



CHAPTER 1
THE CLIMATE RESILIENCE OF
CRITICAL INFRASTRUCTURAL
NETWORK SECTORS

An Interdisciplinary Method for
Assessing Formal Responsibilities
for Climate Adaptation in Critical
Infrastructural Network Sectors

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ABSTRACT

This chapter presents and applies an interdisciplinary (law & governance) method for the assessment of the climate resilience of critical infrastructural network sectors. Broadly applicable, this methodological framework comprises three phases, within which six logically arranged steps are set out. The central assessment criterion for climate resilience, the ‘expected effectiveness’ of responsibilities for climate adaptation, is operationalized through six indicators. These are: awareness, proactivity, appropriateness, explicitness, transparency and legitimacy. Apart from academic purposes, this assessment framework can prove useful to law and policy makers in assessing and (re)developing the relevant arrangements that govern critical infrastructural network sectors. To give examples of the functioning of the assessment framework, this framework is applied in two case studies that address the Dutch electricity and internet sectors. These case studies show a rather low level of expected effectiveness of responsibilities for climate adaptation in both sectors. Apart from their exemplary purpose, these case studies provide insights into potential pitfalls which can be relevant for increasing the climate resilience of other network sectors in the Netherlands, in other EU Member States and abroad.

1. INTRODUCTION

Modern societies and key societal functions, such as emergency management and health care, depend largely upon the smooth-functioning of critical infrastructural networks, such as energy, ICT, drinking water and transportation networks. The collapse of such networks can cause an array of societal disruption and damage. Critical infrastructural networks are particularly prone to external influences, such as floods and other water-related events. The expected climate change increases the chance of such events, thus also increasing the infrastructural networks’ vulnerability. International, EU and domestic climate change scenarios display rather clear trends.¹ Focusing on the EU and its Member States, increases in the duration, probability and intensity of weather extremes (e.g. heavy rainfall and extreme droughts) are already being perceived throughout the continent and are expected to increase

* This chapter builds upon research commissioned by the Netherlands Environmental Assessment Agency and the National Research Programme ‘Knowledge for Climate’ within the framework of the establishment of the Dutch National Adaptation Strategy.

¹ See *Intergovernmental Panel on Climate Change*, Climate Change 2014: Impacts, Adaptation, and Vulnerability, IPCC Working Group II contribution to AR5; *European Commission*, An EU strategy on adaptation to climate change (COM(2013) 216); and *Koninklijk Nederlands Meteorologisch Instituut*, KNMI’14-klimaatscenario’s voor Nederland – Leidraad voor professionals in klimaatadaptatie, De Bilt 2014.

even further.² The associated risks, in this chapter, are referred to as climate risks. The question arises how the responsibilities to combat climate risks for critical infrastructural networks are divided in the EU and in its Member States particularly, and to what extent these responsibilities, and the division thereof, are expected to be effective.³

This question is at the heart of this chapter; however, it cannot be addressed to its fullest extent. Therefore, we focus on the second part of this question, or in other words, on the assessment of vulnerable critical infrastructural network sectors' climate resilience.⁴ Adopting an interdisciplinary methodological approach, combining insights and experiences from both the disciplines of (environmental) law and governance, we first present a comprehensive and broadly applicable framework for the ex-ante assessment of the 'expected effectiveness' of formal responsibilities for climate adaptation and the division thereof between relevant public and private actors (Section 2). Through this assessment framework, we intend to provide a tool for both academics and law and policy makers to evaluate, compare and (re)develop relevant domestic arrangements that govern critical infrastructural network sectors from an integrated 'law & governance' perspective.⁵ After having operationalized the central criterion of expected effectiveness, and having identified a number of indicators in Section 3, we apply this framework to two infrastructural network sectors in the Netherlands; namely, the electricity sector and the internet sector (Section 4). These case studies are mainly meant to show the functioning of the framework, and thus have an exemplary and explanatory role. We conclude with general remarks about the application of

² See *European Commission*, An EU strategy on adaptation to climate change (COM(2013) 216), pp. 2-4.

³ See *P.P.J. Driessen & H.F.M.W. van Rijswijk*, Normative aspects of climate adaptation policies, *Climate Law* 2011 (2), pp. 559-581; *H.L.P. Mees, P.P.J. Driessen & H.A.C. Runhaar*, Exploring the scope of public and private responsibilities for climate adaptation, *Journal of Environmental Planning Policy and Management* 2012 (3), pp. 305-330; and *A.M. Keessen et al.*, The concept of resilience from a normative perspective: examples from Dutch adaptation strategies, *Ecology & Society* 2013 (2), pp. 45-56.

⁴ This chapter builds upon previous studies; see *H.A.C. Runhaar et al.*, Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014; *H.A.C. Runhaar et al.*, Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors, *Regional Environmental Change* 2016 (in press), accepted and published online in 2015 (<http://link.springer.com/article/10.1007/s10113-015-0866-2>), pp. 1-12 (in this chapter, we refer to the page numbers of the 2015 online publication); and *H.K. Gilissen et al.*, De klimaatbestendigheid van de vitale infrastructuur beoordeeld van juridisch-bestuurlijk perspectief – Over de verwachte effectiviteit van de verdeling van verantwoordelijkheden voor de beheersing van klimaatrisico's in de elektriciteits- en de internetsector, *Nederland Juristenblad* 2015 (25), pp. 1640-1648.

⁵ We define such 'arrangements' as coherent sets of distinguishable actors, rules and policies governing a specific sector.

the assessment framework and potential (transferable) lessons to be learnt from the case studies (Section 5).

Here, we first seize upon the opportunity to briefly outline some backgrounds relevant to this chapter. Adaptation is a key strategy in combatting the adverse effects of climate change in EU policies, formally since 2005.⁶ Since that time, the concept has developed, along a policy track by and large⁷, resulting in the adoption of the European Adaptation Strategy (EAS) in 2013⁸, encouraging the Member States to adopt and implement comprehensive adaptation policies (National Adaptation Strategies; NASs) by 2017 at the latest and to ‘mainstream’ the concept into their relevant sectoral governance domains, among which are those governing critical network sectors.⁹ Although the adaptation approach was integrated into sectoral EU legislation on, for instance, flood risk management (i.e. the Floods Directive)¹⁰, it has to be kept in mind that this concept, as far as it is relevant for this work, is mainly rooted in soft law documents at the EU level.¹¹ There is, to date, no formal obligation stemming from EU law for the Member States to mainstream the adaptation approach into their sectoral law and policies regarding infrastructural network sectors.

