Towards ecological governance in EU energy law

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Chapter Five

The role of technology neutrality in incentivising energy-related innovations

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Abstract

This article discusses the concept of technology neutral legislation and its use in EU energy law. For this reason, the applicable EU Directives are assessed in the light of their level of such neutrality. Additionally, the overall desirability and feasibility of technology neutral legislative design is examined and weighed against other legislative goals, in particular the need to foster technological innovations in the energy sector. This assessment is carried out from the perspective that, in order to mitigate climate change, it is essential to come to a legislative system for ecological governance. On the basis of this premise, it is concluded that technology neutrality should not be the prime concern of legislators, but that adaptability and comprehensiveness of the legal framework are more important factors to come to a sustainable energy system.

Keywords: technology neutrality, energy law, ecological governance, innovation, best available techniques (BAT), EU law, sustainability.

5.1. Introduction

The many environmental problems that humanity currently faces compel and motivate us to change our way of life and to amend our production and consumption patterns in order to bring them (more) in line with the planetary boundaries that we see ourselves confronted with.[1] Achieving this is particularly important in regard to energy, which is 'the life blood of society'[2] while its production and consumption are simultaneously one of the prime causes of greenhouse gas (GHG) emissions and thus of climate change and environmental degradation.[3]

One way of bringing our consumption patterns in line with the planetary boundaries would be to implement a system of ecological governance which centres around a continuous strive to reduce the cumulative stresses that our activities put on ecosystems.[4] Such an approach would require an adaptive legal framework aimed at progressive reductions of impacts, via reduced consumption, substitution of damaging activities by less disruptive alternatives and the 'sunsetting' (i.e. timely prohibition) of the most polluting and/or damaging activities.[5] These guiding principles show great similarity with the concept of 'best available techniques' (BAT) as

1 J. Rockström *et alia*, 'A safe operating space for humanity' (2009) 461 *Nature,* pp. 472–5.
2 European Commission, 'Energy 2020 – A Strategy for Competitive, Sustainable and Secure Energy' (Communication) COM(2010) 639, at p. 2.
3 'Greenhouse-gas emissions from the energy sector represent roughly two-thirds of all anthropogenic greenhouse-gas emissions', according to the International Energy Agency (IEA). International Energy Agency, *Energy and Climate Change. World Energy Outlook Special Report* 2015, at p. 20.
4 O. Woolley, *Ecological Governance - Reappraising Law's Role in Protecting Ecosystem Functionality* (CUP 2014), at p. 54.
5 Ibid, at pp. 71-7.

currently deployed in European Union (EU) industrial emissions abatement.[6] Hence, ecological governance could largely be operationalized by reinterpreting the concept of BAT and expanding its scope of application.[7] One implication thereof is that the regulations prescribing the use of BAT must largely be 'technology neutral'.[8] On top, technology neutrality as a legislative principle features prominently in energy law in a broader sense.[9] For these reasons, this article assesses to what extent technology neutral legislation has been implemented EU energy law and whether the use of the concept does indeed lead to innovations and whether its use aids the transition to more sustainable energy production and consumption patterns.

Technology neutrality can be defined as 'that different technologies offering essentially similar services should be regulated in similar manners'.[10] The term was first used primarily in the field of ICT regulation, but its use has gained much momentum since then.[11] In fact, '[t]he desirability of technology neutral regulation has become part of the general wisdom, and is rarely questioned.'[12]

6 The BAT concept is defined in article 3(10) of Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) [2010] OJ L334/17 (Industrial Emissions Directive, IED) and elaborately explained in S. Bell *et alia*, *Environmental Law* (OUP 2017), at pp. 518-21.

7 As discussed at greater length in: R.A. Giljam, 'Better BAT to bolster ecosystem resilience: Operationalising ecological governance through the concept of Best Available Techniques' (2017) 26(1) *Review of European, Comparative & International Environmental Law (RECIEL)* 5-18; and: R.A. Giljam, 'Extended application of 'Best Available Techniques' as a means to facilitate ecological governance: Assessing the legality of an ecologically oriented interpretation in the European Union (EU) of 'Best Available Techniques' (BAT) under international trade law and in particular in relation to energy production' (2018) 36(2) *Journal of Energy and Natural Resources Law (JERL)* 181-208.

8 As explicitly acknowledged in IED, n. 6 above, art. 15(2): '… emission limit values […] shall be based on the best available techniques, without prescribing the use of any technique or specific technology.'

9 See, e.g. European Commission, 'Energy roadmap 2050' (Communication) COM(2011) 885 final, at p. 3.; European Commission, 'State aid: Commission authorises UK Capacity Market electricity generation scheme' (Press release) Brussels, 23 July 2014, available at: http://europa.eu/rapid/press-release_IP-14-865_en.htm; or more implicitly: European Commission, 'Guidelines on State aid for environmental protection and energy 2014-2020' (Communication) [2014] OJ C 200/1, e.g. guideline 226.

10 Definition from ICT Regulation Toolkit, available at: http://itlaw.wikia.com/wiki/Technology_neutrality#cite_note-0.

11 The term was first used in an EU legislative proposal in 1998, according to Reed, n. 12 below, at p. 264. Now the principle can *inter alia* be found in: European Commission, 'Principles for regulating Audiovisual Media Services at European level', available at: https://ec.europa.eu/digital-single-market/en/general-principles; Directive 2002/21 on a common regulatory framework for electronic communications networks and services [2002] OJ L108/33, recital 18.; Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC [2006] OJ L396/1, which covers chemicals, including nanomaterials.

12 C. Reed, 'Taking Sides on Technology Neutrality' (2007) 4(3) *SCRIPT-ed,* pp. 263-84, at 265. Even though his work concerns ICT regulations, it is applied by analogy here.

Put briefly, the desire to design technology neutral regulations stems from one of the three following reasons.[13] First, laws tend to aim to regulate functions and effects, rather than means. Thus, 'behavio[u]r as such is not the point of regulation, it is rather the effect of behavio[u]r on society or on other people that is the focus of regulation.'[14] Second, laws overall aim to avoid any negative consequences or unintended side effects of regulations, i.e. they mean to avoid discrimination and hindrance in the development of technologies. Third, technology neutrality can be seen as a principle of law making: a law must sustain the test of time, be proportionate and subsidiary and be transparent. Whether technology neutral legislative design can actually live up to these expectations is a matter open for debate. After all, '[r]ules are devised in a particular technological context, with explicit and implicit assumptions as to what is possible' and '[t]he link between a rule and its goals is [also] based on assumptions about the world.'[15] Reed in fact argues that the desirability of technology neutral rules can only be determined after examining (i) whether the implicit aims are achievable; (ii) whether technology neutral drafting is in this particular case possible at all; and (iii) whether there are potential undesirable consequences.[16]

One such potential negative consequence could be a risk of reduced legal certainty. After all, '[b]y definition, technology neutral regulation cannot be very specific about the subject matter which it regulates. This can produce the undesirable consequence that the law, or its application in practice, is insufficiently clear.'[17] Therefore, in the design of technology neutral legislation a delicate balance must be struck between the flexibility that the rules offer and the legal certainty that they provide.[18] On top, the vagueness resulting from the enhanced flexibility of the legal framework might affect the legislation's 'power to steer'. The latter is important in order to come to more sustainable production and consumption patterns. In energy especially, radical innovations in production processes are a crucial aspect for replacing damaging practices with less disruptive ones. Stimulating the development of such new technologies, may well require additional efforts other than implementing a neutral overall framework. As such, in order for new technologies to be developed and placed on the market, it can be necessary to implement (temporary) technology specific policies to stimulate these innovations. Hence, in the design of

13 B.J. Koops, 'Should ICT Regulation be Technology-Neutral' in B.J. Koops, M. Lips, C. Prins & M. Schellekens, *Starting Points for ICT Regulation: deconstructing prevalent policy one-liners* (The Hague: TMC Asser Press 2006), pp. 77-108, at 83-90.

14 Koops, n. 13 above, at p. 83.

15 L. Bennett Moses, 'Recurring Dilemmas: The Law's Race to Keep Up With Technological Change' (2007) 2 *University of Illinois Journal of Law, Technology & Policy,* pp. 239-85, at 265-6.

16 Reed, n. 12 above, at p. 275. The implicit aims he discerns are a desire to 'futureproof' legislation, a wish to ensure equivalent treatment of technologies, and a hope to encourage the development and uptake of technologies.

17 Reed, n. 12 above, at p. 280.

18 Thus, regulations can only be 'as much technology-neutral as is compatible with sufficient legal certainty'. Koops, n. 13 above, at p. 90. As also affirmed by J. Ebbesson, 'The rule of law in governance of complex socio-ecological changes' (2010) 20(3) *Global Environmental Change,* pp. 414-22, at p. 417.

