9

Insights into Zero-Carbon Energy, Sustainability Transitions, and Security

Chapters 5–8 delved deep into four case countries: Estonia, Finland, Norway, and Scotland/the UK. This chapter looks at the empirical findings of this book in a comparative light. It does so by using conceptualizations introduced in Chapter 2, such as negative and positive security, securitization, and politicization, as well as by focusing on the analytical dimensions of interest in Chapter 4: coherence and integration between energy (transition) policies and security and defence policies, security as part of the landscape for energy transitions, and security in niche expansion and regime decline processes.

The chapter also aims to answer the questions presented in Chapter 1: What are the security implications of energy transitions? What elements of positive and negative security can be found? How should energy security and security of supply be redefined in the context of the energy transition? Is there a hidden side to policymaking with regard to the energy–security nexus? It first discusses the interplay between energy, security, and defence policies, followed by securitization and politicization. Subsequently, focus is placed on the security implications of energy transitions and negative and positive security. The chapter ends by summarizing the key technological, actor-based, and institutional aspects of the country cases, looking at Russia as a landscape pressure, and then providing final conclusions.

9.1 Interplay between Energy, Security, and Defence Policies

As explained in Chapter 4, the research conducted for this book approached policy coherence and integration in different ways. On the one hand, it looked at processes and measures that aimed to integrate security into energy policy – and vice versa. On the other hand, it examined synergies and conflicts between energy (transition) policy and defence and security policy. Before 2022, one can observe low or moderate levels of policy integration in the two domains under scrutiny, insufficient administrative interaction, and conflicts between the objectives and

means of advancing the zero-carbon energy transition and the objectives and means of national security and defence policies.

Table 9.1 summarizes the results of the country cases. The level of policy integration has varied across countries but also between policy domains. Estonia has had the highest level of integration between the objectives of energy and security policies but has still suffered from informal administrative interaction and conflicts between the implementation of energy and security policies – most visible in the problems related to the phaseout of oil shale and the expansion of wind power on security grounds. In Finland, policy integration has ranged from low to moderate. Both policy domains' strategies have mentioned supporting integration and included some measures, such as the Power Pool (see details in Chapter 6) or assessments of the effects of wind power on defence radars. However, administrative coordination has been fragmented and tensions have existed, exemplified by the difficulties of expanding wind power to certain parts of Finland, the justification of peat energy for reasons of energy security, and the avoidance of discussing geopolitical risks pertaining to Russian energy collaboration before 2022. In Norway, policy integration and coherence have been on a low level because security was largely a nonissue in relation to energy policy before 2022, while economic security provided by oil and gas exports gave continued support of this direction. In Scotland/the UK, there has been a relatively high integration of energy and climate change issues into security and defence policy strategy documents, but integration of security into energy policy has been modest and the coordination of energy and security policies fragmented. In general, the perceptions of risks in energy policy have been more focused on economic–political aspects than technical and physical risks from military or terrorist attacks.

When one looks at how policy integration in this nexus has changed since 2022, there is evidence of learning-based integration in the case countries. First, many expert interviewees reported gradual improvement of the interaction between the administrative sectors in charge of energy, security and defence. And, for instance, the role of the North Atlantic Treaty Organization (NATO) in building awareness about climate change within defence contexts was also noted more broadly.

Despite improvements, one problem for policy coherence is due to differing values and worldviews between domains – often unresolved at the political level. For example, the prioritization of different policy objectives varies between sectors: Defence policy actors emphasize operational capability of defence as the most important factor, whereas energy policy actors highlight the secure provision and price of energy and its carbon dioxide emissions. As an illustration, the expansion of wind power, to complement other energy sources, improves energy availability and reduces prices in many places. However, it hinders the operational capability of the defence sector in cases when wind turbines prevent accurate air surveillance imaging. Nevertheless, deepening learning and networking (see Ghosh et al.,