Focusing on vulnerable infrastructural network sectors, the absence of explicit and targeted EU legislation does not necessarily mean that the Member States have not adopted explicit or implicit responsibilities for combatting climate risks into their relevant domestic legislation or policies. These responsibilities could, for instance, aim at limiting the *chance* of network failure (and consequently limiting the chance of societal disruption) caused

⁶ See *European Commission*, *Winning the Battle Against Global Climate Change* (COM(2005) 35), pp. 7-8. About that time, a number of Member States had already adopted National Adaptation Strategies; see *R. Swart et al.*, *Europe adapts to climate change – Comparing national adaptation strategies*, PEER Report no. 1, Partnership for European Environmental Research, Helsinki 2009, and *G.R. Biesbroek et al.*, *Europe adapts to climate change: Comparing National Adaptation Strategies*, *Global Environmental Change* 2010 (20), pp. 440-450.

⁷ See *European Commission*, *Adapting to climate change in Europe – options for EU action* (Green Paper; COM(2007) 354); and *European Commission*, *Adapting to climate change: Towards a European framework for action* (White Paper; COM(2009) 147). Also see *H.K. Gilissen*, *The integration of the adaptation approach into EU and Dutch legislation on flood risk management*, *Journal of Water Law* 2014 (3/4), pp. 159-160.

⁸ See *European Commission*, *An EU strategy on adaptation to climate change* (COM(2013) 216).

⁹ See, for instance, *D. McEvoy et al.*, *Adaptation and Mainstreaming of EU Climate Change Policy: An Actor-Based Perspective*, Centre for European Policy Studies, nr. 149, January 2008; and *C.J. Uittenbroek*, *How mainstream is mainstreaming? – The integration of climate adaptation into urban policy* (diss. UU), Utrecht 2014.

¹⁰ See *H.K. Gilissen*, *The integration of the adaptation approach into EU and Dutch legislation on flood risk management*, *Journal of Water Law* 2014 (3/4), pp. 162-163.

¹¹ Further formalization (e.g. the adoption of an ‘Adaptation Directive’) will be taken into consideration in case the Member States have not adequately fulfilled the objectives of the European Adaptation Strategy by 2017. See *European Commission*, *An EU strategy on adaptation to climate change* (COM(2013) 216), p. 6.

by climate-related events, they could aim to limit the *consequences* of network failures and mitigate the impact on society of such failure, or at *repairing* possible damage to a network as quickly as possible in order to limit societal disruption and to prevent deterioration. Such formal responsibilities (i.e. legal responsibilities generating a degree of accountability)¹² are the subject of this chapter, regardless of whether these are explicitly aimed at combatting climate risks or are only implicitly relevant through their general applicability in this respect. Whereas the assessment framework comprises aspects of different disciplines (law and governance), the ‘objects’ to which it is meant to be applied – i.e. formal responsibilities – are legal in nature.

2. A METHODOLOGICAL FRAMEWORK FOR THE ASSESSMENT OF CLIMATE RESILIENCE

The assessment framework to be presented in this section aims to assess the extent to which the current (division of) responsibilities for climate adaptation within network sectors fosters an adequate adaptation to climate change. In that sense, it is a helpful tool for the identification of potential weaknesses in the sectors selected for assessment, as well as for the formulation of recommendations and the development of strategies to eliminate these weaknesses through legal or other means. The method comprises three phases, within which six logically arranged steps have been set out (see Table 1).¹³ It concerns the phase of preparation (i.e. delineation, justification, exploration and legal analysis; steps 1 to 4), the assessment phase (step 5) and the phase of reflection and recommendations (step 6).¹⁴ In this section, we briefly address the different phases and steps, followed by an operationalization of our assessment criteria in Section 3. The assessment framework will be applied to two case studies in Section 4 in order to show the functioning of the method and its potential results.

¹² With Bovens et al. we define accountability as “an evaluative concept that is used to positively qualify a state of affairs or the performance of an actor”. See *M. Bovens et al.*, “Does public accountability work?” An assessment tool, *Public Administration* 2008 (1), pp. 225-242.

¹³ For the development of this methodological framework the authors drew inspiration from *I. Curry-Sumner et al.*, *Research skills – Instruction for lawyers*, *Ars Aequi Libri*, Nijmegen 2010; and *P. Verschuren & H. Doorewaard*, *Designing a research project*, Eleven International Publishing, The Hague 2010.

¹⁴ The framework presented here largely builds upon and further refines the one presented in *H.A.C. Runhaar et al.*, *Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors*, *Regional Environmental Change* 2016 (in press), online version 2015, pp. 4-6.

Table 1. Phases and steps within the framework for assessing the climate resilience of critical infrastructural network sectors

Phase	Step	Description
Phase 1 'Preparation'	Step 1	Delineation of the object (sector) of analysis and a justification for this selection
	Step 2	Identification and description of the major climate-risks risk for the sector selected for assessment
	Step 3	Description of main sectoral characteristics and recent developments within the sector
	Step 4	Analysis of sectoral formal responsibilities in relevant legislation, policies and case law
Phase 2 'Assessment'	Step 5	Ex-ante assessment of the expected effectiveness of sectoral responsibilities for climate adaptation following six indicators
Phase 3 'Reflection'	Step 6	Reflection on the assessment results and the functioning of the assessment framework; formulation of recommendations for systemic improvements

2.1. PHASE 1: PREPARATION

The main aim of the first phase is to 'set the scene' through the collection and analysis of relevant information in preparation of, and needed for, the actual assessment in phase 2. During this preparatory phase, the object of the analysis (i.e. one or more specific infrastructural network sectors or sub-sectors) is selected and narrowed down, followed by a justification of the choice of these specific (sub-) sectors and any further delineations (step 1). Subsequently, the most important climate-related risks to the concerning sector(s) are set out, where needed, on the basis of (technical) information provided by other disciplines (step 2), and the characteristics and most important developments within a given sector are briefly explained (step 3). As a final and key step in the preparatory phase, an overview is given of the formal responsibilities and competences of the public and private actors within a certain sector on the basis of an analysis of the relevant legal and policy framework(s) and, if applicable, relevant case law (step 4).

2.2. PHASE 2: ASSESSMENT

The second phase (step 5) encompasses the actual assessment of the sectoral (division of) responsibilities for adaptation to climate change, based on the information gathered during the first phase. The central criterion within this assessment framework is the 'expected effectiveness' of such responsibilities and the division thereof. It should be kept in mind that the assessment has an ex-ante character and aims to draw *expectations* about the effectiveness of the sectoral

responsibilities. The question, thus, is to what extent the system – on the basis of a set of objective indicators – can be expected to be effective. The framework does not aim at assessing the *factual* effectiveness of responsibilities, which can merely be assessed ex-post, after a climate-related event. The question of the extent to which the system has actually proven to be effective will not be addressed through this framework.