EU energy policy, a clear tension can be identified between the need to steer production in a specific ('green') direction – which at first sight seems to require technology specific rules - and the need for laws to be comprehensive and time-resilient which would likely require technology neutral legislation. Matters are complicated even further by the notion that currently EU energy policy is not aimed solely at making energy production and consumption sustainable, but that the policy simultaneously pursues affordable energy for all, as well security of energy supply.[19]

Nevertheless, incentivising innovation is essential, because environmental protection requires a swift, radical energy transition. To facilitate this transition, major technological changes are required, as new production methods are crucial to make the energy sector sustainable.[20] On top, technical innovations are also needed to diversify energy supplies to ensure security of supply thereof.[21] Hence, in addition to 'future proofing' legislation via technology neutral formulations, the regulatory framework should simultaneously stimulate innovative solutions.

The resulting outline of this article is the following. First, the characteristics and regulation of the EU energy sector are described and discussed in the light of the level of technology neutrality of these rules. After that, the potential for technological neutral legislative design to stimulate innovations is discussed in more detail, and this contrasted with the role of technology specific legislation in incentivising (radical) innovations. This will lead to a discussion on what is needed for the legal system to enhance ecological governance in the energy sector. In this, particular attention will be paid to the need to deal with uncertainties and externalities. Finally, overall conclusions are drawn. Throughout this article, the focal point is on EU energy law, and in particular on an expanded use of BAT as a means to reduce impacts and emissions from energy production.[22]

19 This is also referred to as the 'energy trilemma', as reiterated in para. , n. 27 below. See N. Gunningham, 'Confronting the Challenge of Energy Governance' (2012) 1(1) *Transnational Environmental Law,* pp. 119-35, at pp. 120 & 123-26.

20 As also acknowledged in European Commission, 'Energy Technologies and Innovation' (Communication) COM(2013) 253 final, at p. 2.

21 At the same time, the need to ensure the safety and functioning of the networks sets boundaries to the type and level of the changes that can be implemented.

22 For this reason, as well as for a lack of space, a choice was made not to discuss the EU emissions trading system (ETS) despite its relevance to technology neutral legislative design. For a discussion of the ETS, see E. Woerdman, M. Roggenkamp and M. Holwerda (eds), *Essential EU Climate Law* (Edward Elgar 2015), pp. 43-75.

5.2. Regulation of the EU energy sector

5.2.1. Characteristics of the sector

It is important to be aware that 'energy' entails a broad range of very different products and processes, which are not (and cannot be) all regulated in the same manner.[23] Furthermore, the separate branches of the sector differ in their relative shares of (environmental) impacts and levels of consumption. The largest part of the energy sector is the heating and cooling sector, followed by the transport sector. This leaves the electricity sector as the smallest section of the three.[24] Also, each of these sectors has a different energy mix.[25] These differences in the energy sources used partially impact how the respective sectors can be (effectively) regulated. As mentioned above, in energy regulation it is furthermore crucial to do justice to the 'energy triangle', or triple aim of energy policies: Energy must be sustainable (i.e. 'green') as well as affordable, while energy supplies must simultaneously be secure.[26] This multi-facetted policy leads to a constant need to strike a balance between the different, and at times conflicting, aims.[27]

In such balancing, the timeframe under consideration has an additional impact on where the equilibrium is expected to be found, as a short term perspective leads to different conclusions than a long-term view. The length of the timeframe considered is also crucial in regard to the

23 A full description of EU energy market complexities and regulation falls outside the scope of this article. For that, I refer to: M. Roggenkamp *et alia* (eds), *Energy Law in Europe. National, EU and International Regulation* (OUP 2016). For an overview of energy infrastructures as complex adaptive socio-technical systems, see D. Scholten & R. Künneke, 'Towards the Comprehensive Design of Energy Infrastructures'(2016) 8(12) *Sustainability,* 1291, at p. 3 of 24.

24 Heating and cooling consumes around half of overall European energy demand. Around a third of all energy is then used by the transport sector, which means 15-20% of all energy is used in the electricity sector. See: European Commission, 'Impact Assessment Accompanying the Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources' SWD(2016) 418 final – part 1 of 4, at pp. 12 & 14.

25 Ibid. For instance, the transport sector is almost entirely dependent on oil, while the heating and cooling sector accounts for almost 70% of the EU's gas imports. The majority of renewables is consumed as electricity, even though this sector as a whole is still dominated by more conventional fuels.

26 This security of supply has two aspects. Energy supply must be adequate, in the sense that the system should be capable of meeting demand at all times, while it must also be secure, meaning that is must be able to withstand disturbances. Therefore, it is also important to secure sufficient investment in generation capacity . See H.P.A. Knops, *A functional legal design for reliable electricity supply: how technology affects law* (Intersentia 2008), at pp. 93-5 & 277.

27 Called the 'energy trilemma' by Gunningham, n. 19 above. It is debatable whether it is at all possible to achieve these three aims at the same time, or whether some form of hierarchy is required. See: K.S. Friesenbichler, 'Policy interaction and the integration of volatile renewable energy' (2016) 18(2) *Environmental Economics and Policy Studies*, pp. 193-211, at 209.

required investments in the energy system which are characterized by a long-term range.[28] Due to this, the energy sector is generally characterized by high path dependency and a high potential for technological lock-in. Not only are the investments in infrastructures itself high cost and long-term, but so are the subsequent investments in household appliances that are adapted to these infrastructures.[29] As a result of this, as well as due to the fact that the sector is heavily regulated, existing technological patterns are strongly embedded in society.[30]

This situation is exacerbated by the notion that several energy sources are highly network dependent; in particular electricity and to a lesser extent gas.[31] Related to this network dependency are two complications stemming from the increase in renewable energy sources. Firstly, renewable sources tend to generate a more intermittent supply of energy than traditional (fossil) sources, which (if not managed well) may affect the safe and secure functioning of the networks.[32] On top, current infrastructures are primarily set up for centralized supply, while energy is increasingly generated in a decentralized manner.[33] Both of these characteristics of renewable energy create technical challenges for system operators, which are increasingly addressed by legislators .[34]

28 While accurate figures are hard to find, estimates show that the average lifespan of power installations is typically 20-30 years for renewable sources and 30-45 years for more conventional power plants. (See, e.g.: World Bank, *Transition to a Low Carbon Economy in Poland,* Low Carbon Growth Country Studies Program, Briefing Note 009/11 (2011), at p. 22.) For the various components that make up the network the lifespan ranges between 40 to 60 years. (As estimated in: R. Itten, R. Frischknecht & M. Stucki, *Life Cycle Inventories of Electricity Mixes and Grid,* Version 1.3 (Treeze 2014), at p. 182.) On top, the development and maturing of new technologies also takes time, as affirmed in COM(2013) 253 final, n. 20 above, at p. 8.

29 For instance, in the Netherlands all new buildings have a mandatory connection to the gas network and, as a result, Dutch households are highly dependent on gas for heating as well as cooking. To switch to more sustainable modes of heating and cooking, the mandatory connection requirement was recently scrapped, but to effectuate any innovations all the equipment must be replaced. (Rijksoverheid, 'Verplichte gasaansluiting voor nieuwbouwwoning vervalt' News report (27 June 2017), available at: https://www.rijksoverheid.nl/actueel/nieuws/2017/06/27/verplichte-gasaansluiting-voor-nieuwbouwwoning-vervalt)

30 E. Gawel *et alia*, The Rationales for Technology-Specific Renewable Energy Support: Conceptual Arguments and their Relevance for Germany, UFZ Discussion Paper 4/2016 (Helmholtz Centre for Environmental Research, April 2016), at p. 7.

31 These sources need to be transmitted and distributed through cables and pipelines. Therefore, many rules in the energy sector are centred around the privileged position of the network operators.

32 *Ergo*, volatile renewable energy may create imbalances in the networks and thus impact the security of energy supply, both in terms of safety as well as the availability.

33 This may also lead to 'two-way' traffic, when individuals wish to put their home-produced excess of energy into the network, rather than buying it from the traditional top-down one-way network.

34 E.g. via implementing capacity mechanisms, such as priority access for renewables and enhanced cross-border cooperation and balancing.

Since the 1990s the energy sector has been characterized by increasing Europeanization, due to the creation of an EU internal energy market.[35] This has led to major transformations in the division of competences, in the amount of actors involved in the field, as well as in consumer protection and freedom of choice. As a result of this Europeanization, the EU energy market is now regulated at three levels of (partially overlapping) governance: the EU level, the national level and the local level. This article focuses solely on the European regulatory level. The EU founding treaties mention energy on several occasions and the competence to regulate in this field is shared between the EU and its Members.[36] In a nutshell, the EU can adopt energy market legislation, while the Member States maintain a sovereign right 'to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply'.[37]

Within each governance level, different institutions with differing competences play a role in decision-making, and in the execution and enforcement of the rules.[38] When it comes to the regulation and, especially, enforcement at the national level, national governments decide upon the national policies and fill in the blanks left by EU law, while lower level branches of government are usually the competent authority in permit issuing. Thus, while the latter may have no say in setting the rules, they do influence the level of environmental protection accorded or the adequacy of energy supply, as the local level is eventually where the rules are interpreted, executed and enforced.[39]

35 Up to date, three 'energy packages' have been issued, each leading to further strengthening of the EU market dimension. For a full description of these developments, I refer to Roggenkamp *et alia,* n. 23 above.

