, 15 (observing that "The diversity of the sector-based, decentralized U.S. standardization system can result in duplicative efforts and sometimes overlapping or conflicting standards").
[40] See National Science and Technology Council, above note …, 6-8.
[41] As of January 2012, the SGIP included over 740 member organizations and over 1900 member representatives. Canada had the largest foreign membership with 29 representatives. Other countries were represented by 58 members. See National Institute of Standards and Technology, NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0, February 2012, 142.

SGIP assembly allows the approval of standards without the agreement of utilities and regulators.[42]

This situation confirms what has already been observed with reference to other standardization processes. Instead of a neutral selection of the best technological solution, the choice of standards involves a distributional conflict in which each category of stakeholders tries to affirm its preferences. There are winners and losers, with the latter incurring higher production costs and even risk of bankruptcy.[43]

In the SGIP process, conflicting preferences are clearly visible in the utilities and in the IT, computing and communications industries. The former are accustomed to a slow pace of technological change and want to avoid the risk of stranded costs, that is costs that cannot be recovered through tariffs. The latter entered the SG arena with the expectation to drive the market toward their favoured solutions. One of the strongest points of contrast is about a grid architecture which assumes the traditional electricity meter as the only gateway to two-ways information flows and the opposite view that asks for several alternative gateways. Pushing the standardization process in the first direction would advantage the utilities, while alternative service providers would benefit from the second direction. Other categories of stakeholders may hold conflicting preferences as well. For example, standard-setting organizations could try to impose their own standards, or manufacturers could try to impose technologies they patented. The SGIP process does not seem immune to these problems.[44]

Distributional conflicts in the standardization process will affect the rate and direction of technological innovation. The solutions that are selected will confer a distinctive character to SG implementation in the US. They will not only reflect the goals of energy policy, but also the preferences of dominant stakeholders. Those same preferences will then be projected at the international level and a new battle on standards will be fought.

Besides private actors' preferences, it is clear that several public actors can shape SG implementation. EISA conferred a specific power on the FERC. But the blurring of lines between the communications and electricity industry leads to the direct involvement of the Federal Communications Commission (FCC). Additionally, several governmental departments and federal agencies are involved in cybersecurity and privacy issues raised by

[42] Smart Grid Advisory Committee Report, March 5, 2011, 19f., available at … (last visited …).
[43] Büthe and Mattli, above note …, 11f..
[44] See Paths to Smart Grid Interoperability: A Smart Grid Policy Center White Paper, GridWise Alliance, May 2011, 27-30 (different rates of technological change and divergent interests), 33 (contrast on gateways). With regard to intellectual property rights, J.L. Contreras, Gridlock or Greased Lightning: Intellectual Property, Government Involvement and the Smart Grid, AIPLA 2011 annual meeting, October 20, 2011 (available at www.ssrn.com , last visited …), 16, observes that "NIST and SGIP have taken few concrete steps to toward implementing mechanisms to avoid patent hold-up and stacking in Smart Grid standards."

SG implementation. Finally, US states are actively contributing to the development of the regulatory framework for SGs. To what extent this multiplicity of public bodies and jurisdictional boundaries is affecting the selection of standards ?

Evidence of a direct impact can already be found in the architectural choices, that is the selection of the reference model which describes the relationships among actors in different domains, communications paths and requirements for the development of lower-levels applications and equipments. NIST observes that the US regulatory framework for the energy sector, with its peculiar division of competences between the FERC and state public utilities commissions (PUCs), underlies the chosen reference model.[45] Of course, a different distribution of regulatory powers can be found elsewhere, so to the extent that architectural choices are tightly linked to the US regulatory framework they cannot be deployed in other countries unless adaptation costs are incurred. Though, in its discussion of international cooperation NIST never explains how this problem should be addressed.

The impact of the US regulatory framework on the standardization process becomes even clearer in the debate about the proper role of the FERC. Already in 2009 the federal regulator issued a policy statement on SG in which priorities for standard-setting were identified. NIST focused its work on those same priorities.[46] Hence, a strong interaction between regulatory and technological processes is visible from the outset. Such interaction became even more visible when NIST asked the FERC to adopt a group of standards it had selected. After several rounds of consultations, the FERC concluded that no sufficient consensus had been achieved.[47] Almost all categories of stakeholders expressed their dissent on regulatory adoption. Reasons ranged from lack of satisfactory cybersecurity safeguards to insufficient lab testing to difficulties with the accessibility of documents and the whole standardization process. But an underlying theme was that the FERC did not clarify the nature of its authority on the adoption of SG standards.

In its 2009 policy statement, the federal regulator observed that EISA did not make any standards mandatory, but left open the possibility to use its general authority under the Federal Power Act of 1935. Moreover, the FERC found that EISA conferred upon it the authority to adopt standards for the distribution and retail levels, that is outside its usual

[45] NIST, above note …, 41f..
[46] FERC, Smart Grid Policy, 128 Ferc ¶ 61,060 (July 16, 2009); NIST, above note …, 23-25.
[47] FERC, Smart Grid Interoperability Standards, 136 Ferc ¶ 61,039 (July 19, 2011).

jurisdiction. At the same time, it conceded that ratemaking authority and standard compliance monitoring had to be left to state regulators.[48]

This statement did not provide definitive answers on the two most pressing issues, that is the mandatory or voluntary nature of the standards and the vertical relationship with state regulators. NIST and SGIP themselves, while submitting the standards for FERC's adoption, argued that, should the standards become mandatory, innovation could be stifled and the voluntary participation of the industry to the standardization process could be discouraged. Even the US government, while acknowledging that EISA delegated to the FERC the task of defining the meaning of sufficient consensus and adoption, suggested that the standards should be recommended as best practices in the field.[49] But at least some parts of the electricity industry seemed to believe that an entirely voluntary standardization process would be incompatible with the EISA mandate.[50] An additional problem, pointed out by a GAO report, was that the FERC did not have monitoring mechanisms on industry compliance with voluntary standards and effective enforcement tools besides its general authority on reliability and costs.[51] In its policy statement, the federal regulator suggests a two-tier system, with the higher level setting the standards and the lower level monitoring their adoption. This collaboration could become problematic as soon as state regulators decide to follow different SG implementation programs or are not willing to allow full recovery of investments conforming to FERC standards. So far, state regulators stuck to traditional jurisdictional boundaries, without acknowledging the increased interdependence among the different parts of the electricity systems which stems from SG implementation.

Cybersecurity and privacy issues raised by SG implementation highlight other peculiar features of the US regulatory system. Again, jurisdictional boundaries are murky. Moreover, cybersecurity is a national priority which downplays any other goals and affects both the standardization process and the balance with consumer privacy.

[48] FERC, above note …, 13-18. A FERC-NARUC Smart Grid Collaborative was created to facilitate the transition to the SG, but state regulators have constantly reaffirmed their intention to stick to traditional jurisdictional boundaries: see, e.g., NARUC, Resolution on Smart Grid Principles, July 20, 2011 ("Federal policies should not interfere with State jurisdiction or programs but help ensure that consumers can receive the full benefits of smart grid deployments").

[49] NSTC, above note …, 29f.. The report suggested to follow the US Nuclear Regulatory Commission model: the federal regulator encourages the utilities to rely on the NIST Interoperability Framework for guidance, but leaves it to the individual utilities to decide how best to comply.

[50] Comments on the adoption of the standards submitted by the NIST in late 2010 are discussed by B.W. Radford, Techno-regulation: The Smart Grid and the Slippery Business of Setting Industry Standards, Pub. Utilities Fortnightly, June 2011, 26.

[51] Government Accountability Office, Electricity Grid Modernization: Progress Being Made on Cybersecurity Guidelines, but Key Challenges Remain to be Addressed, January 2011.