Table 9.1 *Summary of policy coherence and integration before and after 2022*

	Estonia	Finland	Norway	Scotland/the UK
Pre-2022	Moderate-to-high integration with help of market collaboration with Europe, diversity of supply, oil shale, desynchronization from Russian grid. But insufficient formal collaboration between ministries and conflict between wind power expansion and defence radars as well as oil shale phaseout aiming for decarbonization and (perceived) security. Synergies via the desynchronization project.	Low-to-moderate integration, lack of concrete holistic policy measures, fragmented collaboration, and conflict between wind power expansion and defence radars. Yet, coordinating elements with potential, for example, national security-of-supply organization, power pools composed of public and private actors, and the comprehensive security model. Synergies more generally in terms of phasing out fossil fuels and energy security.	Low integration, nonidentified links between energy and security. Some emergency preparedness and cybersecurity measures (coordinated by Norwegian Water Resources and Energy Directorate (NVE)) that involve energy and security actors, but not in a major role. Conflict between economic security and geopolitical influence of Norway with zero-carbon transition. Synergies not recognized in expert interviews.	High-to-moderate integration of energy and climate change into defence and security policy. Low-to-moderate integration of security in energy policy, mainly limited to energy security. Conflict between zero-carbon transition and the military securing the fossil fuel trade. Synergy in terms of expanding wind power in Scotland and (perceived) improved energy security.
Post-2022	Improved collaboration regarding wind power expansion and defence; conflict of maintaining oil shale (receiving increased political consensus due to energy security) versus energy transition; acquiring liquefied natural gas (LNG) terminal with Finland as an example of exceptional measures.	Moving from diverse views to consensus about Russian risk and increased attention to security in energy policy. Extraordinary policy measures, for example, LNG terminal with Estonia, discontinuing Russian energy imports, emergency stockpile of peat, reinvestigating opportunities to increase wind power in eastern Finland. Generally, increased recognition of energy security provided by the energy transition.	Increased focus and connections between energy and security, for instance, pertaining to military actors securing critical energy infrastructure and the vulnerability of infrastructure to intentional attacks and climate change effects. Conflict in terms of Norway's importance for European energy security and decarbonization.	Some examples of increasing interaction between energy and security (e.g., "Critical Minerals Strategy") and more focus on energy security from a geopolitical perspective, but overall coherence still lacking.

2021) across defence and energy sectors have been paramount in partially resolving the conflict between wind power expansion and defence radar operation. It is important to note that achieving perfect coherence is often impossible. Improving coherence to advance chosen trajectories does, however, mean that some policy objectives or measures may need to be abandoned. For instance, stockpiling fossil fuels becomes an impossible energy security measure when energy transitions are advanced. Or securing the operational capability of defence forces may mean that electrifying a country's military fleet cannot be an objective for defence policy.

Unlearning established practices (see Van Oers et al., 2023) in the energy administration seems vital in order to take a new updated approach to the energy–security nexus. This also means a disruption of existing skills of both civil servants and energy businesses and a search to find areas in which existing skills can be repurposed (Kivimaa and Sivonen, 2023). Expectation dynamics played a relatively small role in the energy–security nexus before 2022. For instance, there was relatively little discussion on critical materials security in relation to expanding renewable energy at that time.

One explanation for the incoherence between energy (transition) policy and security and defence policies is the low political importance assigned to such coherence before 2022 in all the case countries, apart from Estonia. This seems to be the case in many other Western and Northern European countries too (Kuzemko et al., 2022). This incoherence has partly been affected by the depoliticization of energy (or at least certain energy sources) and, in cases, even by its desecuritization (see Section 9.2). Despite some modes of coordination, policy outputs and outcomes have often been incoherent. As a follow-up to the 2022 events, the interconnections between security and energy have become some of the key topics in the media and policymaking alike. As a result, policy integration and coherence are likely to improve but require an explicit recognition of the connections – both synergies and conflicts – in the implementation of policies in both domains. The increasing debate on climate security generally (Busby, 2022) and its growing focus in security policy (Farham et al., 2023) create opportunities to find improved alignment between the two domains.