36 The basis in EU law is that as long as a specific competence is not conferred upon the EU institutions, it rests with the Member States. Thus, in certain policy areas the EU has exclusive competence, while in others, it shares its competence with the Member States. On top, in the use of its conferred competences, the EU must adhere to the principles of subsidiarity and proportionality. See Articles 4 & 5 of the Consolidated version of the Treaty on European Union [2012] OJ C326/13 (TEU) and Articles 3 and 4 of the Consolidated version of the Treaty on the Functioning of the European Union [2012] OJ C326/13 (TFEU).

37 TFEU, n. 36 above, art. 194(2). At the same time, this sovereignty can be ceded by the Council acting unanimously, provided certain conditions are met (ibid, art. 192(2).) Additional powers are, under conditions, conferred to the Council in order to take 'measures appropriate to the economic situation, in particular if severe difficulties arise in the supply of certain products, notably in the area of energy' (ibid, art. 122) Lastly, the EU has to contribute to the development of trans-European networks in energy (ibid, art. 170-172).

38 On the division of competences, see more elaborately R. Leal-Arcas, A. Filis & E.S. Abu Gosh, *International energy governance: selected legal issues* (Edward Elgar 2014), at pp. 278-92.

39 On how and whether Member States use their discretionary power, see L. Squintani, *Gold-plating of European Environmental Law* (PhD Law, Groningen 2013).

5.2.2. Material norms

Many of the regulatory changes since the 1990s stem from so-called ‘unbundling requirements’ which led to the separation of the production and supply of energy from the transmission thereof.[40] Besides the creation of an internal market, additional rules aimed at sustainability and environmental protection were implemented, for instance in the form of minimum requirements for energy from renewable sources and energy efficiency.[41] Furthermore, the opportunities offered by smart grids and appliances have also increasingly received regulatory attention.[42] Lastly, in so far that production activities amount to ‘large industrial installations’, they are also covered by the rules on industrial emissions.[43] Without going into detail on all the material norms, the most important EU rules are discussed below in the light of assessing to what extent they are (or are not) technology neutral.[44]

Hydrocarbons Directive

The Hydrocarbons Directive provides an outline of the procedure and the requirements that authorizations for the prospection, exploration and production of hydrocarbons must adhere to.[45] In granting such authorizations, Member States have to consider, *inter alia,* the financial and technical capabilities of the applying entities, as well as their proposed methods for prospecting, exploration, and/or production.[46] In this respect, Member States have to ensure that the size of the affected area and the duration of the activities as well as the corresponding rights do not exceed beyond what is necessary.[47] Since the Directive is quite general in its wording and applies to all types of hydrocarbons, it can be considered technology neutral.

40 ‘Unbundling’ means that a producer or a supplier cannot be involved in the transmission of energy, whereas previously this was the norm. Such unbundling was required to create competition and to avoid abuse of power by network operators which hold a natural monopoly caused by the network dependency of electricity and gas. For this reason, rules on connection and access to the network also received a prominent place.

41 The latter measures are part of the EU’s ‘20-20-20 policy’, the aim of which is to achieve 20% renewable energy, 20% efficiency increase and 20% reduction in GHG emissions by 2020.

42 See also I. Lammers & L. Diestelmeier, ‘Experimenting with Law and Governance for Decentralized Electricity Systems: Adjusting Regulation to Reality?’ (2017) 9(2) *Sustainability*, 212.

43 As addressed further on in this paragraph, under ‘Industrial Emissions Directive’.

44 For the purpose of this article, I hold that the general (legal) distinction between renewable energy and fossil fuels is in itself technology neutral.

45 Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons [1994] OJ L164/3 (Hydrocarbons Directive).

46 Ibid, art. 5.

47 Ibid, art. 4.

Gas Directive and Electricity Directive

The Gas Directive and the Electricity Directive basically provide common rules for the internal markets in gas and electricity respectively.[48] These directives are largely similar and the rules are characterized by the network dependency of these energy sources. In both markets, the unbundling of production and supply activities from transmission and distribution activities is required,[49] as is non-discriminatory access to the networks (and in the case of gas: storage facilities) provided certain conditions are met.[50] Member States are responsible for monitoring the security of supply,[51] and for adopting authorization procedures. Authorization is mandatory for the construction of all new electricity generating facilities, and the directive lists the criteria that must at least be considered in granting such authorizations.[52] The rules on the construction of natural gas facilities are more lenient.[53] Furthermore, Member States are responsible for the design of technical safety criteria.[54] Both directives also list the general objectives for, and duties and powers of, the national regulatory authorities. Essentially, the former require Member States to promote the development of the internal market in various ways, while the latter entail monitoring requirements and ensuring compliance with the directives.[55] All these provisions apply to all sources of electricity and gas, regardless of the technology used to extract the primary sources and/or the technology used for their conversion into secondary energy. Hence, these directives are fully technology neutral in this respect. Additionally, the risk of path-dependence is lessened by the requirement for the transmission system operator (TSO) to yearly submit a ten-year network development plan.[56] This requirement is technology neutral as investments are only steered to the extent that the sum of measures must 'guarantee the adequacy of the system and the security of supply'.[57]

However, both directives also contain elements that are (potentially) less neutral. In the Electricity Directive, two provisions accord explicit differential treatment to electricity from renewables and

48 European Parliament and Council Directive 2009/73/EC of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC [2009] OJ L211/94 (Gas Directive); European Parliament and Council Directive 2009/72/EC of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC [2009] OJ L211/55 (E-Directive).

49 Gas Directive & E-Directive, n. 48 above, art. 9 for TSO; art. 26 for DSO.

50 For details, see art. 32 *et seq.* in both directives, n. 48 above.

51 E-Directive, n. 48 above, art. 4; Gas Directive, n. 48 above, art. 5.

52 E-Directive, n. 48 above, art. 7.

53 Gas Directive, n. 48 above, art. 4.

54 E-Directive, n. 48 above, art. 5; Gas Directive, n. 48 above, art. 8.

55 E-Directive, n. 48 above, arts. 36 & 37; Gas Directive, n. 48 above, arts. 40 & 41.

56 Gas Directive & E-Directive, n. 48 above, art. 22. Since these plans are adjusted on a yearly basis, they have, at least in theory, a strong potential for reducing path-dependence. However, as they are also coupled with more long-term focused investment decisions in practice path-dependence may still pertain.

57 Gas Directive & E-Directive, n. 48 above, art. 22(1).

electricity from traditional sources. As a result, in dispatching the installations,[58] the transmission system operator must give priority or guaranteed access to the grid of electricity made from renewables.[59] Additionally, Member States may opt to also provide such priority to electricity from combined heat and power plants.[60] For the network operators in the distribution grid providing priority for electricity from renewables is not mandatory, but only optional.[61] Despite the fact that these provisions are formulated in a technology neutral manner (i.e. they apply to all renewables vis-à-vis all traditional sources), they do seem to be at odds with the notion that electricity from renewables is often generated in a more decentralized manner. Thus, in effect, these provisions may put certain renewables at a disadvantage, because giving priority is only mandatory for those renewables that are produced at the 'traditional' level of electricity generation.

Under the Gas Directive, the situation is different. The directive applies to natural gas as well as biogas and other gases from renewable sources, 'in so far as such gases can be injected safely into, and transported through, the natural gas system.'[62] However, unlike in the Electricity Directive, no priority access to the network is granted for such gases, nor does the directive provide any other stimulus to promote biogases.[63] At the same time, the competent regulatory authorities are required to integrate large and small scale production of gases from renewable sources and to facilitate their access to the network.[64] The directive does not specify how they should do this.[65]

Consequently, both directives can be considered technology neutral, at least in their wording. Yet, in effect, under both directives renewable sources might be at a (slight) disadvantage,

58 'Dispatching' is turning on and off of installations and determining who will get access to the network in case of overcapacity.

59 However, it is proposed in a recast of the RED that this preferential treatment is scrapped after 2020. See
European Commission, 'Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast)' COM(2016) 767 final/2, at p. 86.

60 E-Directive, n. 48 above, art. 15(3). For reasons of security of supply, Member States may also provide priority for indigenous primary energy fuel sources, up to a maximum percentage (ibid, art. 15(4)).

61 E-Directive, n. 48 above, art. 25(4). Transmission concerns the transport of electricity through the high voltage network, while distribution occurs at a lower voltage.

62 Gas Directive, n. 48 above, art. 1(2).

63 On several occasions, the directive does refer to the need to integrate 'new sources of gas supply' (e.g. in art. 36(2)). However, this is a broader category than gases from renewable sources, as it may also include shale gas.