The assessment of the expected effectiveness is conducted following six predetermined indicators. Firstly, the explicitness, transparency and legitimacy of the responsibilities concerned are selected as benchmarks for the effectiveness expected.¹⁵ Furthermore, factors such as awareness, a sense of urgency and the type of responsibility (proactive or reactive) play a role in the assessment, just as the question of the extent to which responsibilities and competences are appropriate and appropriately divided amongst the relevant actors does (by reflecting the notions of subsidiarity and proportionality). These indicators are of a mixed nature, comprising legal and governance aspects, and will be further operationalized in Section 3 below. The results of the assessment help to identify potential points for improvement within the arrangements governing relevant infrastructural network sectors. Moreover, they can be a rich source of cross-country comparisons and serve as a good entry point in the search for (transferable) good practices and potential common pitfalls.

2.3. PHASE 3: REFLECTION AND RECOMMENDATIONS

The final phase (step 6), first encompasses an analysis of, and reflection on, the assessment results. In the event that the results show that the expected effectiveness of the selected sector is insufficient, because of a lack of transparency or clarity about the division of responsibilities for instance, targeted recommendations for improvement can be put forward. These can, for instance, entail the adoption, clarification or explication of such responsibilities in legislation or in explanatory/policy documents. The second aim of the reflection addresses the assessment framework itself, in particular the potential difficulties or imperfections encountered in the application thereof. These may include both imperfections regarding the successive steps or the indicators selected for assessing the expected effectiveness. In case of imperfections, recommendations should be made for the improvement of the assessment framework, be it through the rearrangement or addition of specific steps, or through the introduction of new indicators or the reconsideration of those in place.¹⁶

¹⁵ See also *H.L.P. Mees*, *Responsible Climate Change Adaptation – Exploring, analysing, and evaluating public and private responsibilities for urban adaptation to climate change* (diss. UU), Utrecht 2014.

¹⁶ The application of earlier ‘versions’ of this assessment framework, for instance, resulted in the adoption of new, additional indicators. The indicator ‘explicitness’ was first adopted in

3. SIX INDICATORS FOR ASSESSING CLIMATE RESILIENCE

As mentioned above, we consider the expected effectiveness of sectoral responsibilities for climate adaptation to be a central criterion for the assessment of critical infrastructural network sectors' climate resilience. For the purposes of this contribution expected effectiveness is understood as the probability that actors, who are involved in a certain sector, are inclined to adjust their activities to the adverse effects of climate change proactively in order to reduce climate risks to an acceptable level. This probability has to be seen in the light of the current division of responsibilities within those sectors. More specifically, it concerns the extent to which actors internalize climate-related risks in their operational management and the related decisions they make about the implementation of their responsibilities and competences.

The determination of what is an 'acceptable level' depends on the nature of the sector selected for assessment. As far as the critical infrastructure is merely being used for the individual (economic) interests of the involved actors, these actors could determine the acceptable level themselves. However, if the critical network serves a public interest mainly (e.g. electricity, communication, drinking water), it is evident that an external party or mechanism determines the acceptable level, through a democratic legislative process, parliamentary involvement and close (market) supervision for example. This is especially important with regards to the question of whether governmental regulatory or supervisory action – or another form of public intervention – is deemed necessary, since the failure of critical infrastructure can lead to disruptions that have consequences for the society as a whole.

There are multiple indicators for expected effectiveness. In this section, we discuss a selection of six key indicators: (a) the extent of problem recognition (awareness/sense of urgency); (b) the type of the responsibilities (proactive/reactive); and (c) the appropriateness, (d) the explicitness, (e) the transparency, and (f) the legitimacy of the responsibilities and the division thereof. These indicators comprise both objective (responsibility-based) and more subjective (actor-based) elements, because the degree of the effectiveness expected depends not only on the way in which responsibilities are allocated and formulated, but also on the way in which these are perceived by their addressees and by others who are interested. We have selected these specific indicators, because these, in our view, address the main factors that are potentially influential to the expected

H.K. Gilissen et al., De klimaatbestendigheid van de vitale infrastructuur beoordeeld van juridisch-bestuurlijk perspectief – Over de verwachte effectiviteit van de verdeling van verantwoordelijkheden voor de beheersing van klimaatrisico's in de elektriciteits- en de internetsector, *Nederland Juristenblad* 2015 (25), p. 1643, whereas in the current chapter, the indicator 'appropriateness' is introduced (see Section 3).

effectiveness of responsibilities relating to the adverse effects of climate change for network sectors. More indicators, from other disciplines, can also be added to this framework in future research if deemed fruitful and necessary.

It should be borne in mind that these indicators are closely interrelated. Ambiguously formulated responsibilities can, for instance, cause a misinterpretation thereof; this means that a lack of explicitness can, at the same time, generate a lack of transparency. Moreover, it has to be noted that they are meant to assess a selected arrangement from an interdisciplinary (i.e. an integrated law & governance) perspective, so they comprise both legal and governance aspects. Even though the indicators have a certain normative tenor, in the sense that these indicators *should* be complied with in order to optimize expected effectiveness, these are not in the first place meant to draw strict conclusions about the lawfulness of the arrangements governing infrastructural networks. They are instead meant to identify strengths and weaknesses within such arrangements and formulate recommendations for their improvement by means of legal or extra-legal instruments.

Problem recognition: Those who are not aware of certain risks are not likely to take them into account in daily life. The awareness of climate risks can, therefore, be considered to be a condition for risk-minimizing behaviour.¹⁷ For such behaviour, it is not necessary that the actors involved have a complete knowledge of the risks and their potential adverse effects; incentives can be generated to minimize the risks even if there are uncertainties.¹⁸ However, in such cases the relevant actors, whether public or private, need to be sufficiently convinced that proactive action is already needed at that point, instead of taking a passive and observant demeanour. In other words, there also needs to be a sufficient sense of urgency regarding the implementation of adaptive measures.¹⁹ Both climate risk awareness and a sense of urgency can be stimulated, for example, through awareness raising campaigns, through addressing climate risks and potential adaptive potentials in policies and other relevant documents or, if necessary, through the reinforcement of responsibilities in legislation.

Proactivity: Uncertainty about climate risks requires a proactive approach.²⁰ There is certainly a need for clarity on the responsibilities to repair or, if necessary,

¹⁷ See H.A.C. Runhaar *et al.*, Adaptation to climate change-related risks in Dutch urban areas: stimuli and barriers, *Regional Environmental Change* 2012 (12), p. 778.

¹⁸ See, for instance, N.A. Marshall *et al.*, Climate change awareness is associated with enhanced adaptive capacity, *Agricultural Systems* 2013, pp. 30-34.