In conclusion, improvements in policy coherence are needed on many levels to accelerate energy transition and do it with security questions in mind. First, explicit identification of synergies and conflicts between the energy transition and security and defence policies is required so that attempts can be made to resolve potential conflicts and improve synergies. Some issues of increasing importance deal with long-term trajectories for fossil fuels and the material dependencies related to the expansion of renewable energy. Second, administrative interaction between the policy domains is essential, with formalization of processes that improve the transparency of policymaking outside the energy elite to the broader society. Third,

improved focus is needed on learning-based processes to support policy integration in a rapidly changing world.

9.2 Securitization and Politicization of Energy Transitions

The concepts of securitization and politicization and their nuances were explained in Chapter 2. In one interpretation, energy was mostly depoliticized and desecuritized prior to 2022 in the case countries – apart from some specific questions of politicization around peat in Finland. Evidence of securitizing moves and audience acceptance was not found in the interview data, following the classical definition of securitization by the Copenhagen School of Security Studies. This can be explained by the principal market logic of energy policy, as well as the technocratic perspective that often dominates in the energy sector.

In another interpretation, if one thinks about securitization in a lighter manner, for instance, as described by Johnstone et al. (2017) as altering policy goals in terms of military-oriented national security, one can see signs of securitization in Estonia in terms of the strong pursuit to disconnect from Russian energy flows and the influential role of the transmission network owner Elering. Estonia can, however, be regarded as an outlier among the case countries, because security has been a standard part of its energy policy for many years, as in many other Eastern European post-Soviet countries. In the UK, connections between military and civic nuclear power, as reported by Johnstone and colleagues, hint toward securitization, but in many respects energy policy in the UK has been associated with both desecuritization and depoliticization. In Finland, attempts have been made to keep geopolitical considerations of energy nonpoliticized and energy policy desecuritized. In Norway too, energy questions appeared desecuritized before 2022.

For a third interpretation, Heinrich and Szulecki (2018) have proposed three dimensions of securitization in the energy context: exceptional measures, strengthening the executive powers of selected agencies, and isolating selected decisions and potentially important information from public access. None were particularly evident before 2022. Regarding the latter, most interviews did not reveal a consciously hidden side to policymaking in the energy–security nexus – although those interviewees outside the energy elite would not know about the hidden side. There was one reference to the previously hidden connections between civil and military nuclear power in the UK (see Johnstone and Stirling, 2020). Some of the issues identified in this study appear to have been "public secrets," such as the geopolitical risks Russia posed to the Finnish energy sector. On occasion, they have been discussed in the media by selected experts but omitted or ignored as unrealistic by others. Generally, the lack of discussion on the energy–security nexus was very observable before 2022. The informality of

the exchanges between energy and security administrations have reduced transparency and could in principle be seen to be contributing to securitizing energy policy, because the few discussions and decision-making that have taken place in the nexus have been hidden from the public eye. This setting changed since 2022, the events of which politicized energy.

In 2022, the invasion of Ukraine by Russia and the ensuing energy crisis made energy transitions more strongly politicized, especially concerning energy prices and availability. These events did not appear to lead to securitization as defined by the Copenhagen School. There has, of course, been increasing collaboration across the policy domains of energy and security. The policy measures taken do not appear exceptional to the extent defined in security studies, while again, if interpreted in a somewhat lighter manner, they do amount to extraordinary measures that break with normal political practices (see Heinrich and Szulecki, 2018). Yet decisions have been made in ministries that have been more open for public scrutiny than before, as the crisis increased the interest of the public on energy matters, making energy politicized. Hence, the post-2022 situation in the case countries does not match with all three elements of securitization proposed by Heinrich and Szulecki (2018).

Politicization of energy has a beneficial dimension. According to security studies, environmental issues should be politicized, if they are not securitized, to make sure they will be addressed (Floyd, 2019; Trombetta, 2009). This will create openness and transparency with regard to decision-making. Politicization is particularly important in the context of energy transitions and security, because the case studies showed how security can be used both as an argument for and against sustainability transitions. However, politicization also creates risks that relate to, for instance, important decisions being made within short timeframes and with the motive of appearing popular to the electorate. By politicizing decision-making, but making sure decisions are based on the latest scientific knowledge, security implications of the transitions can be best assessed.