The protection of critical infrastructures from cyberattacks has been the object of an intense debate. On the legislative side, the Homeland Security Act of 2002 assigned the new Department of Homeland Security (DHS) a key role in coordinating the development and implementation of protective measures. Sector-specific agencies were entrusted with the task of working in partnership with the private sector to assess and understand cyber risk.[52] However, there has been no major legislative intervention on cybersecurity in the last decade. More than 40 bills and resolutions on this matter have already been introduced in the 112th Congress (more than 60 in the 111th Congress). The White House proposed its own, comprehensive proposal in April 2011.[53]

Despite this high level of attention to cybersecurity, there seems to be no consensus on the magnitude of the risks involved and on the best strategies to address them. It has been argued that there is no verifiable evidence of the real danger for critical infrastructures. Different kinds of problems are often conflated to justify sweeping regulatory interventions. But without a clear definition of the nature and extent of cyber risks any proposal may be driven by the interests of the cyber-industry and by political competition for public funds.[54] Moreover, cybersecurity may be another instance of technopanics and fear cycles, that is psychological and institutional mechanisms fuelling the tendency to inflate the threats stemming from a new technology and to adopt mutually reinforcing behaviours which perpetuate societal fears.[55] Disagreement can also be observed on the choice of regulatory strategies. Both legislative proposals and the academic debate advance arguments in support of a wide range of tools. In order of decreasing coerciveness, they include criminal enforcement, mandatory standards, tort liability, information sharing, incentives and subsidies, self-governance, insurance.[56]

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[52] See Government Accountability Office, Critical Infrastructure Protection: Cybersecurity Guidance Is Available, but More Can Be Done to Promote Its Use, December 2011.
[53] See E.A. Fischer, Federal Laws Relating to Cybersecurity: Discussion of Proposed Revisions, Congressional Research Service, December 22, 2011; E.C. Liu *et al.*, Cybersecurity: Selected Legal Issues, Congressional Research Service, March 14, 2012.
[54] See J. Brito and T. Watkins, Loving the Cyber Bomb ? The Dangers of Threat Inflation in Cybersecurity Policy, 3 Harv. Nat. Sec. J. 39 (2011). See also P. Rosenzweig, Cybersecurity and Public Goods: The Public/Private "Partnership", in P. Berkowitz (ed.), Emerging Threats in National Security and Law, 2011, 7, available at www.emergingthreatsessays.com (last visited …) (observing that "we lack a solid quantifiable risk assessment of the cyber threat to national security and this leaves policy makers only with a speculative guess as to the extent of our risk from a cyber attack by a willful cyber opponent").
[55] See A. Thierer, Technopanics, Threat Inflation, and the Danger of an Information Technology Precautionary Principle, Mercatus Center, George Mason University, Working Paper No. 12-09, February 2012.
[56] For the content of legislative proposals see references in note 38 above. In the academic debate see generally M. Grady and F. Parisi (eds.), The Law and Economics of Cybersecurity, Cambridge UP, 2006; Rosenzweig, above note …, 11-25; N.A. Sales, Regulating Cybersecurity, forthcoming Nw. U. L. Rev., available at www.ssrn.com (last visited …).

Heightened attention to cybersecurity is visible in the electricity sector, too. The grid is a critical infrastructure which could be exposed to new vulnerabilities because SG implementation will increase the number of devices and connections.[57] Still, reliable evidence on the extent of such vulnerabilities is difficult to come by. For example, no major blackout in the last few years was connected to cyber attacks, nor suspicions about power grids being infected by hackers have been confirmed.[58]

Lack of evidence is not preventing federal authorities from actively promoting cybersecurity standards. The Energy Policy Act of 2005 introduced a dual system for ensuring the reliability of the US electricity system. The FERC shall approve the standards developed by the National Electricity Reliability Council (NERC), a private corporation. Upon approval, the standards become mandatory. Enforcement powers are shared between the two bodies. In the last few years, the FERC has directed NERC to tighten cybersecurity standards.[59] However, NERC's process for developing such standards has been judged unsatisfactory under several respects. First of all, the standards must be approved by the regulated entities themselves. This means that the least costly option could be chosen.[60] Secondly, the process can take a long time and the FERC does not have the power to adopt its own standards or issue orders when urgent action is required.[61] Thirdly, NERC's reliability and cybersecurity standards are only mandatory for the "bulk power system", which does not include local distribution infrastructures and grids in some major cities like New York.[62]

There are clear intersections between NIST and NERC standardization processes. The former coordinates the cybersecurity strategy for SG with its Cybersecurity Working Group

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[57] See National Science and Technology Council, above note …, 49f..

[58] Brito and Watkins, above note …, 54f.. In a congressional testimony, GAO's representatives G.C. Wilshusen and D.C. Trimble provided some examples of cyber incidents in power infrastructures. But such incidents had different causes and do not seem directly related to the "potential vulnerabilities" of the SG: see GAO, Cybersecurity: Challenges in Securing the Modernized Smart Grid, February 28, 2012, 10f..

[59] FERC, Order No. 706, Mandatory Reliability Standards for Critical Infrastructure Protection, 122 F.E.R.C. ¶ 61,040 (2008). A detailed description of the follow-up standardization process is provided by Z. Zhang, NERC's Cyber Security Standards: Fulfilling Its Reliability Day Job and Moonlighting as a Cyber Security Model, 2001, available at www.ssrn.com (last visited …).

[60] See R.J. Campbell, The Smart Grid and Cybersecurity – Regulatory Policy and Issues, Congressional Research Service, June 15, 2011, 13f..

[61] See Testimony of J. McClelland, Director, Office of Electric Reliability, Federal Energy Regulatory Commission, before the Committee on Energy and Commerce, Subcommittee on Energy and Power, US House of Representatives, May 31, 2011; J. Wellinghoff, Letter to senators Inouye and Cochran, February 14, 2012. Legislative proposals pending in Congress would confer the FERC the power to issue emergency orders: see Campbell, above note …, 20 (describing H.R. 668); Fischer, above note …, 13f. (S. 1342 and H.R. 5026, passed by the House in the 111th Congress and then introduced in the 112th Congress in May 2011).

[62] With Orders Nos. 743 of November 2010 and 743-A of March 2011, the FERC directed NERC to revise its interpretation of the bulk power system so as to include any facilities that could significantly affect reliability. But Naruc's resolution of July 20, 2011, objected that "standards designed for the bulk system applied to the local distribution system can be inappropriate and overly costly and can undermine the reliability of the entire system".

(CSWG), now integrated as a standing working group in SGIP. The CSGW first set up the requirements to be accounted for when selecting SG standards in an interagency report.[63] Existing and new standards are reviewed and assessed from the point of view of cybersecurity on a rolling basis.[64] One criticism levelled at the CSWG is that it has been unable so far to coordinate with the several other bodies engaged in cybersecurity activities at the federal level.[65] Another problem is the compatibility between interoperability and cybersecurity, with the latter making more difficult to achieve the former.[66]

Whatever the weaknesses of NIST's cybersecurity strategy, the FERC directed the NERC to consider NIST's cybersecurity guidelines for inclusion in its own reliability standards for critical infrastructures.[67] This means that NIST cybersecurity standards are going to become mandatory to a large extent through the NERC-FERC process. Besides usual objections about the chilling effects of mandatory standards on innovative products, it is possible that US cybersecurity standards will not gain widespread acceptance at international level because many other countries are less concerned with cyber attacks.[68]

An additional problem is that in the US standardization process cybersecurity issues are influencing the approach to the privacy issues raised by the SG. This is clearly visible in the organization of the CSWG, which includes a standing sub-group on privacy. In other contexts, too, the tight relationship between cybersecurity and privacy is increasingly taken for granted.[69]

SG implementation raises several privacy concerns. A huge amount of data on consumers' behaviour will become available. Different categories of market players and public authorities will be interested in accessing such data. Moreover, risks of unauthorized uses will become larger. Regulating information flows is crucial both from a business and a consumer perspective. As to the former, regulatory choices on access and control of personal information will have an impact on the competition between different business models. As to

[63] National Institute of Standards and Technology Interagency Report (NISTIR) 7628, August 2010.
[64] CSWG's activities are described in NIST, above note …, 167-176.
[65] See SGAC report, above note …, 20f..
[66] See D. Deblasio, Achieving Interoperability: The Smart Grid Requires Utilities and Regulators to Assert Leadership, Public Utility Fortnightly, October 2011, 62 ("Do we need standards for cyber security to counter the interoperability standards we're writing for smart grids ?")
[67] See already FERC's Order 706, above note …, par. 25, and more recently FERC, Version 4 Critical Infrastructure Protection Reliability Standards, Order No. 761, 139 FERC ¶ 61,058, April 19, 2012, par. 92-95.
[68] The literature explaining differences in US and EU risk regulation is relevant here: see, e.g., D. Vogel, The Politics of Precaution, Princeton UP, 2012 (highlighting public pressures, policy preferences, and criteria for assessing and managing risks); C.R. Sunstein, On the Divergent American Reactions to Terrorism and Climate Change, 107 Col. L. Rev. 503 (2007) (highlighting behavioural factors).
[69] For example, GAO, above note …, 9, includes unauthorized disclosure and use of private information among the potential vulnerabilities associated with SG cybersecurity.

the latter, adequate levels of data protection will foster trust in the new SG technologies and lead to widespread acceptance by consumers.