¹⁹ See H.A.C. Runhaar *et al.*, Adaptation to climate change-related risks in Dutch urban areas: stimuli and barriers, *Regional Environmental Change* 2012 (12), p. 780.

²⁰ See, for instance, J. Spier, *Shaping the Law for Global Crises*, The Hague 2011; E.R. de Jong, Regulating Uncertain Risks in an Innovative Society: A Liability Law Perspective, in: E. Hilgendorf & J.P. Günther (ed.), *Robotik und Recht Band I*, Baden-Baden 2013, pp. 163-183; E.R. de Jong & J. Spier, *Climate Change. A Major Challenge and a Serious Threat to*

compensate for potential damage in reaction to climate-related events, but there should be at least as much emphasis on minimizing both the probability and consequences of the potential effects of such events. A merely reactive approach to risks, in terms of this assessment framework, will thus be detrimental to the expected effectiveness of climate adaptation. This implies that responsibilities for the minimization of the probability of climate-related damage to networks, and the mitigation of the related consequences of network failure, should also be allocated within the arrangements governing specific network sectors.²¹ In our view, though, this should not be of a too informal and non-committal nature. Giving these responsibilities an appropriate, explicit and clear legal basis could increase the expected effectiveness (see also the following paragraphs).²² This could, moreover, confirm, clarify and secure the rights of those who are dependent upon specific network services, increasing legal certainty and creating possibilities for legal actions, regardless of whether such rights are also safeguarded as fundamental rights under domestic Constitutions.²³

Appropriateness: Given the need for the allocation of both proactive and reactive responsibilities, another factor influential in the effective implementation thereof is the extent to which these are ‘appropriately’ allocated.²⁴ This indicator touches upon the notion of subsidiarity (in a broad sense)²⁵, which for the purposes of

Enterprises, *Dovens Schmidt Quarterly* 2013 (1), pp. 34 – 40; and *H.K. Gilissen*, The integration of the adaptation approach into EU and Dutch legislation on flood risk management, *Journal of Water Law* 2014 (3/4), p. 157.

²¹ We refer to ‘minimizing risks’ in the context of implementing measures in order to minimize the risk of damage or a disruption of services due to climate-related disasters. An example of such a measure is, for instance, refraining from building fragile infrastructure on a location that is prone to flooding or to design the infrastructure in a way that it is more resistant against floods or water-related disasters. ‘Mitigating consequences’ in this context refers to the implementation of measures in order to minimize the consequences of disasters that are related to climate change. This can be achieved by building a back-up network which can be used in case of failure of the primary network. In practice, this is referred to as creating ‘redundancy’ or ‘back-up capacity’.

²² See *H.A.C. Runhaar et al.*, Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors, *Regional Environmental Change* 2016 (in press), online version 2015, p. 4.

²³ In some EU Member States (e.g. Germany) access to specific network services, such as access to the internet and energy supply, are explicitly formulated as fundamental rights under domestic Constitutions.

²⁴ See *J.G. March & J.P. Olsen*, The logic of appropriateness, ARENA Centre for European Studies, Oslo 2004; and *H.K. Gilissen*, The integration of the adaptation approach into EU and Dutch legislation on flood risk management, *Journal of Water Law* 2014 (3/4), p. 157.

²⁵ The term ‘notion of subsidiarity’, in this chapter, is used in a broader sense than the subsidiarity principle underpinning EU law is commonly conceived. Whereas the principle is commonly strictly interpreted as a form of ‘vertical’ subsidiarity (determining the level of government at which specific responsibilities and competences should be implemented), our approach also covers a ‘horizontal’ dimension, regarding the question of whether certain responsibilities should be imposed on public or private actors. See, for instance, *A. Maltoni*, The Principle of Subsidiarity in Italy: Its Meaning as A “Horizontal” Principle and Its Recent Constitutional Recognition, *The International Journal of Not-for-Profit Law* 2002 (4), available at

this chapter comprises two key elements. At first, the responsibilities should be imposed upon the actors and at the level best suited for implementing such responsibilities, keeping in mind the specific domestic polity and the manner in which critical network sectors are organized. Furthermore, the actors on which specific responsibilities are imposed, should also have the powers, competences and resources relevant for the effective implementation thereof. In other words, the expected effectiveness ought not to be considered optimal if an actor is responsible for the implementation of a specific responsibility, but lacks the potential for its actual implementation, because of legal impediments or a lack of (financial) means for instance. Through the lens of appropriateness, the responsibilities should, moreover, be proportional from a twofold perspective; they should not unnecessarily put an insuperably excessive burden on the responsible actors, and their desired implementation should not excessively and unnecessarily infringe on other societal or individual interests.

Explicitness: The more general, more vaguely or more broadly a responsibility is formulated, the more uncertainties can arise about their specific objectives. In objective terms, this can be detrimental to the level of legal certainty such responsibilities provide, both to addressees and others interested, potentially affecting the level of expected effectiveness.²⁶ A highly general responsibility to ‘minimize external risks’ moreover gives the addressees much discretion to determine which risks to prioritize and which (kinds of) measures to choose in order to minimize these risks. Especially in cases where the awareness of climate risks is low, it is likely that the management of these risks would be given low priority and would be/remain of a reactive nature. Making both the risks and the related proactive and reactive responsibilities more explicit, could benefit the expected effectiveness thereof and could, moreover, increase their legal enforceability if needed. Furthermore, this could increase risk awareness and sense of urgency. There are various ways in which risks and responsibilities can be made more explicit, ranging from ‘soft’ measures, such as drawing involved actors’ attention to their responsibilities by a letter or brochure or by campaigning to raise awareness, to more profound legal measures, such as adopting explicitly formulated and targeted responsibilities in legislation or rules of conduct.

Transparency: A lack of transparency is often related to a lack of explicitness. Whereas the criterion of explicitness mainly addresses the formulation of relevant responsibilities from an objective perspective, transparency in this

www.icnl.org/research/library/files/Italy/The%20Principle%20of%20Subsidiarity%20in%20Italy.pdf; and A. Colombo, *The Principle of Subsidiarity and European Citizenship*, Milano 2004, pp. 16-19 (available at www.academia.edu/2293646/The_Principle_of_Subsubsidiarity_and_European_Citizenship).

²⁶ See T. Tridimas, *The General Principles of EU Law*, Oxford 2007, p. 242; and A.W.G.J. Buijze, *The Principle of Transparency in EU Law* (diss. UU), Utrecht 2013, pp. 134-135.

chapter is understood, from a more subjective perspective, as the way in which responsibilities are perceived by their addressees. Do they consider these responsibilities as clear and accessible, or in other words: do they know that they are responsible, and do they know and understand what they are exactly responsible and accountable for? In this view, a high level of explicitness does not yet guarantee that also addressees will consider their responsibilities as clear and transparent, regardless of the question whether the responsibilities could and therefore should have been perceived as such following more objective (legal) standards.²⁷ This could negatively affect the expected effectiveness of such responsibilities. A perceived lack of transparency can be abated through an explication of responsibilities and a clarification of their exact purposes. Any ambiguities and uncertainty about the question who is responsible and what this responsibility entails should be avoided.