9.3 Security Implications of Energy Transitions

The security implications of energy transitions, based on the views of interviewed experts from the case countries, were analyzed in detail in a scientific article (see Kivimaa and Sivonen, 2023). I summarize here some of the key elements and connect them to the processes of niche development and regime decline as well as the conceptualizations of negative and positive security described in Chapters 2 and 4. To recap, negative security refers to the traditional understanding of security against the appearance of threats, whereas positive security emphasizes people's feelings of being free from insecurity, emancipation and empowering individuals and communities (Booth, 2007; Hoogensen Gjørv, 2012; Hoogensen Gjørv and Bilgic, 2022).

In the case countries, the negative security approach toward energy security has traditionally been rather prevalent; that is, in terms of maximizing the production of domestic energy (typically fossil fuels) and stockpiling fuels in case of crises. The former was especially visible in Estonia, whereas Norway has sufficient hydropower for domestic energy consumption. The latter has been typical of Finland and is growing in importance in Estonia. For Norway, stockpiling has not been a concern, whereas the UK only reinstated its gas reserve recently. In addition, energy security has involved preparedness for military and other types of physical and cyber risks, although the events of 2022 and 2023 illustrated that the risks for critical infrastructure had been underestimated. In the UK, the involvement of defence sector actors to safeguard global fossil fuel trade routes is another illustration of the traditional negative security approach in this nexus. Nevertheless, attention toward negative security has been limited because market logic largely prevailed over security-oriented thinking.

The term positive security was not used explicitly in policy documents or by the experts. Instead, the associations with positive security were explored via the assumptions, practices, and actors in the case countries. For instance, renewable energy is often associated with positive security. Especially when decentralized, it can enable local communities and improve local energy resilience. In this way, it creates freedom from insecurity (see Booth, 2007). Examples of positive security in the case countries included Scotland's Just Transition Commission and policies to reduce energy poverty. In addition, the EU's Just Transition Mechanism has been applied, for instance, in the regions of oil shale production in Estonia and peat production in Finland to support the energy transition and alleviate its negative consequences. The Norwegian Sovereign Wealth Fund is an example of positive security creation associated with fossil fuels, and hence it is feared that the phaseout of fossil fuel production in Norway will reduce societal security. Nevertheless, broadly, countries orienting their energy policies toward just energy transitions, citizen participation, and energy democracy are more likely to align with positive security – with added potential to combat internal security risks arising from fossil fuel phaseout and populist politics.

The areas in which security was seen by the interviewed experts to be affected by the energy transitions in different ways included: energy security, electricity system operability, geopolitics, defence, cybersecurity, and internal stability. The research conducted did not analyze the magnitude of these risks, which have been noted to differ (see Winzer, 2012).

In terms of energy security, there were widely shared expectations in the four case countries that the expansion of renewable energy niches will improve self-sufficiency, where new technical solutions alongside local energy communities (with potential for positive security) will continue to improve energy security. However, there are also technical and institutional risks involved, including

the reliability of renewable energy sources, the availability and price of critical materials, and the functioning of new kind of network dependencies. The analyses presented in this book showed that explicit assessments of such benefits and risks were largely not conducted in the case countries before 2022, whereas they were of interest to the EU and international organizations such as the International Energy Agency (IEA). The decline of the fossil fuel regime is also an energy security concern, especially for those countries with domestic hydrocarbon resources. For instance, the phaseout of oil shale has been difficult in Estonia, because it reduces the country's energy independence before renewable energy becomes more widely adopted. In contrast, the UK coal phaseout has been such a long-term process that it is no longer seen to substantially impact energy security. The security implications of emerging energy niches (e.g., green hydrogen) were largely unexplored.