US states may choose to balance in different ways consumers' individual rights to control the flow of information and grid security. California was the first state to adopt privacy regulations for the SG in July 2011.[70] It left open the possibility to implement advanced approaches like privacy by design, which is grounded in the idea that privacy should not be traded off with the goal of security.[71] However, other states left more discretion to utilities in managing some categories of customers' data.[72] To be sure, the federal government tried to give some guidelines on privacy for SG.[73] Moreover, the proposals for comprehensive frameworks on privacy issues advanced at federal level may ease convergence on common models.[74] But in the name of flexibility, different regulatory options on crucial issues (ownership of data, opt-in or opt-out systems, roles of utilities and other kinds of energy services providers, extent of the customer's consent requirement) are left open. It is still not clear whether a dominant approach to SG privacy will come out or the US states will stick to their own preferences. Of course, the latter outcome will increase compliance costs for the industry and slow SG implementation.[75] Convergence may also be hampered by uncertainty on jurisdictional boundaries. With new functionalities made available by two-ways communications on the SG and new energy services providers competing side-by-side with

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[70] California P.U.C. Decision 11-07-056, Docket R. 08-12-009, July 28, 2011. See J.R. Forbusch, Regulating the Use and Sharing of Consumption Data: Assessing California's SB 1476 Smart Meter Privacy Statute, 75 Albany L. Rev. 341 (2012).

[71] See A. Cavoukian, Smart Grid Privacy 101: Privacy by Design in Action – Power Morning – A Primer for Regulators, 2010, available at www.privacybydesign.ca (last visited …). A Resolution on Privacy by Design was adopted at the 32nd International Conference of Data Protection and Privacy Commissioners, Jerusalem, 27-29 October, 2010, available at … (last visited …). Privacy by design was included in art. 23.3 and 30.3 of the European Commission's proposal for a General Data Protection Regulation, COM (2012) 11 fin. of 11 January 2012, as well as in the best practices recommended by Federal Trade Commission, Protecting Consumer Privacy in an Era of Rapid Change, March 2012. On experiments on privacy by design carried out at San Diego Gas & Electric see Applying Privacy by Design Best Practices to SDGE's Smart Pricing Program, March 2012, available at www.privacybydesign.ca (last visited …).

[72] See D.T. Doot and F.K.S. Davis, Keeping Your Kilowatts Private: A Survey of State Policies on Release of Customer Data, Public Utility Fortnightly, April 2012, 48 (comparing regulations on SG data in California, Colorado and Oklahoma).

[73] See Cyber Security Working Group, Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid, National Institute of Standards and Technology Inter-agency Report, NISTIR 7628, August 2008; Department of Energy, Data Access and Privacy Issues Related to Smart Grid Technologies, October 5, 2010; NSTC, above note, 46f..

[74] See White House, Consumer Data Privacy in a Networked World: A Framework for Protecting Privacy and Promoting Innovation in the Global Digital Economy, February 2012 (proposing to enact federal legislation that should provide nationally uniform data privacy rules); Federal Trade Commission, above note … (calling on companies to implement best practices to protect consumers' private information).

[75] See E.L. Quinn and A.L. Reed, Envisioning the Smart Grid: Network Architecture, Information Control, and the Public Policy Balancing Act, 81 Colo. L. Rev. 833, 840 (observing that "A lock-in of conflicting state regulatory architectures could thwart the development of data markets even if individual state regulatory commissions wished to foster them").

utilities, the traditional regulatory compact grounded in the vertical relationship between the FERC and the PUCs cannot be taken for granted. The Federal Communication Commission, while not advancing any jurisdictional claim, clearly showed the strong connection between the communications and the energy sectors when it devoted an entire chapter of its National Broadband Plan to energy and made recommendations on access and control of digital energy information.[76] Additionally, pending legislative proposals on cybersecurity may broaden the regulatory role of the DHS and confer on it new powers about SG privacy issues.

While the US regulatory context will shape the answers to SG privacy issues, it cannot be forgotten that more general trends of American legal culture on privacy regulation will play a role, too. It has been observed that deep-seated differences in core values between Europe and America led to divergent sensibilities on privacy violations.[77] In a related vein, several institutional aspects push the regulatory styles on privacy matters in divergent directions on both sides of the Atlantic.[78] In the context of the present discussion, one important example is the principle of privacy by design: it is widely followed in EU privacy legislation, but it is considered an amorphous concept lacking clear implementation guidelines for businesses in the US.[79] May be such differences are not insurmountable and a new Transatlantic agreement will be possible in the near future.[80] But it cannot be excluded that the EU and the US will keep on pursuing different models of privacy regulation in the attempt to strengthen their global leadership.[81] In the latter case, agreement on global standards for SG privacy issues will be unlikely.

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[76] Federal Communication Commission, Connecting America: The National Broadband Plan, 2010, chap. 12. See H.R. Frisby, Jr. and J.P. Trotta, The Smart Grid: The Complexities and Importance of Data Privacy and Security, 19 CommLaw Conspectus 297 (2011). Commentators tend to exclude FCC's jurisdiction on SG privacy issues: see S. Hempling, Broadband's Role in Smart Grid's Success: Seven Jurisdictional Challenges, National Regulatory Research Institute, January 2011; A.S.V. Wokutch, The Role of Non-Utility Service Providers in Smart Grid Development: Should They Be Regulated, and If So, Who Can Regulate Them ?, 9 J. Telecomm. & High Tech. L. 531 (2011).

[77] See J.Q. Whitman, The Two Western Cultures of Privacy: Dignity versus Liberty, 113 Yale L.J. 1151 (2004) (suggesting that American desire to protect liberty and European desire to protect dignity shaped privacy laws, although the two forms of privacy protection can coexist).

[78] See F. Bignami, Cooperative Legalism and the Non-Americanization of European Regulatory Styles: The Case of Data Privacy, 59 Am. J. Comp. L. 411 (2011) (contrasting American adversarial legalism to European cooperative legalism).

[79] See I.S. Rubinstein, Regulating Privacy by Design, 26 Berk. Tech. L. J. 1409 (2011).

[80] For this perspective see D.J. Solove, Understanding Regulation, Harvard UP, 2008, … The U.S.-EU Joint Statement on Privacy from EU Commission Vice-President Viviane Reding and U.S. Commerce Secretary John Bryson, Mar. 19, 2012, available at …, suggests that uniformity in the privacy laws will not be sought, but interoperability and enforcement cooperation will be strengthened.

[81] The factors leading to the diffusion of the European privacy model worldwide are analyzed by A.L. Newman, Protectors of Privacy, Cornell UP, 2008. See also updates on national privacy laws in G. Greenleaf, The Influence of European Data Privacy Standards Outside Europe: Implications for Globalisation of Convention 108 ?, 2(2) International Data Privacy Law … (2012), who adds that US and China are the two major exceptions to the development of EU-influenced privacy laws, but do not represent coherent alternatives to the EU model.

What evidence of regulatory innovations the discussion of US SG policy does provide ? Second-order innovations are clearly visible in the standardization process. However, regulatory innovations on other fronts are almost lacking. The reasons can be identified in the influence of already existing policy (the case of cybersecurity, but also the fragmented legal framework for data protection) and in the multiplicity of jurisdictional boundaries with blurred dividing lines.

4. Smart grids policies in the EU

Differences between the US and the EU in the regulation of SGs are partly due to the way the broader goals of energy policy and climate change policy have been pursued on the two sides of the Atlantic. Even deeper differences can be detected in the vertical and horizontal relationships among European and national regulatory levels, in the structure of the standardization process and in the dominant features of data protection legislation.

As far as the goals of EU climate policy are concerned, targets set up in the medium and long term provide the most important impulse for MSs' national policies and give the Commission the power to propose implementation measures with an increasing degree of stringency.[82] In the broader EU energy policy, environmental sustainability is pursued side by side with other two major goals, that is integration of national energy markets and security of supply.

The earliest European initiatives on SGs are clearly influenced by those three goals. For example, the European Technology Platform for the Electricity Networks of the Future (ETP), which began its work in 2005, was born out of the need to coordinate the research activities of key private and public stakeholders. Its Smart Grids Vision paper, published in 2006, charted a course towards an electric supply network capable of meeting Europe's future needs. It was followed in 2007 by a Strategic Research Agenda and in 2010 by a Strategic Deployment

For a different view see K.A. Bamberger and D.K. Mulligan, Privacy on the Books and on the Ground, 63 Stan. L. Rev. 247 (2011) (identifying the emergence of new corporate privacy practices prompted by privacy professionals and FTC's enforcement threats).