Legitimacy: Legitimacy, in this work, comprises two interrelated aspects. These concern the extent to which relevant actors play or (could) have played a role in the actual development and division of their responsibilities and, subsequently, the extent to which these actors consider their responsibilities and the division thereof as reasonable and acceptable.²⁸ The first (formal) component mainly addresses the question to which extent the responsibilities and their division are the result of a democratic/public decision-making process or other type of public debate or process in which relevant actors and others interested were invited to actively participate and have actually participated. The absence of such a process/debate is not only detrimental to the creation of a legitimate basis for the division of responsibilities for climate adaptation, but can also hamper raising awareness of climate risks and the related creation of sense of urgency in a broader sense. The second component is more subjective in nature and addresses the question how relevant actors perceive their responsibilities in terms of reasonableness and acceptability, given that they are aware of these responsibilities. A low level of support can be detrimental to the expected effectiveness of responsibilities for climate adaptation, as it is assumed that the ones who do not accept their responsibilities and the way they are divided, will be less likely to take them seriously and might neglect them or at best will constantly seek to re-discuss them, generating systemic imbalances.²⁹

²⁷ In that latter respect, see A.W.G.J. Buijze, *The Principle of Transparency in EU Law* (diss. UU), Utrecht 2013; and M. van den Broek, *Preventing money laundering – A legal study on the effectiveness of supervision in the European Union* (diss. UU), Eleven International Publishing, Den Haag 2015, p. 134.

²⁸ Also see D. Curtin & A.J. Meijer, *Does transparency strengthen legitimacy? A critical analysis of European Union policy documents*, *Information Polity* 2006 (11), pp. 111-113; K.O. Lindgren & T. Persson, *Output and input legitimacy: synergy or trade-off? Empirical evidence from an EU survey*, *Journal of European Public Policy* 2010 (4), pp. 450-453; and F. Biermann, *Earth System Governance – World Politics in the Anthropocene*, The MIT Press, Cambridge 2014, pp. 121-144.

²⁹ See H.A.C. Runhaar et al., *Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors*, *Regional Environmental Change* 2016 (in press), online version 2015, p. 4.

4. APPLICATION OF THE ASSESSMENT FRAMEWORK: TWO CASE STUDIES FROM THE NETHERLANDS

Having presented our assessment framework, this assessment framework, by way of example, is applied to two Dutch network sectors (i.e. the electricity sector and the internet sector) in the following sections. The results of these case studies are presented following the discerned methodological steps and largely build upon data resulting from empirical research previously conducted by the authors.³⁰

4.1. STEPS 1 AND 2: JUSTIFICATION OF THE SELECTION AND THE CLIMATE RISKS PER SECTOR

For the purposes of this work, two Dutch critical infrastructural network sectors have been selected as case studies. These two sectors – the electricity sector and the internet sector – are in fact sub-sectors within the broader energy and ICT sectors respectively. The choice of these sub-sectors is mainly based on the results of research conducted by the Dutch *Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek* (TNO; the Dutch Organization for Applied Scientific Research) on climate risks within the overarching sectors. This research was conducted in the framework of the preparation of the Dutch National Adaption Strategy (NAS) and was commissioned by the Netherlands Environmental Assessment Agency.³¹ TNO has indicated these two sub-sectors

³⁰ See *H.A.C. Runhaar et al.*, Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014; *H.A.C. Runhaar et al.*, Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors', *Regional Environmental Change* 2016 (in press), online version 2015, pp. 1-12; and *H.K. Gilissen et al.*, De klimaatbestendigheid van de vitale infrastructuur beoordeeld van juridisch-bestuurlijk perspectief – Over de verwachte effectiviteit van de verdeling van verantwoordelijkheden voor de beheersing van klimaatrisico's in de elektriciteits- en de internetsector, *Nederland Juristenblad* 2015 (25), pp. 1640-1648.

³¹ See *Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek*, Klimaatverandering en energie-infrastructuur – Actualisatie van de risico's en kansen voor klimaatadaptatiebeleid, Projectnummer 060.06852, 25 juni 2014; and *Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek*, Klimaatverandering en de sector Informatie- en Communicatietechnologie (ICT) – Actualisatie van de risico's en kansen voor klimaatadaptatiebeleid, Projectnummer 060.06852, 25 juni 2014. TNO has furthermore made an overview of the most important climate risks for the transport sector (*Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek*, Klimaatverandering en transport en infrastructuur – Actualisatie van de risico's en kansen voor klimaatadaptatiebeleid, Projectnummer 060.06852, 25 juni 2014). This has brought forward interesting insights, but we have chosen to leave this sector out, considering the space and the special nature of this sector compared to the other two sectors. See *O.E. Jonkeren*, Adaptation to climate change in inland

as being the most critical amongst a selection of other (sub-)sectors. Below, some key results of the TNO studies are presented.

Climate risks for the energy sector: Even though the climate risks within the energy sectors are not estimated to be very significant in general, the risks within the electricity sector stand out. The flooding of interconnectors, transformer stations, electrical substations and power stations specifically through extreme rainfall and other severe weather conditions are considered to be major climate risks. Power failures can have serious consequences for society, since almost all facets of society highly depend on a power supply. Whereas the risk of fluvial flooding is rather small, pluvial flood risks especially have increased considerably over the last decades and are still increasing. The potential consequences of such risks (with possible domino or cascade effects)³² are great, giving these risks an ever more imminent character.³³

Climate risks for the ICT sector: TNO has indicated flooding of physical infrastructure, through heavy rainfall or surface water as being the most important climate risk within the ICT sector. Data centres, interconnectors, network cables, street electrical boxes and transformer boxes, as part of the internet infrastructure, are characterized as especially vulnerable objects. Moreover, heat waves can negatively influence the power supply and cooling potential, thereby hindering the proper functioning of servers in data centres. A long-lasting failure of ICT infrastructure can cause societal unrest, as well as serious economic damage and security risks, given that many societally and economically relevant processes are strongly automatized and depend on well-functioning infrastructural communication networks.³⁴

waterway transport (diss. VU), Amsterdam 2009; and O. Jonkeren *et al.*, Climate change and economic consequences for inland waterway transport in Europe, *Regional Environmental Change* 2014 (3), pp. 953-965.