Broader energy security effects are linked with electricity system operability, which becomes more important with the advancing electrification of society. The expectations regarding this were not consistent, ranging from the system becoming too risky to containing mostly solvable challenges. It was emphasized that the transition will require new learning and increases other actors' dependence on large universities and global companies regarding technical solutions. Institutionally, there was an expectation of increased cross-border reliance on neighboring countries via interconnected electricity systems. The existing electricity interconnections between the case countries, forming new and expanding grid communities, address part of this risk. Yet there are many questions around electricity storage and variable pricing related to system operability. In this context, electricity interconnections can be connected to broader questions of geopolitical alliances, that is, with which countries does one choose to build such systems. The interconnections are influenced by geography, but the Estonian desynchronization project shows that foreign policy decisions too can be made regarding such issues. The interconnections (or their lack) also indicate the willingness of states to collaborate (or not) with other states in the advancement of the energy transition, while interconnections also mean new electricity export opportunities.

The geopolitical implications of energy transitions are likely to be manifold, and have already been rather extensively covered in Chapter 3. The large hydrocarbon-based conflicts are expected to reduce, while new types of conflicts around critical materials are emerging relating to the relations of the EU with the rest of the world, especially China. Connected to resourcing such materials from the Global South, there are many examples of negative impacts on the environment, health, and human security – that is, declining positive security more locally (e.g., Sovacool, 2019). In turn, sourcing materials from the Global North depends on the setting. In some cases, positive security can occur via improvement of local communities, while there are also many risks, for instance, related to the "resource colonialism"

of the Sámi lands (e.g., Sörlin et al., 2022) or local environmental destruction. The case countries of this book are likely to benefit geopolitically from renewable energy, due to their high technological competences (Kivimaa and Sivonen, 2023).

With respect to the broader dimensions of security, starting with defence there were expectations that wind power is broadly beneficial to national security and micro-grids offer military operations more security. Such issues have also been acknowledged elsewhere to accelerate energy independence in connection to military combat (Farham et al., 2023). The experts highlighted emerging opportunities via military research and development (R&D). In turn, technological and institutional learning have already enabled some of the conflicts between defence radars and wind power to be resolved, as evidenced in Estonia and Finland. The security implications of the transition in the defence sector are mainly connected to the negative, that is, hard security, perspective. Experiences from the case countries showed that improved dialogue and interactions are needed between energy and defence sector actors on this topic. NATO has been oriented toward this theme for some time and can advance discussions across countries (Farham et al., 2023).

The electrification of the energy system and expansion of renewable energy are connected to more digitalized and complex systems. Digitalized systems are expected to increase vulnerability to cyberattacks, for example, such that described in the case of Norsk Hydro (see details in Chapter 7). Whereas physical power plants are typically not connected to the Internet, their office systems may be subject to attacks. The interviewed experts also emphasized the need for civil servants and companies to learn more about cybersecurity and collaborate more broadly.

Finally, energy transitions can affect countries' internal stability by creating tensions around fossil fuel phaseout and fast-advancing niche expansion. Experts in Estonia, Norway, and Scotland/the UK referred to a risk of tensions and unrest created by livelihoods threatened by climate change goals. In Estonia, an added problem is that oil shale production is located in a region of economic hardship and high unemployment. Therefore, attention needs to be paid to compensation, and to retraining and repurposing fossil fuel industry skills and assets; this is where the just transition initiatives can help. Another area of potential tension is inequality between people's ability to benefit from the technologies associated with transitions, such as solar panels, heat pumps, or electric vehicles. These technologies may be unavailable to those on low incomes or living in rented accommodation. This links to energy poverty, a key policy area in Scotland. Tensions around the energy transition can further escalate, because many political far-right (or sometimes far-left) parties are working to resist decarbonization efforts (Vihma et al., 2021) and use social disruptions for political gains. Instead, increased measures oriented toward social justice and just transitions are needed and can alleviate some of the tensions.

With respect to the internal and external dimensions of energy security listed in Figure 3.1 (Chapter 3), it is easy to see that internal dimensions have had a long-term presence in all countries' energy policies. These include access to energy, affordability, diversity of sources, degree of self-sufficiency, nondependence on a specific geographical region, and resilience to shocks. The external dimensions that relate to broader security have perhaps been less considered, apart from impacts on climate change. For instance, impacts on welfare and energy justice have been considered for some time in Scottish energy policy, but in the other case countries only emerged because of the 2022 energy crisis. Risk of military and terrorist attacks have been acknowledged for many years in the case countries' policy strategies, but the risk has only fully realized since 2022. Security and supply of materials and components necessary for the energy transition and the effects of renewable energy deployment on land use have mostly only become considerations in the last few years. In conclusion, policy coordination needs to improve so that the external dimensions of energy security and the range of security implications described in this book become integral parts of energy policymaking.