[82] Binding targets of 20% reduction of GHG emissions and 20% increase of renewables by 2020 were agreed among EU institutions and officially included in the 2009 Climate Package. The non-binding target of 20% energy efficiency by 2020 was agreed among EU institutions since 2007. According to the proposed directive on energy efficiency (COM (2011) 370 fin. of 22 June 2011), that target could become binding after 2014 if national policies make it unlikely to be achieved. The long-term objective of 80-95% GHG emission reduction by 2050 was reconfirmed by the European Council in February 2011. These targets go beyond the commitments of 15 MSs under the Kyoto Protocol to reduce GHG emissions by 8% by 2012.

Document. A March 2012 update to the Strategic Research Agenda discusses research needs towards 2035.[83]

The ETP tried to provide a forum where the energy industry could overcome the inefficiencies of fragmented national research. At the same time, the documents mentioned above supplied the scientific background for EU legislative measures. Attention to SG issues can be found in four different areas of EU energy policy: energy efficiency, energy markets liberalization, support for renewable sources, and funding for infrastructures. In all these areas, MSs were encouraged to introduce technological changes in their electricity networks which could help achieve the European targets. At least initially, much flexibility was left to the national level on the details of technological deployment. After 2009, with the adoption of the Third Energy Package and the Climate Change Package, binding obligations were imposed on MSs.[84]

For example, directive 2006/32/CE on energy services asked MSs to provide final customers with individual meters which reflect actual energy consumption and provide information on actual time of use. However, provision of individual meters was conditional on technical and financial feasibility. In 2011 the Commission's proposal of a directive on energy efficiency repealed such conditionalities and introduced minimum requirements for metering and billing.[85]

In the 2009 Third Energy Package, MSs were asked to undertake an economic assessment of long-term costs and benefits of intelligent metering. Subject to a positive outcome of such assessment, roll-out of meters should be completed within a timeframe of ten years, with 80% of customers already equipped by 2020.[86] A reference to the development of intelligent networks, with the aim to integrate renewable sources, can also be found in the renewables

[83] These documents are available at www.smartgrids.eu (last visited …). In parallel with the ETPs, the Commission launched in 2007 the Strategic Energy Technology Plan (SET-Plan), aimed at fostering innovation in low carbon technologies. One of the implementation mechanisms of the SET-Plan are the European Industrial Initiatives, whose task is to target technologies for which the barriers, the scale of investment and risk involved are better tackled at Community level. Among the six priorities, the European Electricity Grid Initiative focuses on the development of the smart electricity system. See European Commission, A European Strategic Energy Technology Plan, COM (2007) 723 fin. of 22 November 2007.

[84] For an overview see M. Swora, Intelligent Grid: Unfinished Regulation in the Third EU Energy Package, 28(4) J. Energy & Nat. Res. L. 465 (2010); M. Swora, Smart Grids After the Third Liberalization Package: Current Developments and Future Challenges for Regulatory Policy in the Electricity Sector, 4(4) Yearbook of Antitrust and Regulation Studies 9 (2011).

[85] See, respectively, art. 12 dir. 2006/32/EC; art. 8 and annex VI proposed directive on energy efficiency, COM (2011) 370 fin. of 22 June 2011. Introduction of intelligent metering should also be encouraged whenever a building is constructed or undergoes major renovations: see art. 8.2 directive 2010/31/EU of 19 May 2010 on the energy performance of buildings.

[86] See annex I.2, directives 2009/72/EC for electricity and, with some differences, 2009/73/EC of 13 July 2009 for gas.

directive.[87] Finally, the proposed regulation on trans-European Energy Infrastructure lists SGs deployment among the priority thematic areas which are eligible for EU financial assistance.[88]

Compared to the US situation, the availability of a legislative framework for climate change in the EU should boost the chances of accelerating the transition to SGs. However, it was soon realized that, without additional adaptations, the standardization process would not have been able to provide timely answers to the need for interoperability and uniformity on crucial architectural choices. Moreover, several MSs have already started to implement SG roadmaps. Without coordination mechanisms these early efforts risk jeopardising the broader European goal of integrating national energy markets.

The European standardization process displays some features that mark its distance from its American counterpart. First of all, the European process is strongly hierarchical. In each MS there is one standard-setting body. It represent national interests in the European standard-setting bodies, that is CEN, CENELEC and ETSI. Standards adopted by the latter are then transformed in national standards. At the same time, specific agreements connect the European bodies to international standard-setting bodies like ISO and IEC. These links make it easy to transform European standards in international ones. From the point of view of international competition, the hierarchical structure strengthens the representation of European interests and puts at disadvantage the fragmented American system.[89]

A second important feature of the European standardization process is the role it plays in the implementation of European policies. Uniform standards were needed to complete the Single Market. Progress on this goal has been made possible by legislative reference to industry standards fulfilling minimum requirements or by harmonised standards adopted at the request of the Commission. Even though industry and harmonised standards are voluntary, manufacturers are eager to follow them because they are presumed to fulfil the legal requirements and can be freely traded across the EU. This approach to standardization made it possible to achieve several public policy goals, such as the interoperability of networks and systems, a high level of environmental and consumer protection, and more innovation and social inclusion.[90] In contrast, the US federal government has never tried to use the standardization process for public policy purposes. Its only role has been to build public-private partnerships and to coordinate the activities of standard-setting bodies.

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[87] See art. 16.1 directive 2009/28/EC of 23 April 2009

[88] See European Commission, Proposal for a regulation on guide-lines for trans-European Energy Infrastructure and repealing decision No 1364/2006/EC, COM (2011) 658 fin. of 19 October 2011.

[89] See Büthe and Mattli, above note …, 151-159.

[90] See European Commission, A Strategic Vision for European Standards: Moving Forward to Enhance and Accelerate the Sustainable Growth of the European Economy by 2020, COM (2011) 311 fin. of 1 June 2011.

Although successful in achieving some policy goals, the European standardization process has shown several weaknesses. The implementation of SGs is probably one of the cases where the problems experienced in recent years gained more visibility. According to the impact assessment carried out by the Commission and to the report of an expert panel, the process for adopting the standards requested by the Commission is not fast enough, SMEs and societal stakeholders are underrepresented, standards developed by global fora and consortia in the ICT field cannot be referenced in public procurement. A proposal for a regulation addressing these issues is currently pending before the European Parliament. However, it is already clear that, without significant improvements in the European standardization process, climate change policies will lack the metrics and good practices which help integrate new technologies and to monitor the effectiveness of regulation. Moreover, European industries might be unable to compete in global markets for green technologies.[91]

Given the central role of SGs in the EU energy policies, the Commission did not wait for the approval of the new standardization process by the Parliament and the Council. Shortly after the enactment of the Third Energy Package, it appointed a Task Force for Smart Grids with the purpose to: a) produce a common vision for the implementation of the SGs; b) indentify EU-wide regulatory recommendations; c) produce a strategic roadmap. Participants to the Task Force were the relevant services of the Commission's Directorates General, industry organizations (both energy and communications sectors), consumer organizations, standard-setting bodies and the network of national energy regulators CEER/ERGEG. Such a broad membership already shows that the main goal was to jumpstart the implementation of SG with a new process which could partly avoid the strictures of the traditional standardisation process. At least partly, the goal has been achieved. Three expert groups were formed within the Task Force. The deliverables on their activities were published between 2010 and 2011. They formed the basis for the ensuing Commission's initiatives.

First of all, a new and wide-ranging standardisation mandate for SG deployment was given to the European standard-setting bodies.[92] The set of standards, to be developed by the end of 2012, will be based on the reports issued by the Task Force. In practice, this mandate covers all the aspects which should be addressed to ensure the uniform deployment of SGs

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[91] See European Commission, Proposal for a Regulation on European Standardization, COM (2011) 315 fin. of 1 June 2011, as well as the accompanying impact assessment, SEC (2011) 671 fin.; Expert Panel, Standardization for a Competitive and Innovative Europe: A Vision for 2020, 21f. (climate change and environmental issues), available at … (last visited …).

[92] See European Commission, Standardization Mandate to European Standardization Organizations (ESOs) to support European Smart Grid deployment, M/490, 1 March 2011. Previous mandates M/441 of 12 March 2009 and M/468 of 29 June 2010 referred to utility meters and charging of electric vehicles.

across the EU. Interestingly, a close interaction between the standard-setting bodies and the Task Force is envisaged.