64 Gas Directive, n. 48 above, art. 40(d&e).

65 For an extensive appraisal on how these tasks are regulated in the Netherlands, see (in Dutch) D.G. Tempelman, *Alternatieve gassen en aansprakelijkheid. De Nederlandse gasketen in een geliberaliseerde markt: contractuele en buitencontractuele aansprakelijkheid van groen-gasinvoeding en waterstofbijmenging* (WLP 2016).

precisely because of this neutral wording. As a result of the fact that new energy sources are treated identically to traditional ones, the playing field may become uneven. The Electricity Directive attempts to remedy the situation by stimulation renewable sources though providing priority access, but the Gas Directive does not.

Renewable Energy Directive

The Renewable Energy Directive (RED)[66] creates a more even playing field for renewables to enter the market through positive discrimination. This directive specifically aims to promote energy form renewable sources, so its wording is much less technology neutral than in the Gas and Electricity Directives.[67] While the primary distinction between renewables and fossil energy is considered technology neutral, many of the steering instruments used in the RED are not. The directive starts out neutral, as it sets overall targets for the share of renewables that must be achieved by 2020, without prescribing which sources should be used.[68] The directive distinguishes three branches of energy consumption, namely electricity, heating and cooling, and transport.[69] As these sectors differ significantly, each requires a different approach and a different combination of measures.[70] To achieve their targets, Member States may take various national support measures[71] or achieve their targets in cooperation.[72] For the electricity and heating and cooling sectors, it is mostly left to the Member States to choose which renewable sources to promote and how to do so. However, it is mandatory for the Member States to provide preferential access to the networks for electricity made from renewable sources.[73]

The 'greening' of the transport sector is regulated in more detail under the RED. First of all, an additional minimum requirement of at least 10% energy from renewable is imposed

66 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources […] as amended by Directive (EU) 2015/1513 [2015] OJ L239/1 (Renewable Energy Directive, RED).

67 As such, it is an elaboration of the general strive for sustainability, while the aims of security of supply and affordability of energy are less prominent.

68 This target is set at 20% for the EU as a whole, with individual targets for each Member State (RED, n 66 above, art. 3(1) & annex I). On top, in the transport sector at least 10% renewable energy must be consumed (ibid, art. 3(4)).

69 RED, n. 66 above, art. 5(1).

70 An overview of the various measures taken can be found in European Commission, 'Renewable Energy: Progressing towards the 2020 target' (Communication) COM(2011)31, at p. 10.

71 These have to be described in a national action plan; see RED, n. 66 above, art. 4.

72 Ibid, arts. 6-11.

73 This is mandatory at transmission level, and optional at distribution level; ibid, art. 16. However, as said before, this preferential treatment may be scrapped after 2020. See COM(2016) 767 final/2, n. 59 above, at p. 86.

on this sector.[74] As this target will primarily be achieved by using biofuels, the RED imposes sustainability criteria for such fuels.[75] These criteria set thresholds for the minimum level of GHG reductions that must be achieved by using these fuels, and they prohibit the production of biofuels in specified vulnerable areas.[76] As a result of this, certain production paths, and hence technologies, are explicitly ruled out.[77] On top, through the methodology used to calculate the share of renewables, the directive provides further technology-specific incentives to enhance the consumption of renewable energy in transport. Firstly, a list of specified biofuels is counted twice towards the target.[78] Secondly, to stimulate the use of renewable electricity in transport, several usages thereof are also multiplied in the calculations. If renewable electricity is used for rail transport it counts 2.5 times towards the targets; if used in road vehicles it counts five times.[79] These latter requirements are technology-specific in the sense that they promote a specific application of energy (i.e. electric transport), while remaining neutral about how this energy was produced (i.e. through any of the renewable options). Such neutrality is particularly important in regard to the choice for energy sources, which is a competence explicitly left with the member States.[80]

Industrial Emissions Directive

The Industrial Emissions Directive (IED), to which many energy installations are subject, merges and recasts seven directives that were all aimed at reducing pollution from various substances by industrial activities.[81] The directive aims at an overall 'high level of protection of the environment taken as a whole.'[82] It advocates an integrated approach to pollution, to avoid the shifting of

74 Simultaneously, so-called 'first generation' biofuels are capped at 7%, while 'advanced' biofuels must reach a minimum share of 0.5%. See RED, n. 66 above, art. 3(4). The proposed recast of the RED deletes this 10% share all together. See COM(2016) 767 final/2, n. 59 above, at p. 65.

75 RED, n. 66 above, art. 17.

76 However, they do not ban production as such, but merely rule out 'below-standards fuels' to be eligible for subsidies or to be counted towards the renewables target, see ibid, art. 17(1).

77 While the criteria predominantly focus on the (cultivation of the) raw materials used for the fuels, the GHG reduction that is achieved is also partially dependent on the technology used for production; to illustrate, see RED, n. 66 above, annex V, part A.

78 Ibid, art. 3(4)(f) & annex IX.

79 Ibid, art. 3(4)(c).

80 TFEU, n. 36 above, art. 194. In fact, it is striking that the RED was adopted via the ordinary legislative procedure using 'qualified majority voting' (QMV), since article 192 TFEU demands that 'measures significantly affecting a Member State's choice between different energy sources and the general structure of its energy supply' must be adopted with unanimity. (See art. 192(2)(c), in combination with arts. 289 and 294 TFEU, n. 36 above).

81 European Parliament and Council Directive 2010/75/EU of 24 November 2010 on industrial emissions (integrated pollution prevention and control [2010] OJ L334/17 (Industrial Emissions Directive, IED). The incorporated directives are listed in recital 1. Not all of these norms are discussed here.

82 Ibid, art. 1.

pollution from one medium to another.[83] For this reason, all large industrial installations must have an operating permit in which limits are set for their emissions to water, air and soil.[84] These emission limit values 'shall be based on the best available techniques, without prescribing the use of any technique or specific technology.'[85] Additionally, environmental quality standards may require stricter conditions than those achievable by BAT.[86] What the BAT are is not static and the techniques are not described in the directive itself;[87] in fact, prescribing a specific technique in the permit conditions is not allowed.[88] Instead, what the BAT and the corresponding emission levels are is explained in BAT reference documents (BREFs) that are drawn up in a more informal, institutionalized, extensive information exchange.[89] Thus, the prescription of BAT in its current form constitutes a multi-level approach in which the overall norms have been set at EU level, while the more detailed technical descriptions have been addressed in a more soft law form with a higher degree of flexibility. An additional layer of governance is formed by the implementation of the EU rules at Member State level and subsequent application at local level.

The overall design of the directive is technology neutral, as it uses emission limit values (i.e. performance standards) and environmental quality standards as the benchmark for permit authorizations. However, in the fine-tuning of these standards the system is much more technology specific, since the amount of technologies listed as BAT is limited. On top, in its current form, the definition of BAT places much emphasis on the economic viability and availability of techniques,[90] resulting in maintaining the status quo in techniques.[91] This situation is exacerbated by the codification of BREFs as '*the* [emphasis added] reference for setting permit conditions'[92], rather than using these emission levels as the lower threshold. Furthermore, only part of the energy market is regulated via the IED and the use of BAT is therefore only mandatory for those elements of the production chain that are covered by the IED.[93] As a result, in practice the directive does not provide strong incentives for stark emission reductions in the energy sector,

83 Ibid, recital 3.
84 Ibid, arts. 4(1) & 14(1).
85 Ibid, art. 15(2).
86 Ibid, art. 18.
87 The directive does contain several emission limits for certain categories of installations in its annexes, but most of these have been surpassed by new BAT with lower emissions.
88 IED, n. 81 above, art. 15(2).
89 Ibid, art. 13.
90 Ibid, art. 3(10)(b).
91 C. Backes, *Law for a Circular Economy*, Inaugural Address, University Utrecht, 12 April 2017 (Eleven International 2017), at p. 33.
92 IED, n. 81 above, art. 14(3).
93 These activities are listed in IED, n. 81 above, annex I.

and *de facto* only leads to incremental change. These notions severely impede the strength of BAT as a tool to achieve 'a high level of protection of the environment'.[94]

5.3. Technology neutrality and stimulating innovation

Parallel to the rules discussed above, EU has adopted an action plan to stimulate innovation and to advance 'environmental technologies'.[95] According to this plan, '[e]co-innovation potential should be at the centre of the revision of existing infrastructure standards, including transport, energy, buildings, and ICT, while simultaneously leading to enhanced climate resilience'.[96] Despite this broad mandate, the subsequently adopted Ecodesign Directive[97] focuses mainly on enhancing energy efficiency, so that it reduces the demand for electricity,[98] but does not alter electricity production itself.[99] The directive addresses the design stage of 'energy-related products', i.e. 'any good that has an impact on energy consumption', including the parts intended to be incorporated in it.[100] The directive sets parameters for (generic) ecodesign requirements that entail all life-cycle phases, and lists the elements that must be assessed in each phase.[101] Specific ecodesign requirements then aim to improve selected environmental aspects of a product.[102] The former requirements do not set limit values, whereas the latter do. On the basis of a technical, environmental and economic analysis concrete measures must then be taken to minimize the environmental impact.[103] Prior to the marketing of a product, an EC declaration of conformity must be issued and the CE mark[104] must be affixed to the product.[105] As such,

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94 At least in its current form. However, reinterpreting the concept of BAT and expanding its scope of application could, in my opinion, give a significant push to enhanced ecological governance, as further discussed in para. .