³² See H.A.C. Runhaar *et al.*, Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 121-134. We explicitly recommend to include so-called ‘cascade effects’ as a component of the future adaption policy. The research in this field should be intensified. In this chapter, we will not discuss the possible cascade effects (and the responsibilities to constrain the risks related thereto).

³³ See for more detailed information *Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek*, *Klimaatverandering en energie-infrastructuur – Actualisatie van de risico’s en kansen voor klimaatadaptatiebeleid*, Projectnummer 060.06852, 25 juni 2014, especially the graphs on p. 23 and pp. 49-50.

³⁴ See for further information *Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek*, *Klimaatverandering en de sector Informatie- en Communicatietechnologie (ICT) – Actualisatie van de risico’s en kansen voor klimaatadaptatiebeleid*, Projectnummer 060.06852, 25 juni 2014, especially the graph on p. 24.

4.2. STEPS 3 AND 4: OVERVIEW OF SECTORAL CHARACTERISTICS AND CURRENT RESPONSIBILITIES

The electricity sector: The Dutch electricity sector was gradually liberalized since the end of the last century and, therefore, has developed a strong business-oriented character. The current legal framework governing this sector (i.e. the Electricity Act 1998 and its accompanying decrees and regulations; *Elektriciteitswet 1998*)³⁵ illustrates this well. There is no fundamental right to energy/electricity included in the Dutch Constitution, but a notion of this right is one of the pillars under the Electricity Act 1998.³⁶ Private actors play a central role within the electricity sector; the State –the Ministry of Economic Affairs and the Energy Department of the Dutch Authority for Consumers and Markets in particular – plays a regulatory and supervisory role. Key private actors are, on the one hand, the distributional network operators and, on the other hand, the producers, distributors and suppliers of energy.³⁷ The most important infrastructure for the transport and the distribution of electricity comprises the national electricity grid and the regional grids, including their numerous interconnectors, transformer stations, electrical substations, low voltage cables and distribution boxes.³⁸ As the TNO studies point out, regional distributional networks are especially vulnerable to the adverse effects of climate change (to flooding through heavy rainfall in particular). For this reason, the main focus of this case study lies on these regional networks.

The critical infrastructure within these networks is (economically) owned by regional distributional network operators³⁹, who are responsible for their day-to-day management and maintenance. These responsibilities *inter alia* include the obligation to keep the grids working, to maintain them and – if necessary – to repair them.⁴⁰ A specific responsibility concerns the protection of the grids against ‘potential external influences’⁴¹, among which climate related events can

³⁵ A full text of the Electricity Act 1998 is available at <http://wetten.overheid.nl/BWBR0009755/2016-04-01>.

³⁶ See, for instance, Articles 23 and 95b(7) and (8) Electricity Act 1998.

³⁷ See Article 1(1) Electricity Act 1998 for definitions. Network operators are to be considered as semi-public actors; they are appointed by the state as legal persons regulated under private law, of which the Dutch government acts as the only stakeholder (see Article 10 and 10a Electricity Act 1998). Based on the ‘Splitsingswet’, network operators cannot be producers, suppliers or distributors at the same time (and vice versa; see art. 10b(1) and 11(1) Electricity Act 1998).

³⁸ See for more technical information: <http://eduweb.eeni.tbm.tudelft.nl/TB141E/print.php?systemen-ketens-netwerken>.

³⁹ The regional network operators are appointed for a period of ten years by the legal owner of a regional network. The appointment needs the approval of the Minister of Economic Affairs. See Article 10(9) and Article 10 and Article 12(2) Electricity Act 1998.

⁴⁰ For a list of tasks of the network operators, among which the above mentioned, see Article 16(1) Electricity Act 1998.

⁴¹ See Article 16(1)(q) Electricity Act 1998. The Minister of Economic Affairs can give instructions to a network operator on basis of Article 16(d)(a) Electricity Act 1998 in the context of ‘external

also be understood. Other responsibilities of distributional network operators include the obligatory establishment and implementation of emergency plans and risk analyses.⁴² Such plans and analyses can also address climate-related risks, but these are not explicitly mentioned. On the basis of this legal framework, distributional network operators have a relatively large amount of discretion in the interpretation and implementation of their operational and planning responsibilities. In that sense, they can prioritize risks, meaning that they can determine to what extent they will anticipate the expected effects of climate change themselves to a large extent.⁴³ Regarding these aspects, the State only plays a marginal role.

The internet sector: Just like the right to energy, the right to access to the internet is also not considered to be a fundamental right under the Dutch Constitution.⁴⁴ Within the internet sector, private actors play a primary role; the State (i.e. the Ministry of Economic Affairs, the Authority for Consumers and Markets, and the Telecommunication Agency) mainly plays a regulatory and supervisory role. The most important private actors within this sector are the ‘suppliers of public electronic communication networks and services’ (hereinafter referred to as ‘suppliers’), as stated in the Telecommunications Act.⁴⁵ The critical infrastructure of this sector consists of the so-called ‘backbone’ (i.e. the central network of glass fibre cables and internet exchanges), nodes (i.e. servers and data centres) and local network cables, street electrical boxes and transformer boxes. The ‘constructed’ parts of the network (e.g. data centres and electrical substations) were pointed out by TNO as being particularly vulnerable to the adverse effects of climate change. Therefore, this case study focuses on these ‘constructed’ parts, mainly data centres.

On the basis of the Telecommunications Act, suppliers are generally obliged to repair any damage to their networks. They, moreover, have a duty of care regarding the continuity of service, which includes the obligatory drafting of business continuity plans.⁴⁶ Just like the network operators in the electricity

influences’. Enforcement of the responsibilities takes place via the minister and not via Article 77h and 77i of the Electricity Act 1998 (non-compliance penalty and administrative fine).

⁴² See art. 16d lid 1 Electricity Act 1998 jo. art. 20a ‘*Regeling kwaliteitsaspecten netbeheer elektriciteit en gas*’, as well as art. 15 en 21 *Regeling kwaliteitsaspecten netbeheer elektriciteit en gas*.

⁴³ See H.A.C. Runhaar et al., Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 49-56.

⁴⁴ However, recently (early 2016) a public debate is (re-)initiated about whether access to the internet should be considered to be a fundamental right.

⁴⁵ See art. 1.1 Telecommunications Act for definitions. A full text of this Act is available at <http://wetten.overheid.nl/BWBR0009950/2016-01-01>.