Secondly, the Commission issued a recommendation that draws on the work done by the Task Force expert groups on data protection and security considerations, methodology for economic assessment of costs and benefits for the roll-out of smart metering systems, and common minimum functional requirements for smart metering.[93]

The strategy chosen by the Commission clearly shows an attempt to overcome the weaknesses of the standardisation process. The Task Force should broker a consensus among the key public and private stakeholders. Such consensus should then quickly be translated to European standards. Moreover, the Task Force will closely monitor the activities of the European standard-setting bodies. If compared with the NIST standardisation process in the US, the European approach still displays a more hierarchical character. Whereas the SGIP selects among existing standards, the Task Force prescribes normative requirements to be followed by standard-setting bodies. Additionally, both the guidelines of the Task Force expert groups and the minimum requirements recommended by the Commission are aimed at fostering a fully integrated market for energy services. The primacy accorded to market integration explains why the Commission declared its willingness to deploy all the hard and soft regulatory tools at its disposal. In the 2011 communication on smart grids, it stated that, should the deadline for SG standards not be met, the power to issue a network code could be used. New initiatives could also be undertaken should progress be deemed unsatisfactory in the other fields of SG implementation, namely regulatory incentives, permitting procedures, information services and demand management.[94]

While innovating somewhat on the traditional standardization process, the main strength of the European approach to SG implementation is the construction of a forum where key stakeholders can meet, identify divergent viewpoints and reach an agreement on common principles. Analogies to the method of "experimentalist governance" already employed in the energy sector and in other areas of EU policy are clearly visible here.[95] Of course, the success of this approach is far from certain. The European standard-setting bodies have already

[93] See European Commission, Recommendation on preparations for roll-out of smart metering systems, C (2012) 1342 fin. of 9 March 2012. See also Joint Research Centre, Guidelines for Conducting a Cost-Benefit Analysis of Smart Grid Projects, 2012.

[94] European Commission, Smart Grids: From Innovation to Deployment, COM (2011) 202 fin. of 12 April 2011.

[95] On Energy fora as a tool to implement European liberalization policies see B. Eberlein, EU Experimentalist Governance in the Energy Sector, in C. Sabel and J. Zeitlin (eds.), …, 2010, … The Task Force for Smart Grids can also be understood as a conflict management mechanisms, belonging to the broader family of arena-shifting or arena-creation strategies. See B. Eberlein and C.M. Radaelli, Mechanisms of Conflict Management in EU Regulatory Policy, 88 (3) Pub. Admin. 782 (2010).

pointed out that new processes should be introduced to manage the full life cycle of SG standards from upstream requirement definitions down to interoperability testing. However, it is still unclear which bodies will be in charge of the different phases and how they can best be coordinated in this top-down process. An additional element of complexity is the role played in the standardization process by industry consortia of the ICT sector. To the extent they are able to produce influential SG standards, care should be taken of interoperability and intellectual property rights issues.[96] Another problem could be the divergent approaches to SGs by the national regulators. Widely different choices may not only hamper interoperability, but also the fast development of a pan-European market for energy services. To some extent, the guidelines worked out by the CEER/ERGEG network of national energy regulators already provide an answer.[97] They have been influential in shaping the position taken by the Task Force expert groups, in which CEER is represented. It can be expected that they will be a reference point for national regulators striving to support SG deployment. From this point of view, the European approach differs from the US regulatory landscape, where jurisdictional conflicts between the FERC and state PUCs make it difficult to agree on common regulatory principles.

The European approach to SG implementation also impacts on the way the two issues of privacy and cybersecurity are handled. For the reasons explained in the previous section, in the US cybersecurity became the dominant issue and the protection of consumers' personal data was understood as an aspect of cybersecurity. In contrast, EU policies do not give prominence to cybersecurity and keep it distinct from privacy issues. Two reasons explain such a divergence. Firstly, there is no overall EU cybersecurity strategy. The Commission has launched several initiatives aimed at fostering cooperation among MSs and coordination among national plans.[98] A new Internet Security Strategy for Europe will be proposed in 2012. The role of the European Network and Information Security Agency (ENISA), so far only charged with the task of collecting information, could be extended in the near future.

[96] CEN/CENELEC/ETSI, Final Report of the Joint Working Group on Standards for Smart Grid, May 2011, 35f., 83, available at … (last visited …).

[97] See especially ERGEG, Position Paper on Smart Grids, 10 June 2010; ERGEG, Final Guidelines of Good Practice on Regulatory Aspects of Smart Metering for Electricity and Gas, 8 February 2011.

[98] See European Commission, Communication on Critical Infrastructure Protection – Protecting Europe from Large Scale Cyber-Attacks and Cyber-Disruptions: Enhancing Preparedness, Security and Resilience, COM (2009) 149 fin. of 30 March 2009; European Commission, Communication on Critical Infrastructure Protection – Achievements and Next Steps: Towards Global Cyber-Security, COM (2011) 163 fin. of 31 March 2011. Several actions on cybersecurity are announced in European Commission, A Digital Agenda for Europe, COM (2010) 245 final/2 of 26 August 2010, 16-18.

Still, the lack of a comprehensive regulatory framework at European level prevents the Commission from including cybersecurity among the top priorities for SG implementation.

To be sure, the connection between SGs and cybersecurity has been explicitly addressed in a number of documents. The Task Force expert group argued that the top priorities are the adoption of the security by design principle, the foundation of national certification authorities, and the consolidation of security guidelines at European level.[99] ENISA undertook a study on SG security in which the relationship between privacy and cybersecurity is directly addressed. The study recommends to treat them jointly. Other important recommendations refer to mandatory risk assessments by distribution system operators (DSOs) and transmission system operators (TSOs), as well as the establishment of a EU-level coordinating entity for SG cybersecurity initiatives.[100]

It seems that a close connection between data protection and cybersecurity finds support in the EU and could lead to a convergence with US positions.[101] However, a second reason why cybersecurity is not given priority in the EU is that data protection can rely on a strong regulatory framework, with a comprehensive regime backed by supervisory authorities. This means that the privacy framework will provide the starting point for the assessment of new data protection issues raised by SGs. Two consequences are already visible. Firstly, the most advanced solutions already experimented for other kinds of personal data will be implemented in SGs. For example, there is wide agreement that privacy by design and by default shall apply.[102] Secondly, cybersecurity issues will probably be addressed by extending to them the same solutions already adopted for data protection. For example, the identification of the agent charged with the task of ensuring the adequate level of protection from cybersecurity risks could follow the same criteria applied in the privacy framework for the identification of the data controller. In contrast, NIST recommendations on SG privacy issues referred to several sector regulations on data protection, but left open the possibility to choose among different models. As we have seen, state choices vary widely.

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[99] Task Force Smart Grids Expert Group 2, Essential Regulatory Requirements and Recommendations for Data Handling, Data Safety, and Consumer Protection, Final Draft, 6 June 2011, 60-70. The recommendations on security were taken up in the standardisation mandate M/490 and included in CEN/CENELEC/ETSI, above note …, 50.

[100] The ENISA study is forthcoming in the next few months. A synthesis is available in the minutes of the workshop organised by ENISA on 29 February 2012. Another study by the ad hoc expert group on security and resilience of communication networks and information systems for smart grids will be published in the second quarter of 2012.

[101] See I.L.G. Pearson, Smart Grid Cyber Security for Europe, 39 Energy Policy 5211 (2011) (noting the transatlantic divide on SG cybersecurity and arguing that the EU should commit itself to promoting security).

[102] See Task Force Expert Group 2, above note …, 31-58; Article 29 Data Protection Working Party, Opinion 12/2011 on Smart Metering, 4 April 2011. For an overview of the issues see R. Knyrim and G. Trieb, Smart Metering Under EU Data Protection Law, 1(2) International Data Protection Law 121 (2011).

Second-order innovations are clearly visible in the way the Commission managed to overcome the weaknesses of the traditional standardisation process. However, it is still not clear whether the reorganization of the electricity supply chain will be accomplished on time. To some extent, the need for regulatory innovation was made less pressing by the availability of a strong regime for data protection. But it is still unclear whether it will provide the foundations for the distribution of costs and risks along the chain.

5. Smart grids and transnational networks

The two previous sections show that SG implementation strategies are affected by several components of the institutional context at national or regional level. Differences between US and EU policies can at least partly be traced back to such institutional components. However, the domestic context is not totally separated from external influences. Indeed, in the last few years there has been a rapid increase of different kinds of transnational bodies engaged in producing technological standards, guidelines, recommendations and economic analyses for SGs. Table 1 lists some prominent examples for each type of transnational body. It also shows the variety of activities in which those bodies are involved. They can be classified in three groups:

1) standardization
2) knowledge sharing, industry alliances and technology transfer
3) regulatory convergence

Table 1. SG transnational bodies.