95 European Commission, 'Innovation for a sustainable Future - The Eco-innovation Action Plan (Eco-AP)' (Communication) COM(2011) 899 final. This plan was preceded by the 2004 'Environmental Technologies Action Plan' (ETAP), available at: http://ec.europa.eu/environment/ecoap/sites/ecoap_stayconnected/files/pdfs/etap_action_plan.pdf.

96 COM(2011) 899, n. 95 above, at p. 8.

97 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast) [2009] OJ L285/10 (Ecodesign Directive).

98 Ibid, recital 6.

99 However, the wording of the directive does leave room for more comprehensive, life-cycle improvements. See also Backes, n. 91 above, at p. 40.

100 Ecodesign Directive, n. 97 above, art. 2(1).

101 Ibid, annex I.

102 Ibid, annex II.

103 Ibid, annex II.

104 This marking signifies that the product complies with EU rules on health and safety and environmental protection. The CE mark is mandatory for many, but not all, products placed on the European market. An overview of all CE Marking Directives is available at: https://cemarking.net/eu-ce-marking-directives/.

105 Ecodesign Directive, n. 97 above, arts. 3 & 5, further details in annexes IV-VI.

the Ecodesign Directive is a rather technical regulation and does not specifically facilitate the energy transition.

In sum, the directives discussed in paragraph 5.2.2 reflect the need to strike a balance between, on the one hand, steering production and providing guidance through technology specific rules and, on the other hand, the desire to have a durable and open legal framework through technology neutral wording. Essentially, for each directive the level of neutrality varies with its general primary aim. The Gas and Electricity Directives, aimed primarily at market integration and liberalization, are thus rather neutral in their wording. In contrast, the RED, aimed at enhanced sustainability, provides stronger non-neutral steering mechanisms. Lastly, the IED, aimed at environmental protection through progressive innovation, is also quite neutral in its wording.[106] In regard to such innovations, it is important to distinguish between rules that enable change and those that incentivize change.[107] The former simply aim to avoid obstacles to incorporating technological changes in the existing legal framework, whereas the latter explicitly aim to promote innovations. From this perspective, the Gas Directive, the Electricity Directive and IED are aimed more at enabling innovations, while the RED means to incentivize them.

This observation illustrates the notion that technology neutrality is never a goal in itself but rather a means to achieve non-discrimination between different technologies with similar functions. It is meant to ensure that legislation does not force or favour the use of any particular technology over another, regardless of whether these are present or future technologies.[108] This way path dependence is believed to be avoided, a level playing field appears to have been created via neutral wording and it is assumed that this way legislation will be future proof.[109] Nevertheless, the pre-regulation of future technologies may cause unintended side effects or may even hinder the deployment of new technologies.[110] Also, an 'important factor in determining whether technology neutral drafting is possible is the extent to which the legislator understands the technology.'[111] On top, even a comprehensive understanding of the technologies provides no guarantee there will be 'no consequences from unanticipated changes to that technology.'[112]

106 This is, the BAT concept in the directive itself is quite neutral, but its subsequent effectuation in BREFs is less so, as also mentioned in para. 5.2.2, under 'Industrial Emissions Directive'.

107 This is illustrated by the fact that the overall EU energy policy (aimed at facilitating change through technology neutrality) is supplemented by more specific innovation-stimulating policies. In fact, an 'EU energy technology and innovation strategy is an integral part of […] EU energy policy.' (COM(2013) 253 final, at p. 12).

108 Bennett Moses, n. 15 above, at p. 273.

109 Reed, n. 12 above, at p. 275.

110 D.J. Gervais, 'Towards A New Core International Copyright Norm: The Reverse Three-Step Test' (2005) 9(1) *Marquette Intellectual Property Law Review*, pp. 1-35, at n. 128.

111 Reed, n. 12 above, at p. 279.

112 Ibid, at p. 280.

Thus, in practise, the sought-after non-discrimination may very well require the opposite: the implementation of (temporary) technology specific policies to stimulate the development of new technologies and facilitate their access to the market.[113] Without such positive discrimination the development and market penetration of new technologies may be difficult, because it can be virtually impossible for these new techniques to gain access to the market. Partly, this is due to the fact that large technical systems such as the energy sector tend to favour incremental change over radical change.[114] In general, 'operators do not have any interest in abandoning existing technologies before they can recoup long-term investments.'[115] At the same time, avoiding path dependence is particularly important in the energy sector, which is characterized by long-term investments. Once (significant) investments have been made, it is difficult to alter the course of action, leading to a high risk of technological lock-in and, consequently, a high degree of path dependency.[116]

A reluctance to drastic changes to the energy system seems additionally motivated by fear of societal repercussions in terms of energy prices and security of supply considerations.[117]

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113 Three phases in developing new technologies require particular regulatory attention. These are the actual development of a technology, or the R&D phase; the transition from the lab to large scale deployment thereof; and determination on how to deal with this technology when implemented in society. Each phase requires different treatment, also in regard to the desirable level of technological neutrality of the rules. See also A.B. Jaffe, R.G. Newell & R.N. Stavins, 'Technology Policy for Energy and the Environment' in A.B. Jaffe, J. Lerner & S. Stern (eds) *Innovation Policy and the Economy* (MIT 2004), pp. 35-68 ('Jaffe, Newell & Stavins 2004'), who refer to Josef Schumpeter's trichotomy at p. 63, n. 1.

114 Radical change refers to the adoption of new technologies, whereas incremental change means adapting or improving existing technologies. To be effective, innovations must always be coupled with market penetration (M. Jänicke & S. Lindemann, 'Governing environmental innovations' (2010) 19(1) *Environmental Politics* 127-41, at 129-30). Other authors use a different terminology and refer to a need for 'disruptive regulation' versus 'moving target regulation' or 'innovation' versus 'improvement'. (Respectively: J. Verschuuren & K. Bink, *Naar slimme milieuregelgeving die innovatie stimuleert* (University of Tilburg, 2015), at p. 9; Scholten & Künneke, n. 23 above, at p. 5). In this article the term 'innovation' refers to radical change.

115 G. Bellantuono, 'Law and Innovation in the Energy Sector', in B. Delvaux, M. Hunt & K. Talus, *EU Law and Policy Issues* ELRF Collection (Euroconfidentiel 2009), pp. 263-96, at p. 9 of the SSRN version, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1480071.

116 As elaborated on in para. 5.2.1.

117 In this sense, safety requirements can be considered a threshold for the level or amount of change that can be implemented at once. Thus, (technical) safety requirements form the bottom line of 'what can be absorbed', i.e. of the maximum achievable level of technology neutrality in the legal design. At the same time, this should not be used as an excuse for non-implementation of innovations. Furthermore, it must also be avoided that innovations are hampered by parties with vested (fossil) interests in maintaining the status quo. In a similar vein, the argument that climate issues must be 're-balanced' against competitiveness has been identified as one of arguments used by trade associations for energy-intensive sectors and the fossil fuel industry to exert influence over EU climate policy. (B. Fagan-Watson, B. Elliott & T. Watson, Lobbying by Trade Associations on EU Climate Policy. (Policy Studies Institute, 2015), at p. 8.)

It must therefore be borne in mind that energy production and use are not 'an end in itself but is used to achieve commercial and social ends, and it is these that may be changed by technology development in a way which outdates the regulation'.[118] Thus, energy essentially provides a means through which to accomplish the tasks and activities that drive society. For this reason, taking account of this (societal) context of the regulation is also of importance.[119] On top, energy infrastructures are increasingly perceived as complex adaptive socio-technical systems, which means that energy infrastructures are not exclusively defined by a technical topology, but additionally the interaction of the integrated physical and social/organizational networks is considered a crucial element in determining system performance. In this light, energy infrastructure performance is also about how (embedded) institutions, technologies and legislation mutually influence, incentivize and re-enforce each other.[120] The existence of these interacting forces at work implies that segregated technical and economic regulatory designs do not suffice to address the complexities of energy infrastructures, but that instead the two types of design need to be interwoven into a more comprehensive energy infrastructure design.[121]

Furthermore, from literature the picture emerges that rules that foster innovations are crucial to achieve the required transition, and that they must be coupled with far-reaching goals.[122] Innovation can be stimulated or forced by ambitious environmental targets that cannot be achieved by existing technologies.[123] However, innovation is a complex process influenced by different variables, which makes it hard to (empirically) identify what factors or what measures are decisive for achieving breakthroughs.[124] Innovation in the energy sector is particularly difficult due to (i) the network structure of energy systems; (ii) the distinctive features of energy-related technologies; and (iii) the uncertainty about the impact of regulatory interventions on the rate

118 Reed, n. 12 above, at p. 282. This statement was made in the context of ICT regulation, but also holds true for energy regulation.