⁴⁶ See art. 11a.1 and 11a.2 Telecommunications Act. See also Section 3 of the *Besluit continuïteit openbare elektronische communicatienetwerken en -diensten*. For more information, consult

sector, suppliers within the internet sector have a great deal of discretion in interpreting and implementing their responsibilities.⁴⁷ These provisions, however, are not applicable to services that are not fully or principally concerned with data transmission. For instance, data storage is not covered by this legislation. This implies that the duty of care for business continuity does not apply to data centres, insofar as they confine themselves to data storage and do not offer public access to the internet.⁴⁸ An important part of the market, from the perspective of the continuity and quality of services, is therefore not regulated. Incentives for continuous services, thus, are only generated through economic self-interest of the involved actors. Within this context, they fully determine themselves to which extent they will anticipate in their business management to the expected adverse effects of climate change. In this respect, the State does not interfere to a great extent.

4.3. STEPS 5 AND 6: ASSESSMENT, REFLECTION AND RECOMMENDATIONS

In Section 3 above, the concept of ‘expected effectiveness’ – as a central criterion for the assessment of the climate resilience of infrastructural network sectors – was operationalized through the identification and elaboration of six indicators. In this section, the electricity and the internet sectors’ climate resilience will be assessed following these indicators. We present the most important findings per indicator, in order to highlight sectoral differences and similarities and to sketch a view of the climate resilience in both sectors. Where needed, we formulate recommendations for improvement.

Awareness/Sense of Urgency: In both sectors, the levels of awareness and sense of urgency prove less than satisfactory, especially amongst private actors. This is not to say that climate risks are being denied structurally or consciously ignored, but there is an observed lack of structural anticipation in strategic decision-making in operational management.⁴⁹ Climate adaptation, in other words, has

the following website: www.agentschaptelecom.nl/onderwerpen/openbare-netwerken/continuïteit-en-veiligheid/zorg-en-meldplicht-continuïteit.

⁴⁷ See *H.A.C. Runhaar et al.*, *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 26-32.

⁴⁸ See *H.A.C. Runhaar et al.*, *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 27-28.

⁴⁹ See *Planbureau voor de Leefomgeving*, *Aanpassen aan klimaatverandering – Kwetsbaarheden zien, kansen grijpen*, Den Haag 2015, pp. 79-80.

not yet sufficiently been ‘mainstreamed’ within these sectors’ decision-making frameworks. In the internet sector particularly, climate risks seem to almost completely be set aside for the benefit of other relevant factors, such as optimizing economic benefit. In the electricity sector, on the other hand, there is a positive development: climate risks are increasingly being recognized as threats, as a result of which they are being increasingly taken into account in risk analyses, especially in cases of new network investment.⁵⁰ At the level of government, specific policy developments, especially those in the framework of the Dutch Delta Program⁵¹ and the National Adaptation Strategy⁵², show an increasing amount of attention being paid to climate risks and their adverse effects for network sectors. These developments, however, have not yet resulted in concrete sectoral policies, guidelines or regulations. As we consider raising awareness and creating a sense of urgency to be primarily a task for the State (both on the central and decentralized level), especially where major public interests are involved, the State should engage further in such efforts, preferably in close cooperation with private actors and their branch organizations.⁵³

Proactivity: In the electricity sector, as well as in the internet sector, there are clear and concrete responsibilities for private actors to repair their network infrastructure as soon as possible after calamities. Apart from such reactive responsibilities, also proactive responsibilities in anticipation of risks are adopted in legislation in the electricity sector, albeit these are very generally formulated and not specifically focused on climate-related risks (also see the paragraphs below about ‘explicitness’ and ‘transparency’).⁵⁴ In the internet sector, and for data centre operators in particular, no such statutory proactive responsibilities exist. Any incentives for proactive behaviour have to be generated through their economic self-interest by and large. In practice, in the electricity sector (where risk awareness seems to increase; see above), climate-related risks are increasingly taken into account in operational planning and anticipatory decision-making. This has not been observed to be the case in the internet sector, arguably due to a lack of statutory proactive responsibilities in combination with a low level of risk awareness. Despite positive developments in the electricity sector, the general attitude towards climate-related risks in both sectors is still of a very reactive

⁵⁰ See *H.A.C. Runhaar et al.*, *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 40 and 65.

⁵¹ See www.deltacommissaris.nl/deltaprogramma/inhoud/deltaprogramma-2016.

⁵² See www.ruimtelijkeadaptatie.nl/en/nas2016.

⁵³ Also see *Planbureau voor de Leefomgeving*, *Aanpassen aan klimaatverandering – Kwetsbaarheden zien, kansen grijpen*, Den Haag 2015, pp. 101-104.

⁵⁴ Network operators must put effort into ‘*protecting their networks against external effects*’, carry out risk analyses, and establish emergency plans based thereon. Also see Section 4.2.

nature.⁵⁵ The expected effectiveness could be increased through adopting concrete proactive responsibilities in the internet sector, and to draw more attention to such responsibilities in both sectors. The State plays a clear role in this respect, but so too do key actors within the sectors and the sectors' branch organizations who can support in generating an attitudinal shift towards greater proactivity.⁵⁶

Explicitness: As stated above, there is an absence of concrete proactive responsibilities in the internet sector, whereas such responsibilities do exist in the electricity sector, albeit these are very generally formulated. The level of explicitness, therefore, is to be considered rather low in both sectors. This can be detrimental to the expected effectiveness of climate adaptation within these sectors, both from the perspective of the likelihood that relevant actors will adopt a proactive approach in their planning and operational management, as well as from the perspective of the enforceability of such responsibilities if and where needed.⁵⁷ The explication of responsibilities could both increase this likelihood and enforceability. This could, moreover, benefit the legal certainty of both addressees of these responsibilities and those dependent upon the specific network services. Explication, in other terms, could make clear for network operators that they have certain responsibilities, and what is actually expected from them in that respect, and thus what others can reasonably expect and, if necessary, even require. This can be achieved through the adoption of more concretely formulated responsibilities in relevant legislation – which is worth considering, especially for the internet sector – and through the explication and substantiation thereof in explanatory memoranda or other documents.

Transparency: As stated above, a lack of transparency is often closely related to a lack of explicitness. Explicitness has been operationalized from a more objective perspective, whereas transparency in this chapter is understood as the way in which responsibilities are substantively perceived by their addressees. Do they consider these responsibilities to be clear and accessible, or in other words: do they know that they are responsible, and do they know and understand what they are exactly responsible and accountable for? Empirical studies have revealed that most actors within both sectors are aware of their responsibilities or at least assume they (might) have certain responsibilities in relation to climate

⁵⁵ See *H.A.C. Runhaar et al.*, *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 41 and 66.

⁵⁶ See, in a more general sense, *Planbureau voor de Leefomgeving*, *Aanpassen aan klimaatverandering – Kwetsbaarheden zien, kansen grijpen*, Den Haag 2015, pp. 86-87.