Type of transnational body	Examples	Type of activity
International standardization bodies	IEC, ISO, ITU	Technological standards
Transnational industry networks	OpenSG (UCAIug), OPENmeter	Technological standards
National standardization bodies with international collaborations	NIST	Technological standards
Public-private transnational networks	ISGAN, ASGI, GSGF	Industry and regulatory issues
Bilateral agreements	EU-US Energy Council EU-China cooperation	Industry and regulatory issues
Transnational regulatory networks	CEER, ERRA, ICER, IWGDPT, TACD	Regulatory issues

As far as standardization is concerned, activities undertaken in the SG sector show the usual confrontation between international standard-setting bodies on one hand and national or regional standard-setting bodies and industry on the other. The former try to extend their influence, the latter try to guide the standardization process and avoid high adaptation costs.[103] Hence, the most interesting question is whether EU and US standard-setting bodies are exerting a visible influence. As explained in section 4, European standard-setting bodies have been able to coordinate with international standard-setting bodies through formal agreements. But in the SG sector, NIST seems to have adopted a strategy which increases its influence at international level. To begin with, NIST chose to rely to the largest possible extent on international standards.[104] Two reasons explain why: a) avoiding problems with obligations stemming from WTO Agreement on Technical Barriers to Trade, which asks to

[103] For activities that clearly show the attempt of international standard-setting bodies to drive the debate see SMB Smart Grid Strategic Group (SG3), IEC Smart Grid Standardization Roadmap, June 2010; IEC, Coping with the Energy Challenge: The IEC's Role from 2010 to 2030, White Paper, 2010.

[104] According to NSTC, above note …, "Nearly 80% of the standards identified in the initial release of the NIST Smart Grid Framework and Roadmap are international standards."

justify the choice of standards that differ from international ones;[105] b) helping US firms to export SG technologies.[106] At the same time, NIST tried to influence the content of international standards. SGIP membership was gratuitously opened to foreign firms.[107] Moreover, an International Task Force was in charge of promoting the SGIP conceptual model and architecture, as well as shared procedures on testing and certification. Letters of intent signed with the European, Korean and Japanese standard-setting bodies laid the ground for collaboration on common standards.[108] Judging from the high number of references to NIST's publications by other standard-setting bodies, this strategy is beginning to pay off. At the same time, direct adoption of NIST standards is difficult to come by. The international consensus so far has formed around a group of IEC standards.[109] Hence, NIST's influence on the content of IEC standards is indirect at best. Cybersecurity is the area where NIST has a stronger expertise, but it is not clear whether the American position will be shared elsewhere.

Transnational industry networks can provide a competitive alternative to national and international standard-setting bodies. In some cases (e.g. OPENmeter) they receive public funds. In other cases (e.g. UCA International Users Group) they do not write standards, but provide a forum where the various stakeholders can influence, select, and endorse open and public standards for the energy and utility market.[110]

A second type of activity is knowledge sharing on industry and regulatory issues. Several transnational bodies can be the vehicle for such activity. The APEC Smart Grid Initiative (ASGI) started in 2009 under the impulse of APEC energy ministers. Activities include roadmapping, test beds, and development of interoperability standards.[111] The International Smart Grid Action Network (ISGAN) was launched at the first Clean Energy Ministerial in

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[105] On the influence of the TBT agreement on international standardization see Büthe and Mattli, above note …, 6-8.

[106] According to S.-Z. Lin et al., A Comparison of Technology Trajectories Between the Global and the United States in Smart Grid, Proceeedings of the 2011 IEEE IEEM, 1032, the US account for 67,38% of the total smart grid patents worldwide. Given that most future SG investments will take place outside of the US, it is understandable that standardization efforts are aimed at leveraging US technological leadership.

[107] As of January 2012, SGIP included 29 representatives from Canada and 58 from other countries. See NIST, above note …, 141. It is not stated how many foreign representatives do have voting rights.

[108] See SGIP International Task Force Business Plan, document number 2012-001, December 30, 2011. The letters of intent are available at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPGbLOI (last visited ...).

[109] See S. Rohjans e al., Survey of Smart Grid Standardization Studies and Recommendations, First IEEE International Conference on Smart Grid Communications, 2010; M. Uslar et al., Survey of Smart Grid Standardization Studies and Recommendations – Part 2, Innovative Smart Grid Technologies Conference Europe, 2010.

[110] See information at http://www.openmeter.com/ (last visited …) and at http://www.ucaiug.org/default.aspx (last visited ...).

[111] Information about ASGI can be found at the website of the APEC Energy Working Group (http://www.ewg.apec.org/esci.html , last visited ...) and at the website of the APEC Expert Group on New and Renewable Energy Technologies (http://www.egnret.ewg.apec.org/ , last visited …).

2010. It brings together more than 20 countries and private stakeholders like transmission and distribution operators, generators, national laboratories and research institutions. In 2011 it obtained the status of Implementation Agreement under the International Energy Agency. Activities include evaluation of SG technologies, case studies and collection of best practices.[112] The Global Smart Grid Federation (GSGF) was established in 2010 to provide a forum for the national initiatives which aim at developing SGs. No individual corporate members are allowed. The main goals are to establish the Federation as the global center for competency on SG technologies and policy issues, foster the exchange of ideas and best practices, create avenues for dialogue and cooperation between the private and public sectors on SG deployment.[113] Not surprisingly given the overlapping of the respective activities, these transnational networks have already planned close collaborations among themselves.[114]

Bilateral agreements work side-by-side with transnational networks. They are usually signed with strategic commercial partners. In the last few years, they have been focused on SGs. For example, the EU-US Energy Council was established in 2009. SGs are included among the priority areas for technological cooperation. Parallel initiatives on cybersecurity of industrial control systems and SGs have been proposed by the EU-US Working Group on Cybersecurity and Cybercrime, established in 2010 by the EU-US Justice and Home Affairs Ministerial. Another example of bilateral agreement is the EU-China cooperation in energy areas, with SGs identified as one of the six priorities.

A third type of activity in the transnational arena is carried out by regulatory networks. They can work at regional level, like CEER/ERGEG and ERRA, or at global level, like ICER. It is clear that their main goal is to foster convergence among national or regional regulatory frameworks. At the same time, they usually display strong preferences on the direction of such convergence. As explained in the previous section, ERGEG is an active participant to the debate on EU energy policy and is closely monitoring the standardisation process for SGs. ICER was established in 2009 and has so far published reports on major regulatory topics, including one on energy efficiency and one on smart metering.[115] Somewhat close to

[112] ISGAN documents can be found at http://www.iea-isgan.org/ (last visited …).
[113] For GSGF activities and publications see http://www.globalsmartgridfederation.org/ (last visited …).
[114] The International Renewable Energy Agency (IRENA) will start working on SGs in the context of its innovation and technology programme: see IRENA, Work Programme 2012, 30 January 2012, available at www.irena.org (last visited …).
[115] ICER, A Description of Current Regulatory Practices for the Promotion of Energy Efficiency, 21 June 2010; ICER, Report on the Experiences on the Regulatory Approaches to the Implementation of Smart Meters, April 2012. The International Working Group on Data Protection in Telecommunications (IWGDPT), founded in 1983 in the framework of the International Conference of Data Protection and Privacy Commissioners, published in September 2011 a working paper on Privacy by Design and Smart Metering: Minimize Personal Information to Maintain Privacy (available at http://www.datenschutz-berlin.de/content/europa-international/international-

transnational regulatory networks is the Transatlantic Consumer Dialogue (TACD), a forum of US and EU consumer organizations. In 2011 it issued a resolution on SGs and a resolution on security and privacy related to smart meters.[116]

What impact all these transnational bodies and bilateral agreements will have on SG implementation ? It has been suggested that small clubs of leading governments can coordinate their national policies on green innovation and foster private investments.[117] More generally, several transnational bodies involving non-state actors may perform activities like rule-making and implementation, experimentation and testing at local level, financing projects, information sharing, networking and lobbying.[118] However, the effectiveness of transnational bodies in pursuing such activities varies greatly and is dependent on factors like the type of contribution provided by state and non-state actors, the degree of institutionalization, the internal decision-making procedures, and the management of distributional conflicts. Empirical evidence in different sectors show that only in a handful of cases favourable conditions allow transnational bodies to exert a significant influence.[119]

The review provided above also shows that all kinds of transnational bodies are strongly biased toward promoting convergence. Any technological or regulatory difference is perceived as a threat to large scale SG deployment. Such a bias engenders two risks. Firstly, convergence may happen on the solutions proposed by the most powerful actors, but that do not advance global interests. Secondly, even when coercion is absent from transnational bodies, shared solutions will be easier to achieve when the members of the network share the same normative beliefs.[120] Hence, the dominant view will prevail, while alternative, minority views will be discarded.

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working-group-on-data-protection-in-telecommunications-iwgdpt , last visited ...). Several activities connected to SGs were also undertaken by the Energy Regulators Energy Association (ERRA): see, e.g., ERRA, Regulatory Aspects of Smart Metering, December 2010, available at www.erranet.org (last visited …).