119 According to Koops the context of regulation concerns how much 'technological turbulence' there is, what the side effects of regulating are on the technology, what its scope for interpretation is and how the regulation is enforced. He argues that this context, in combination with the purpose of the regulation and its means, determine whether technology neutrality is desirable. (Koops, n. 13 above, at pp. 98-103).

120 Scholten & Künneke, n. 23 above, at p. 3.

121 Ibid, at p. 13.

122 This approach (also known as the 'Porter hypothesis', first formulated in: M.E. Porter, 'America's Green Strategy' (1991) 264(4) Scientific American 168) is advocated by various authors, including: Jänicke & Lindemann, n. 114 above, at p. 133; Backes, n. 91 above, at p. 44; Verschuuren & Bink, n. 114 above, at p. 9.

123 Verschuuren & Bink, n. 114 above, at p. 53. Higgins goes even further and argues that in the absence of ambitious targets no fundamental change will occur at all (P. Higgins, *Eradicating Ecocide: Laws and Governance to Stop the Destruction of the Planet* (Shepheard-Walwyn, 2010), at pp. 10-2).

124 Verschuuren & Bink, n. 114 above, at p. 12; Bellantuono, n. 115 above, at p. 11.

and direction of innovation.[125] On top, the diffusion of innovations is hindered by both practical and legal barriers even though there is an urgent need for technology transfer.[126]

5.4. Implementing ecological governance

As explained in the introduction, technology neutrality in this article is assessed primarily in terms of its contribution to enabling and incentivising innovations with a view to implementing ecological governance. The latter, in turn, largely revolves around the concept of ecosystem resilience. In resilience literature, several criteria have been identified as highly relevant to the ability to govern socio-ecological systems and to deal with uncertain and complex changes.[127] To start with, social systems and institutions need to be flexible in their attitude to change, and open for broad participation. Additionally, multilevel governance appears to be the most effective governance structure. On top, social structures must promote learning and adaptability without limiting the options for future development. Evidently, these are only broad outlines that provide little guidance on how this might be achieved and executed in practice. What is clear is that the more precise and detailed laws try to be, the more likely they are to become disconnected from the rapidly changing technologies that are its regulatory targets.[128] In other words, the higher the degree of technology specificity, the shorter the lifetime of the regulation.[129] As such, legal durability is a concern that impacts the choice of legal instruments as well as the level of regulation and its intensity.[130] This explains the tendency to put our faith in technology neutral legislation, which may not always be justified since the life-span of legislation should not be our prime concern.

In fact, the guiding principles for ecological governance as developed by Woolley (i.e. reduced consumption, and substitution and sunsetting of polluting practices)[131] compel us to put the emphasis on other goals. In sum, we need a three-tier approach to the regulation of human activities and energy production in particular. *Ex ante* the (potential) effects and impacts of the proposed activity need to be identified as much as possible and compared to all available alternatives. If the proposed activity is in principle approved, strict norms for its execution should then be imposed, followed by monitoring of the impacts and effects and enforcement of the set

125 Bellantuono, n. 115 above, at p. 9.

126 Explored in more depth in Z. Chen, 'Climate change: legal impediments to technology transfer' in P. Martin *et alia* (eds), *Environmental Governance and Sustainability (*Edward Elgar 2012), pp. 266-87.

127 Ebbesson, n. 18 above, at p. 414.

128 R. Brownsword & H. Somsen, 'Before We Fast Forward – A Forum for Debate' (2009) 1 *Law, Innovation and Technology,* pp. 1-3, at 3.

129 A. Butenko & P. Larouche, 'Regulation for innovativeness or regulation of innovation?' (2015) 7(1) *Law, Innovation and Technology*, pp. 52-82, at 75.

130 In EU law, the latter two are enshrined the principles of proportionality and subsidiarity (TEU, n. 36 above, art. 5).

131 See Woolley, n. 4 above, at pp. 71-77.

conditions. *Ex post* evaluation of the chosen route should take place and, if needed, operating conditions as well as underlying policies should be amended.

Thus, ecological governance demands that we take fundamental ethical decisions and prioritize our aims, rather than maintaining the currently deployed balancing approaches. From this perspective, technology neutral legislative design is of subordinate importance compared to maintaining a legislative focus on reducing the stresses our activities put on ecosystems. Furthermore, implementing ecological governance requires a holistic approach to regulation to do justice to the complex interactions between and within ecosystems and our impacts upon them. On top, this legal approach should be adaptive to be able to accommodate new insights regarding these interactions and to amend the regulation of our actions and activities accordingly.[132] At the same time, we need to acknowledge the limitations of our ability to fully comprehend the world around us and the effects our activities have on it, as well as the limitations of law as a tool for sustainability.

5.4.1. Uncertainties

Essentially, we need to adapt our legal structures to endemic uncertainty. This goes beyond mere technology neutral formulation of laws. In designing ecological governance structures, aimed at enhancing ecosystem resilience, we will always be unsure about (i) the consequences of our activities; (ii) the casual pathways of interactions between activities and ecosystem effects; (iii) what properties are important for ecosystem resilience; (iv) which elements will become important if changes occur; and (v) when resilience is sufficient. Precisely because of these uncertainties we need a 'proactive precautionary approach'.[133] This means that we should not just halt an activity until sufficient information on its impacts is available, but we need to accept that there will (perhaps) never be sufficient information and we need to develop policies and laws in spite of this realization.

132 The kind of comprehensive, adaptive, multi-level approach advocated here thus has many similarities with the programmatic approach used in environmental law. However, for lack of space the programmatic approach is not discussed in detail here. For that, I refer to F. Groothuijse & R. Uylenburg, 'Everything according to Plan? Achieving environmental Quality Standards by a Programmatic Approach' in M. Peeters, R. Uylenburg (eds), EU Environmental Legislation: Legal Perspectives on Regulatory Strategies (Edward Elgar 2014), pp. 116-145; M.N. Boeve & G.M. v.d. Broek, 'The Programmatic Approach; a Flexible and Complex Tool to Achieve Environmental Quality Standards' (2012) 8(3) *Utrecht Law Review*, pp. 74-85; L. Squintani & H. van Rijswick, 'Improving Legal Certainty and Adaptability in the Programmatic Approach' (2016) 28(3) *Journal of Environmental Law,* pp. 443-70.

133 Woolley, n. 4 above, at p. 67.

Addressing climate change is particularly troublesome as this phenomenon is 'characterised by a cascade of uncertainties that cover every aspect of the problem'.[134] Uncertainties surround climate change science, as well as its impacts and its solutions. Furthermore, three characteristics of such major social-ecological change pose particular challenges for governance. Firstly, the time lapse between the policy measures (or inactivity in this regard) and the effects thereof extend beyond one human generation. Secondly, these challenges are part of complex systems that we can (so far) only partly comprehend. Thirdly, they concern global collective goods and are linked to a wide range of human activities.[135] Each of these characteristics presents a major hurdle in itself, but on top they also coincide and interact, so that designing appropriate governance structures becomes even more challenging.[136]

On top, the technological changes needed as part of climate change solutions are themselves an uncertain phenomenon.[137] Moreover, technological change does not exist in a vacuum. The rate and direction of technological developments interact with policy decisions. Policy interventions create incentives that affect the investment decisions made by technology developers and thus these interventions influence which new technologies are developed and how rapidly they will diffuse.[138] Making such interventions technology neutral may to an extent reduce obstacles to such development and diffusion, by allowing them to be absorbed in the existing legal framework. Nevertheless, a degree of legal uncertainty is almost inevitable in regard to innovations, because there are no precedents.[139] Finally, the fact that the process of technological change is itself characterized by market failures further complicates the design of adequate governance structures.

5.4.2. Externalities

One such market failure is the existence of externalities. Without going into details on all the economics and the exact role and size of externalities, it is important to emphasize here that many externalities exist and that they impact the effectiveness of ecological governance strategies. These external costs and/or benefits vary with each energy source and each technology. Regarding electricity production, there are, for instance, externalities relating to

134 M. Tavoni, 'Coping with Uncertainty' in Valentina Bosetti *et alia*, *Climate Change Mitigation, Technological Innovation and Adaptation. A New Perspective on Climate Policy* (Edward Elgar 2014), pp. 97-114, at p. 97.

135 A. Underdal, 'Complexity and challenges of long-term environmental governance' (2010) 20(3) *Global Environmental Change*, pp. 386-93, at 386. The third characteristic is not so much an uncertainty problem, but rather a regulatory challenge related to free-rider problems and the 'tragedy of the commons'.

136 Ibid, at p. 389.

137 Tavoni, n. 134 above, at p. 108.

138 A.B. Jaffe, R.G. Newell & R.N. Stavins, 'A tale of two market failures: Technology and environmental policy' (2005) 54(2-3) *Ecological Economics*, 164-74 ('Jaffe, Newell & Stavins 2005'), at 165-6.