⁵⁷ See *H.K. Gilissen et al.*, *De klimaatbestendigheid van de vitale infrastructuur beoordeeld van juridisch-bestuurlijk perspectief – Over de verwachte effectiviteit van de verdeling van verantwoordelijkheden voor de beheersing van klimaatrisico's in de elektriciteits- en de internetsector*, *Nederland Juristenblad* 2015 (25), pp. 1646-1647.

adaptation, but that most actors – especially ‘smaller’ actors with less significant market-power – consider their responsibilities to be rather unclear, both as to the concrete division thereof, as well as to their substance.⁵⁸ This could arguably be the case due to a lack of statutory responsibilities as such (internet sector), or the rather general and broad formulation of responsibilities (electricity sector). This perceived lack of transparency can be remedied through explication of the responsibilities as described above, and through an actor-oriented, unambiguous and explicit clarification of their exact purposes.

Legitimacy: In the absence of clear, transparent and explicitly formulated responsibilities in both sectors, it is yet too early – and, to a certain extent, also rather pointless – to assess their legitimacy. The legitimacy of the implicit unwritten responsibilities in the internet sector can be questioned from a legal perspective, even though network operators might not consider these to be unreasonable and unacceptable per se. Given that our recommendations address the adoption of new statutory responsibilities for climate adaptation and/or the explication of already existing ones, encouraging public debate about these responsibilities and the division thereof is of greater importance at this stage, from the perspective of legitimacy, but also for the purpose of raising awareness of climate-related risks from a broader perspective. Although there are already early incentives for such a debate, the debate has only come on stream slowly and takes place largely at a rather abstract level away from the public and relevant market actors. In this respect, the debate should be intensified and the range of participants should be broadened. This is the first step in building a legitimate basis under concrete responsibilities for climate adaptation in infrastructural network sectors. Nonetheless, empirical studies show that there are no direct indications that network actors, from a more subjective perspective, consider any responsibilities for climate adaptation as unreasonable or unacceptable and, thus, illegitimate; it is rather their perceived lack of transparency about their (future) responsibilities that concerns them.⁵⁹ Without the debate and the related explication of responsibilities (i.e. the current situation), mentioned above, the level of legitimacy thereof is to be considered rather low.

⁵⁸ See *H.A.C. Runhaar et al.*, *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 40 and 65; and *Planbureau voor de Leefomgeving*, *Aanpassen aan klimaatverandering – Kwetsbaarheden zien, kansen grijpen*, Den Haag 2015, pp. 78-79.

⁵⁹ See *H.A.C. Runhaar et al.*, *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht 2014, pp. 41-42 and 66-67; and *Planbureau voor de Leefomgeving*, *Aanpassen aan klimaatverandering – Kwetsbaarheden zien, kansen grijpen*, Den Haag 2015, pp. 78-80.

Appropriateness: As stated above, responsibilities for climate adaptation should be imposed upon actors that are best suited for the implementation thereof, keeping the specific domestic polity and the manner in which critical network sectors are organized firmly in mind. Furthermore, the actors upon which specific responsibilities are imposed should have the powers, competences and resources relevant for the effective implementation thereof, and the responsibilities should, as such, be proportional. Under the current circumstances, there are no direct and concrete indications that the responsibilities and the division thereof do not meet such requirements. Given the Dutch organization of the electricity and internet markets, it is not to be considered unreasonable that responsibilities for climate adaptation are imposed upon key market actors. The State plays a regulatory, supervisory and coordinating/stimulating role, and should take an active attitude in this respect, despite the fact that access to energy supply and the internet are not considered fundamental rights under the Dutch Constitution. The State should, moreover, guarantee that relevant actors will not unnecessarily face legal impediments in the implementation of their responsibilities imposed upon them by law, and it should make use of its arsenal of tools and competences, in the domain of spatial planning for instance, to foster an effective implementation of such responsibilities. If necessary, it can financially support actors in implementing their responsibilities if the public interest gives proper reasons thereto. It should, finally, be stated that the requirements mentioned should be at the basis of any future (re)formulation of responsibilities in order to prevent that such developments will become detrimental to the expected effectiveness of climate adaptation in infrastructural network sectors.

5. CONCLUSIONS

In this chapter, we presented and applied a novel interdisciplinary method for the assessment of the climate resilience of critical infrastructural network sectors through the lens of the criterion of 'expected effectiveness' of formal responsibilities for climate adaptation. This central criterion was further operationalized through six indicators: awareness, proactivity, appropriateness, explicitness, transparency and legitimacy. These indicators comprise legal and governance aspects, thus aiming to draw out expectations about the effectiveness of sectoral responsibilities for climate adaptation from an integrated perspective. This is of added value, given that the climate issue – and in particular its relevance for infrastructural network sectors – is a multi-faceted issue, requiring an integrated multi-disciplinary approach, instead of a parallel set of mono-disciplinary approaches. The assessment framework is designed in such a way that it can easily be applied to a wide range of network sectors, that also gain insights from other disciplines and can be easily integrated into it, and that it

can easily be adapted to experiences with its application. This has resulted, for instance, in the recent addition of the indicator of appropriateness, adding more legal aspects stemming from the notions of subsidiarity and proportionality. Apart from its academic purposes of evaluating and comparing domestic sectoral responsibilities for climate adaptation, this framework is also well-suited to more practical applications, such as the assessment and (re)development of domestic arrangements governing critical network sectors within the EU and abroad.

The application of this assessment framework to two Dutch case studies (focusing on the electricity and the internet sectors) shows a rather low degree of climate resilience in both sectors. Although there are sectoral differences in performance, the likelihood that relevant network actors will adequately anticipate climate-related risks in their operational planning and decision-making is considered to be sub-optimal. This is mainly due to a lack of climate risk awareness and a sense of urgency, a lack of explicit and transparent responsibilities (both regarding their formulation, and the way in which these are perceived by their addressees), and a related reactive, instead of a proactive, sectoral attitude towards such risks. Expected effectiveness of sectoral responsibilities for climate adaptation can be increased through awareness raising and the explicitation and clarification of these responsibilities in legislation or other formal documents. The need for an attitudinal shift towards a more proactive approach to climate-related risks of relevant actors within these sectors themselves notwithstanding, the State and other public actors also play a clear role in this respect through their agenda-setting, regulatory and supervisory competences and tasks. These public responsibilities should also be emphasized more and should be taken seriously in order to make climate adaptation more successful overall. These, and other results from our case studies and their related recommendations, can provide valuable lessons for other sectors and/or other countries, facing similar issues. More in-depth evaluations and cross-country comparisons could lead to more concrete and more broadly relevant recommendations and to the identification of potentially transferable good practices.

PART 2
IMPROVING EFFECTIVENESS



2.1. BETTER LEGISLATION