[116] They are available at www.tacd.org (last visited …).

[117] See R.O. Kehoane and D.G. Victor, The Regime Complex for Climate Change, 9(1) Persp. on Pol. 7, 18f. (2011).

[118] See K.W. Abbott, The Transnational Regime Complex for Climate Change, forthcoming in Environment & Planning C: Government and Policy, available at www.ssrn.com (last visited …).

[119] On the contribution of different types of actors see K.W. Abbott and D. Snidal, The Governance Triangle: Regulatory Standards Institutions and the Shadow of the State, in W. Mattli and N. Woods (eds), The Politics of Global Regulation, Princeton UP, 2009, 44-88. On the relevance of institutionalization and internal organization see K. Szuleck et al., Explaining Variation in the Effectiveness of Transnational Energy Partnerships, 24(4) Governance 713 (2011). On the difficulty faced by transnational networks in addressing distributional conflicts see P.-H. Verdier, Transnational Regulatory Networks and Their Limits, 34 Yale J. Int'l L. 113 (2009).

[120] This argument stems from the concept of epistemic communities, first proposed by P. Haas, Introduction: Epistemic Communities and International Policy Coordination, 46 Int. Org. 1 (1992). For an empirical application to transnational networks for financial regulation see D. Bach and A. Newman, It's Time to Join: The Politics of Transgovernmental Network Participation, Annual Meeting of the American Political Science Association, September 2009, Toronto, Canada, available at www.ssrn.com (last visited …).

Of course, the opposite outcome of too little convergence is equally likely. Recommendations and collections of best practices published by transnational bodies may address the surface level of SG issues, without providing more contextual knowledge which helps tackle specific implementation problems. In this case, processes of symbolic emulation may follow, but without a real learning process which could change the preferences of policymakers.[121]

Given the uncertainty about the outcome of international cooperation, one priority of future research is to understand the conditions which lead transnational bodies to produce global or regional public goods.[122] In keeping with the diagnostic approach, the international collaborations on SGs can be described as a polycentric regime without hierarchical linkages and with overlapping boundaries among levels. Each level has some degree of autonomy in dealing with investment choices, regulatory issues and distributional conflicts. However, linkages among levels do exist and become visible when coordination is needed or one level does not have enough financial, cognitive or institutional resources to address a specific problem. In the case of the transition to the SG, the benefits of polycentricity are already visible in the thousands of pilot programs under way in several countries. Successful experiences in a small area may well be scaled up to the global level, but they are even more useful when they show why they worked in that specific place and cannot work in other places.[123] Of course, we need to make sense of the current developments and to provide analytic frameworks which help policymakers to assess the effects of the interaction between technological innovation and the institutional framework. Drawing on the evidence provided by the US and EU cases, the next section suggests some preliminary considerations on such interaction.

6. Patterns of techno-regulation

The case study on SG policies shows that several second-order regulatory innovations are ongoing in both the US and the EU. However, their real impact on accelerating SG implementation is still uncertain. Moreover, no third-order regulatory innovations are in sight. May be gradualism is inevitable when complex systems move to a radically new equilibrium.

[121] On learning and emulation see, e.g., D. Marsh and J.C. Sharman, Policy Diffusion and Policy Transfer, 30(3) Policy Stud. 269 (2009).

[122] See S.V. Berg and J. Horrall, Networks of Regulatory Agencies as Regional Public Goods: Improving Infrastructure Performance, 3 Rev. Int. Org. 179 (2008).

[123] On the benefits of experimenting with different institutional solutions see, e.g., E. Ostrom, Why Do We Need to Protect Institutional Diversity ?, 11 Eur. Pol. Sc. 128 (2012).

But it is important to understand how the American and European regulatory frameworks are changing. The diagnostic approach tries to isolate some institutional factors which affect the effectiveness of the measures aimed at fostering technological innovation. Table 2 shows that US and EU policies on SGs follow different tracks. Such differences can be explained by the peculiar features of the respective institutional contexts. Hence, this case study could provide an example of equifinality, that is different policies producing the same outcome. There are two problems, however. Firstly, we still do not know whether SG implementation will be equally successful in both the US and the EU. By identifying the different answers provided by the two regulatory frameworks, the diagnostic approach should help forecast their effectiveness. Secondly, regulatory convergence or divergence depends on the strength of the linkage between SG policy choices and higher level institutional factors. Let us consider each institutional component from both points of view.

Table 2. SG regulatory framework in US and EU.

Institutional components	US	EU
Regulatory frame	Technological competitiveness Cybersecurity	Climate change Single Market
Position rules	Limits to inclusion due to the high costs of participating to standardization processes	Broader inclusion and standardization processes dominated by public actors
Information rules	Coexistence of several models of data protection	Adoption of the EU model of data protection
Multi-level relationships	Conflicting relationship on the internal side Attempt to transfer national solutions at international level	Coordinated relationship on the internal side Attempt to transfer national solutions at international level

First of all, US and EU display different regulatory frames. Not surprisingly, they are influenced by priorities in energy policy, innovation policy and security policy. Each frame becomes dominant because it is supported by actors that invest resources to ensure its widespread acceptance. This is the case in the US, where a large number of federal bodies is concerned with cybersecurity. In contrast, in the EU issues related to climate change and market integration have better chances to gain a prominent place on the regulatory agenda. For policymaking purposes, the most relevant question is what kind of regulatory options fit the dominant frames. Consider, for example, the alternative between voluntary or mandatory SG standards. The technological competitiveness frame clearly points to the former because of the benefits inherent to market competition among different standards. But the cybersecurity frame points to the latter because of the risks stemming from the lack of coordination in choices about security levels. The coexistence of these two frames in the US explain why the FERC declines to adopt mandatory standards when exercising its EISA powers but pushes towards extended mandatory standards when exercising its EPact05 powers. In contrast, the two EU frames (climate change and Single Market) clearly point to mandatory standards. The way the standardization process is being designed leads to de facto mandatory standards. Hence, the main policy implication is that the regulatory options shall be congruent with the dominant frame. Attempts at pursuing alternative regulatory options that do not fit such a frame will be generally unsuccessful. Of course, the introduction of a new frame is possible, but usually under stringent conditions.

Position rules differ as well in the US and EU regulatory frameworks. In this case, too, the traditional structure of the standardization process makes it difficult to introduce regulatory innovations when faster approval is required. At this stage, it is unclear whether a market-oriented or a hierarchical system is better able to deliver the desired results. But it must be acknowledged that a market-oriented system raises participation costs and cannot ensure wide inclusiveness. The debate on how to distribute costs and risks along the electricity supply chain is still open on both sides of the Atlantic. Unless the same business models and the same regulatory choices are made, this aspect could be another case of divergent American and European approaches.

Information rules for SG policies are directly connected to the general regulatory frameworks for personal data protection. Two extreme views can be detected. According to the first view, customers shall be given full control of consumption data in the most granular form to enhance public acceptance of SG technologies. The opposite view is that utilities and service providers shall be given wide access to consumption data to maximize the benefits of SGs in terms of grid management, energy efficiency and market competition. With further progress in SG implementation, intermediate positions will become viable. Both the US and the EU seem to enjoy manoeuvring space on this aspect. However, persisting differences in enforcement structures may hinder convergence on common solutions.

The relationships among regulatory levels affect SG implementation. In the US, vertical and horizontal jurisdictional conflicts are the rule. To the extent that regulatory fragmentation increases uncertainty, it could slow technological innovation. But some degree of regulatory overlapping can also be beneficial from a polycentric perspective: inertia is avoided and experiments with new initiatives are promoted from the bottom up. In the EU, lack of uniform implementation at MS level and differences in regulatory capabilities are the main hindrance to technological innovation. However, the presence of an overarching legislative framework for climate change policy seems to avoid major frictions on jurisdictional issues. Also, the investments made in building the European Research Area increase the benefits from cooperation for market players and MSs alike.

To what extent these differences are rooted in deep-seated institutional factors ? Answering this question has important policy implications. When a specific regulatory tool is chosen because of the influence of the legal tradition or the political structure, trying to change it by imitating successful experiences elsewhere is hopeless. But there are cases when deep-seated institutional factors leave room for more than one regulatory tool, or exert a minimal influence on its choice. This means that attempts at observing foreign experiences and learning from them could be more fruitful. Moreover, some degree of convergence can be expected.