139 Verschuuren & Bink, n. 114 above, at p. 51.

the environmental impacts of production, but also those relating to the need for electricity system integration of renewables and effects stemming from the impacts on the security of energy supply.[140] Technology development has its own external effects, such as knowledge externalities and adoption externalities. Externalities may work in one of two directions. In the case of externalities from pollution, the polluter incurs costs on society, but lacks an incentive to reduce these costs as he does not pay for them himself. As a result, too much pollution is caused. In the case of technology, the problem is reversed. Investors in new technologies bear all the costs for developing them, while others may reap (part of) the benefits. Hence, the incentive to invest in new technologies is reduced, so that too few of them are developed.[141] Additional market failure *inter alia* stems from incomplete information, i.e. uncertainties.[142] The existence of externalities and other market failures impacts the case for technology neutral regulation. As long as externalities exist, some form of steering is required to correct these market imperfections. Essentially, the greater the positive externalities and societal value expected from an innovation or from a reduction of environmental damage, the stronger the case for policy interventions and support mechanisms.[143]

5.4.3. Adaptability

Under the suggested three-tier ecological approach, a central role is reserved for information and data and the gathering and development of knowledge. Producing data, gathering information and expanding knowledge lay the foundation of informed decision making. However, equally important is how and to what extent this knowledge subsequently needs to be taken into account in these decisions. For instance, performing an environmental impact assessment (EIA) is already mandatory prior to consent for large (industrial) projects,[144] but this is primarily a procedural (albeit extensive) requirement. EIAs are used as an informative tool to reduce uncertainties; yet, their conclusions do not necessarily have a decisive impact on the decision taken.[145] To reduce stresses on ecosystems we need to add an ecological value judgment. In other words, we need to provide a preference for ecosystem protection.[146] If not, the ecological interest can be (and

140 Gawel *et alia*, n. 30 above, at pp. 9 *et seq.*

141 See more elaborately: Jaffe, Newell & Stavins 2005, n. 138 above, at p. 166.

142 Jaffe, Newell & Stavins 2004, n. 113 above, at pp. 38-40.

143 Butenko & Larouche, n. 129 above, at p. 62.

144 Directive 2011/92/EU of 13 December 2011 on the Assessment of the Effects of Certain Public and Private projects on the Environment, [2012] OJ L26/1 (EIA Directive); similar obligations exist for plans and programmes, under Directive 2001/42/EC of 27 June 2001 on the Assessment of the Effects of Certain Plans and Programmes on the Environment, [2001] OJ L197/30 (SEA Directive).

145 By this, I mean that the EIA's conclusions may impact the details of a decision, but not the decision itself at a more fundamental level. See also Woolley, n. 4 above, at p. 184.

146 Ibid.

usually is) outweighed by economic incentives.[147] Still, in more strengthened form EIAs can be a valuable tool in ecological governance, to identify key issues and to assess alternatives, both *ex ante* and *ex post*.[148] At the same time, we have to accept that we may very well never have all the information needed to make fully informed decisions regarding our actions. Hence, we have to adapt our policies and the legal system accordingly.

Furthermore, the degree to which a legal system promotes ecosystem resilience and the extent to which it can adapt to changes and/or new insights depends on quality of the assessment, as well as on the possibility to review and/or withdraw the consent for activities. Thus, the grounds on which a permit, once granted, can be challenged, reviewed or withdrawn are important factors in the flexibility and adaptability of the legal system. Such review procedures are particularly critical when (i) the adverse effects of an activity turn out to be worse than expected; (ii) when the ecosystem has declined or is at risk of declining significantly; and (iii) when better technology has been or could be developed.[149]

5.4.4. The BAT concept

The review procedure described above could provide a strong incentive to progressively reduce the stresses on ecosystems. When it comes to developing new technologies, I argue that an enhanced interpretation and application of the concept of BAT provides a suitable means, not in the least because of its technology neutral nature. By providing leeway to 'absorb' new technologies, it enhances the adaptability of the legal framework. The BAT concept is thus flexible in the sense that the obligations that rest on operators become stricter as technical developments progress.[150] However, in its current application, the use of BAT focuses more on the economic viability of technologies and installations, than on their effects on health, the environment and natural resources. Arguably, therefore, the BAT concept in its current form does not foster innovations, because it focuses primarily on (improving) existing techniques.[151] For this reason, the mandatory use of BAT can now only help to diffuse a (innovative) technology,

147 After all, 'considering' something is not the same as 'accounting for' it, and a requirement to weigh different interests or options does give direction to its outcome. See also C. Voigt, 'The principle of sustainable development: integration and ecological integrity' in C. Voigt (ed), *Rule of Law for Nature. New Dimensions and Ideas in Environmental law* (CUP 2013), pp. 146-157, at p. 150.

148 On the important role of (institutionalized) information gathering, see Woolley, n. 4 above, at pp. 215-33; and Ebbesson, n. 18 above, at p. 418.

149 Ebbesson, n. 18 above, at p. 418. To provide legal certainty for the operator, the conditions under which the permit or consent may be reviewed or withdrawn can be set out either in the statutes on which this consent is based or in the permit itself. Alternatively, or in parallel, the consent could be granted for a limited time, after which new circumstances or insights can then be taken into account (ibid).

150 Ibid, at p. 419.

151 Backes, n. 91 above, at p. 33; Verschuuren & Bink, n. 114 above, at pp. 7 & 53.

but it cannot stimulate inventions or contribute to their marketing in the first place.[152] For the latter, it is needed that 'performance standards of this kind must be supplemented or combined with normative frameworks that take due account of the impact of the activity on health, the environment and long-term utilization of natural resources.'[153] This normative framework could, for instance, take the form of introducing a priority for ecological considerations or mandatory 'eco-proportionality' in decision making,[154] coupled with requiring the use of BAT in (geographical and legal) areas where it was previously not.[155]

The use of BAT as a legal concept holds great potential for technological change, if indeed it is reinterpreted and wielded differently. Literature distinguishes two models for responding to complex long-term ecological governance -the collective action model and the adaptive governance model-[156] which are essentially combined in BAT as a legislative instrument.[157] Through the definition of BAT a collective, technology neutral (EU) norm is set, expressing international consensus, a form of leadership or guidance and a contraction of power, while simultaneously the BREFs and national implementations provide for (technological) specificity, diversity and a variety of locally executed activities. Such decentralization provides each unit with the freedom to act quickly and adequately in regard to the local situation.[158] However, this flexibility is (and needs to be) limited and normatively guided to avoid non-ecological and arbitrary decisions.[159]

152 Jänicke & Lindemann, n 114 above, at p. 132. Thus, the current BAT concept only stimulates one of the three phases of technological change while all three stages of the innovation cycle need to be supported for an innovation-oriented policy (as mentioned in footnote 113).

153 Ebbesson, n. 18 above, at p. 419.

154 G. Winter, 'Ecological Proportionality' in C. Voigt (ed), *Rule of Law for Nature. New Dimensions and Ideas in Environmental law* (CUP 2013), pp. 111-29, at pp. 115-7 & 128.

155 Ibid, at p. 125. Therefore, the concept must be expanded in a material sense, as well as in its scope of application.

156 Underdal, n. 135 above, at p. 390.

157 Underdal indeed affirms that '[…] a system of governance must provide a carefully differentiated framework that combines elements of the adaptive governance model – to enhance flexibility, diversity, and learning capacity – with components of the collective action model—to ensure focus, energy, and sustained commitment. It would be a system of multi-level governance —sufficiently decentralized to provide scope and incentives for local initiatives but also capable of building arenas and networks to facilitate the diffusion of best practices and international regimes and organisations to enhance the capacity for collective action.' (ibid, at p. 392.)

158 Ibid, at p. 391.

159 Such arbitrariness can be induced by the use of decisional discretion, which may render the balancing in individual cases to become political. (See F.M. Platjouw, 'A Coherent Legal System for the Ecosystem Approach' in C. Voigt (ed), *Rule of Law for Nature. New Dimensions and Ideas in Environmental law* (CUP 2013), pp. 158-74, at p. 167; and H.C. Bugge, 'Twelve Fundamental Challenges in Environmental Law' in C. Voigt (ed), *Rule of Law for Nature. New Dimensions and Ideas in Environmental law* (CUP 2013), pp. 3-27, at p. 23.)

In the practical interpretation and application of BAT this would entail the following. First of all, in determining what the BAT are the balance between its three elements (best, viable, and accessible) has to be struck differently, so that the targets and subsequent emission levels are more ambitious.[160] On top, the emission levels achievable with current techniques should be used as the absolute lower threshold, rather than being the accepted reference for permit setting for the next decade.[161] Instead emission levels corresponding with the most promising emerging techniques could be used as the reference for permit setting,[162] in order to keep pressure on operators to achieve lower emissions as soon as possible. Additionally, the interval between reviews of achievable emissions should be shorter and cross-examination between technologies using different energy sources should also take place.[163] The latter could then lead to phasing-out the most polluting production techniques, such as those using lignite or coal, which are at the moment still described as BAT. This novel approach could ensure that the use of BAT leads to 'technology forcing' which has been identified as a potential strong tool for innovation.[164] Furthermore, as technology neutral regulation is not the same as 'technologically blind' regulation, and because this neutrality is not the sole regulatory purpose,[165] the concept of BAT could bring these elements together.

5.5. Conclusions

To recapitulate, this article has identified the following. Technology neutrality as a regulatory principle is primarily aimed at future proofing legislation, and leaving industry sufficient room to develop new technologies. However, it appears that the sought-after effectiveness of this regulatory tool is based on the assumptions that (i) markets function under perfect (efficient) competition and (ii) there are no externalities, i.e. that there are no market failures at force.[166] Yet, in reality matters are much more complex and market failures are persistent, which undermines

160 To achieve this, it might also be necessary to reduce the influence of industry in determining which techniques are 'reasonably available' (as required by IED, n. 6 above, art. 3(10)), as too much input from industry entails the risk of increased focus on economic aspects, which could lower the level of ecosystem protection (as also mentioned in n. 117 above). On top, such influence may politicize the determination of BAT, as also acknowledged in Bell, n. 6 above, at pp. 524-5). However, others argue that the success of R&D programmes seems to (partially) hinge on industry participation, so that the input from and participation of industry is crucial. (Jaffe, Newell & Stavins 2005, n. 138 above, at p. 171.)

161 As this is roughly how often BREFs are reviewed.

162 Such new technologies are currently already described, and thus to an extent embedded, in the BREFs.

163 Currently, for instance, different ways of producing coal-based electricity are compared, but these are not compared to using gas or biomass instead.

164 See para. 5.3 of this article or Jänicke & Lindemann, n. 114 above, at p. 132.

165 U. Kamecke & T. Körber, 'Technological Neutrality in the EC Regulatory Framework for Electronic Communications: A Good Principle Widely Misunderstood' (2008) 5 *European Competition Law Review,* pp. 330-7, at 335.

166 Gawel *et alia,* n. 30 above, at pp. 2-3.

the case for technology neutral legislation.[167] On the basis of the preconditions for the desirability of technology neutrality as sketched by Reed,[168] we may conclude that the aim of future proofing legislation seems to overstretch our capabilities in practice, while the desire to be able to absorb new technologies in existing legislation comes at the detriment of the ability to steer production and consumption in a more sustainable direction.

Moreover, large technical systems consisting of strongly interdependent elements, such as the energy industry at large, tend to favour slow and smooth changes over abrupt, drastic innovations.[169] This preference is currently maintained through the existing legal framework and perpetuated by existing institutional structures.[170] The prevailing legal approach of setting higher standards step-by-step leads only to incremental change rather than radical innovation (and implementation) of energy technologies.[171] As such, technology neutrality alone will unlikely bring about the required innovations, both at a technical and a legal level. While technology neutrality may reduce the risk of new developments falling outside the scope of existing laws, much more is needed to actually incentivize innovations.

On top, ecological governance requires a legal system that prioritizes a focus on enhancing ecosystem resilience and includes 'adequate policies for the consideration of risks and uncertainties'.[172] Particularly important is then how new insights and changed circumstances are subsequently incorporated in decision making as well as in the legal system at large. Adaptability is furthermore important to facilitate breakthrough technologies and to avoid a regulatory framework that creates lock-ins into insufficiently ambitious or outdated standards or technologies.[173] Thus, this new approach must be based on institutionalised learning, enhance multi-level governance, set ambitious targets and have the power to steer, and be flexible and adaptive, in order to deal with endemic uncertainties and progressive insights.

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167 As also affirmed by P. Lehmann & P. Söderholm, 'Technology-neutral or Technology-specific? Designing Support Schemes for Renewable Energies Cost-effectively', IAEE Energy Forum, Antalya Special Issue 2015, pp. 13-5, at 14.

168 See the introduction of this article (around n. 16 above).

169 Bellantuono, n. 115 above, at p. 9. This tardiness is exacerbated by the fact that the sector is largely network dependent and characterised by long-term investments, leading to high path dependency, as touched upon in para. 5.2.1.

170 To foster innovation, not only technical change is needed, but also radical institutional change. (ibid, at p. 1; affirmed (analogously) by P. Martin, J. Williams & A. Kennedy, 'Creating Next Generation Rural Landscape Governance: The Challenge for Environmental Law Scholarship' in P. Martin *et alia* (eds), *Environmental Governance and Sustainability* (Edward Elgar 2012), pp. 46-79, at 57 *et seq.*)

171 Verschuuren & Bink, n. 114 above, at pp. 9 & 11. This situation is aggravated by the embeddedness of the current technologies and infrastructures.

172 Ebbesson, n. 18 above, at p. 419.

173 COM(2011) 899, n. 95 above, at p. 7. Such lock-ins would create barriers to eco-innovation.

These notions have major implications for the design of our legal frameworks. First of all, devising a legal system aimed at adaptability has implications for its degree of legal certainty. There is fundamental tension between the dual desires for stability and flexibility that lies at the heart of the debate on how governance systems can cope with complexity.[174] Legal certainty will essentially have to be transformed from a 'right' to maintain a certain situation or expectation, to a 'right' to be able to know what kind of changes to expect and when to expect them. Similarly, safeguards should be installed to avoid arbitrariness in making value judgments in decisions in individual cases.[175]

Literature points out that there is no 'one size fits all' solution, but that rather a mix of legal instruments is needed and that these must be coupled with monitoring and enforcement.[176] As a consequence, most authors advocate a combination of technology neutral and technology specific policies. Thus, 'the optimal set of […] policies likely also includes instruments designed explicitly to foster innovation and possibly technology diffusion, as distinct from environmental policies that stimulate new technology as a side effect of internalizing environmental externalities.'[177] Others argue that to foster innovation functional or performance norms must be adopted, instead of prescribing specific techniques.[178] Such performance and technology standards can be explicitly used to force (and forge?) new technologies, by 'mandating

174 A. Duit *et alia*, 'Governance, complexity, and resilience' (2010) 20(3) *Global Environmental Change*, pp. 363-68, at p. 366.

175 Specifying and objectifying the required ecological basis for such judgments could limit the chance of decisions becoming arbitrary or political. (On the challenges that value judgments pose, see more elaborately: Platjouw, n. 159 above, at pp. 167-72.)

176 See, for instance, M.J. Faure, 'Instruments for Environmental Governance: What Works?' in P. Martin *et alia* (eds), *Environmental Governance and Sustainability (*Edward Elgar 2012), pp. 3-23, at p. 12. Many authors and institutions advocate market-based instruments as more powerful incentives for innovation, but empirical evidence that they are more effective than 'old-fashioned' command-and-control measures is not conclusive. (Bellantuono, n. 115 above, at p. 12; However, Jaffe, Newell & Stavins disagree. (Jaffe, Newell & Stavins 2004, n. 113 above, at p. 55.) Some say that '[i]nnovation-oriented environmental policy is most likely to succeed if regulatory 'fine-tuning' through command and control measures (a 'regulatory core') is complemented with market-based 'trend-steering' through economic instruments' especially if 'flanked with supporting instruments'. (Jänicke & Lindemann, n 114 above, at p. 135.)

177 Jaffe, Newell & Stavins 2005, n. 138 above, at p. 169. At the same time, these authors acknowledge that too specific regulation may actually stifle innovation (ibid, at p. 171). Other authors also acknowledge this paradox with legislation that steers toward innovation; *inter alia* J. Spaans, 'Circulaire economie: Meer dan minder afval alleen' in Vereniging voor Milieurecht, *Met recht naar een circulaire economie* VMR 2017-1 (Boom 2017), pp. 151-65, at p. 158.

178 E.g. B. Worthington, 'Why Europe must back a technology-neutral energy policy' (2015) Europe's World (17 March 2015), available at: http://europesworld.org/2015/03/17/europe-must-back-technology-neutral-energy-policy/#.V_IIC037WUk. On top, by using performance or technology standards as awarding criteria in tendering, public procurement can also foster innovation, argues Backes. (See n. 91 above, at p. 56.)

performance levels that are not currently viewed as technologically feasible or mandating technologies that are not fully developed.'[179] This indeed calls for a combination of technology specific and technology neutral rules, which could be effectuated via the layered norm setting as implemented via the (enhanced and expanded) BAT concept.

Structural adaptability to changing circumstances allows us to facilitate new technologies, (potential) changes in energy system functionalities and/or consumer behaviour. It is argued that 'only those countries with the capacity to adapt their regulatory frameworks to the needs of an accelerated technological development will rise to the challenge posed by climate change.'[180] On top, institutionalized integration of progressive insights would allow us to amend our activities in line with an enhanced understanding of these actions on, and within, our environment and the ecosystems we are part of. Societies aimed at strengthening the ability to deal with uncertainties and surprises are better equipped to sustain and absorb stress, external interference and complex changes, than societies aimed controlling nature, maintaining a given social or ecological situation, or countering changes.[181]

179 Jaffe, Newell & Stavins 2004, n. 113 above, at p. 50.
180 Bellantuono, n. 115 above, at p. 15.
181 Ebbesson, n. 18 above, at p. 414.