Figures 4 and 5 show the links between higher-tier institutional factors, policy-level variables and chosen regulatory tools. Continuous arrows between higher-tier institutional factors and policy-level variables represent strong ties. Dotted arrows represent weaker ties. Comparing the two figures, it can be concluded that only the US regulatory system is open to experimentation with alternative regulatory tools, at least with reference to the nature of SG standards and the privacy model. In contrast, the features of the EU regulatory framework seem more tightly connected to higher-tier institutional factors. This means that regulatory innovations must be prompted by endogenous adjustments more than imitation of foreign models.

The identification of the links between institutional factors and regulatory tools helps explain the influence of transnational bodies. Both the US and the EU are trying to drive the international debate and to export their standards and their regulatory models. So far, neither seems to have gained a more favourable position. Convergence on common solutions can only be expected for the limited set of issues where institutional factors allow the adoption of alternative regulatory tools. In all other cases, the different starting points will prevent the alignment of preferences and compromise solutions will be difficult to find. Different regulatory frameworks will coexist and compete among them. At least in the short term, such divergences may slow down the development of a global market for SGs.

Figure 4. Institutional factors affecting SG regulation in the US

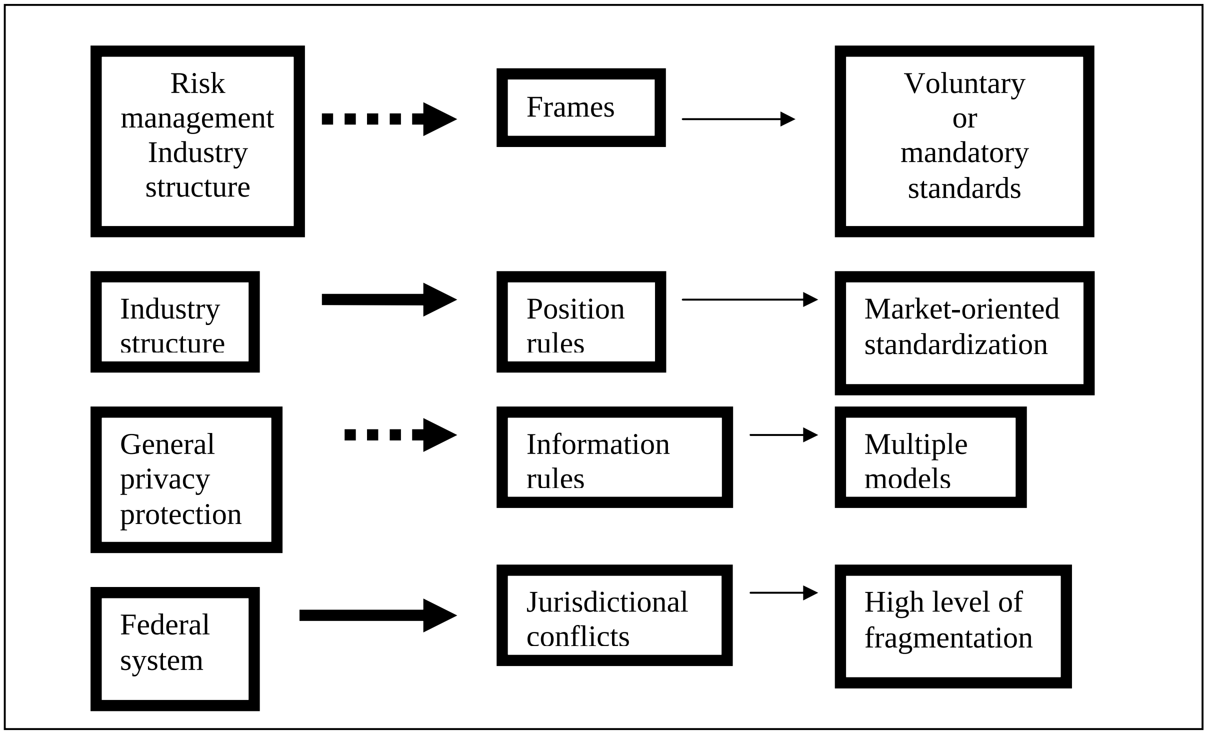
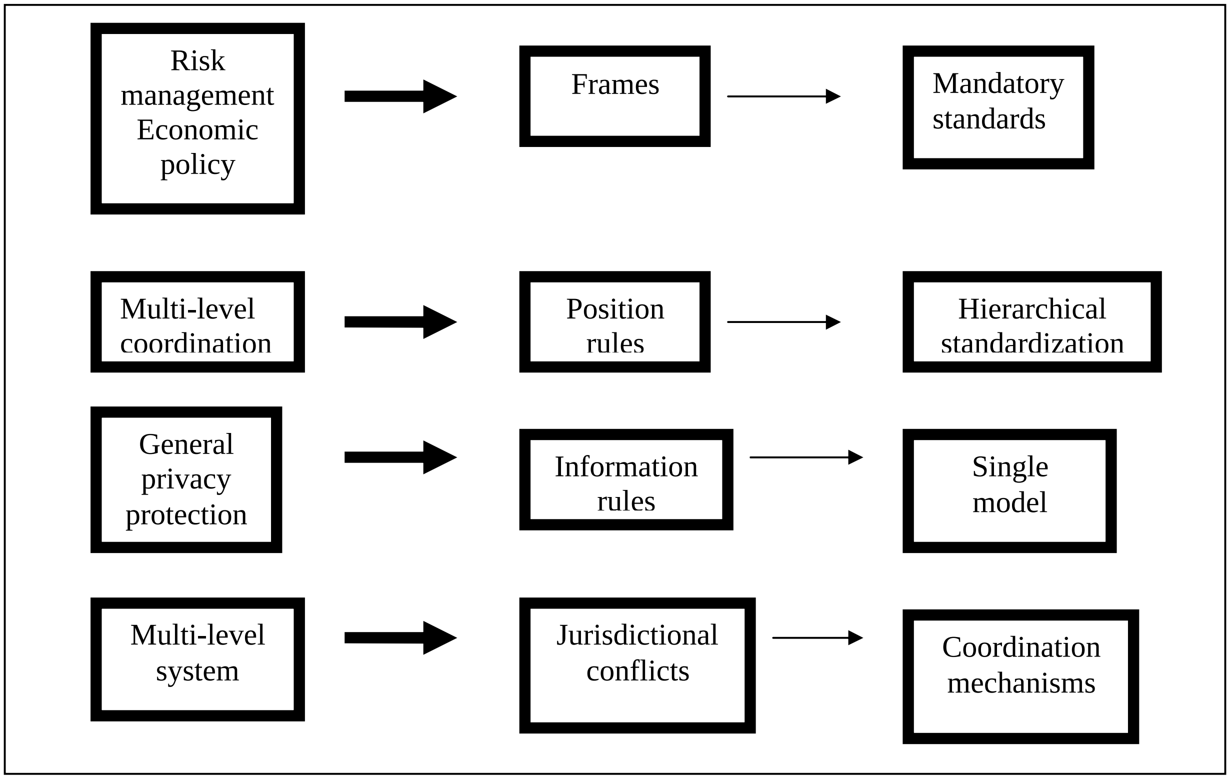


Figure 5. Institutional factors affecting SG regulation in the EU



7. Conclusion

Much hope is put in technological innovations which should drive the transition toward a low carbon economy.[124] However, strong ecological modernization with a radical paradigm change and third-order regulatory innovations does not seem in sight. The case study on SGs proposed in this paper confirms that real regulatory innovation is rare and cannot be obtained in a short time. Fragmented jurisdictions, competing policy goals, and entrenched legal concepts may block attempts at managing the transition toward new equilibria.

Though, comparative analyses can help understand the conditions that make it possible to accomplish effective regulatory innovations. Institutional diagnostics provides a framework which can integrate insights from different streams of the literature on technological innovation and regulatory innovation. Such integration is badly needed to fill the well known

[124] For example, in a statement issued in April 2012 for the Rio+20 Conference, the UN Broadband Commission for Digital Development stated that “Information and Communication Technologies (ICT) can help to achieve a sustainable development model, as modern broadband networks and broadband-enabled applications and services promote the integration of‘smarter’ and more energy-efficient economic growth, social development and environmental protection, the three pillars of sustainable development.”

gap between academic knowledge and regulatory practice. The selective focus of each discipline should be replaced with an organized assessment of all the relevant institutional variables. While comparative law can supply detailed information about the legal landscape and the relevance of each institutional factor, policy studies, comparative politics and innovation studies can supply information about socio-technical, political and economic variables.

To increase the generalizability of findings, the analysis carried out for SGs should be replicated for other regulatory issues affecting the development of green technologies. Important examples include the modifications to intellectual property rights which should foster green innovation and the comparative analysis of the institutional factors that bear on the success or failure of supporting measures for renewable energy sources.