9.4 Technological, Actor-Based, and Institutional Aspects

In this section, I summarize and compare the case country findings related to the categorization of technologies, actors, and institutions (see Chapter 3). Regarding *technological* aspects in this nexus, the largest commonality between the case countries are the security implications of the expanding wind power niche, albeit in differing ways. In Estonia and Finland, the key issue has been the effects of wind turbines on the operation of the defence sector's air surveillance radars due to the closeness of the Russian border. In Scotland, wind power is seen to improve energy security and replace fossil fuels, but the prefabrication work of the turbines in China has caused some concern. In Norway, the expansion of wind power is countered by an antiwind power movement that has created societal tensions. Another emerging commonality is securing critical energy infrastructure against military and terrorist attacks – an increasing concern since 2022 and 2023, which witnessed the explosions targeting the Nord Stream gas pipelines and the damage caused to the Baltic Connector gas pipeline between Estonia and Finland. Such events also exposed the vulnerability of fossil fuel infrastructure to attacks and indicated that renewable energy and local energy solutions can improve energy security. Interestingly, the findings also showed that, during 2020–2021, the governments of the case countries had paid little attention to the security of supply of the critical minerals and metals required by the expansion of renewable energy and energy storage solutions – something that has definitely changed since.

What has become clear is that many security issues connected to the zero-carbon energy transition do not seem important or are not widely discussed until technological niches begin to substantially expand, as shown by the case of wind power, for example. In particular, when niches move from modest fit-and-conform empowerment to much more disruptive stretch-and-transform empowerment that changes the sociotechnical energy system (see Smith and Raven, 2012) the potential implications become much more visible in the security regime and can be possible places of tension and contestation. Therefore, a more future-oriented approach toward analyzing the possible security implications of expanding sustainability niches would be useful in policymaking. Perhaps the current decade of crises has already included security among the expectation formation and learning processes for new sustainability niche development, but it is important to make sure a more long-term anticipatory perspective is truly adopted.

In all the case countries, the destabilization of the fossil fuel-based regime is also somehow affected either by security concerns or, at least, by security rhetoric. The countries, however, revealed divergent issues around fossil fuels and security. In Norway, the export of oil and gas has not only strengthened the country's economic security – bringing positive security to the whole society via the Sovereign Wealth Fund operated by fossil fuel income – but also made the country geopolitically more influential than its size would normally allow. Despite the economic importance of fossil fuels in Norway, the offshore wind sector also provides opportunities to repurpose skills from the hydrocarbon sector for a more managed regime decline. In Estonia, oil shale has provided energy independence from Russia, but its phaseout has also led to concerns over Russia's reaction, because the oil shale production region has a large Russian-speaking population and is close to the country border. Here, the EU Just Transition Mechanism has been used to create new industry and potential positive security for Ida-Viru County, for example, by supporting a new magnet factory producing components for the energy transition. In the UK, fossil fuels have more generally been tied to the operation of the military in safeguarding international supply routes, although the UK too was affected rather substantially by the gas crisis following Russia's full-scale invasion of Ukraine in 2022. Particularly in Scotland, the Just Transition Commission has sought ways to improve positive security, for instance, by reskilling fossil fuel workers. Questions of phasing-out production have, however, been raised at a lesser scale than in Estonia and Norway, perhaps due to the decades-long UK coal phaseout (see Turnheim and Geels, 2012). Nonetheless, the oil and gas sector in Scotland and its future were under lively discussion at the time of writing, with decisions pending. In Finland, domestically produced peat (while not a fossil fuel it produces greenhouse gas emissions equivalent to fossil fuels) has been framed in terms of energy security. Here too, the EU Just Transition Mechanism is used

to seek opportunities to repurpose the skills and assets of the peat industry and its workers. Regarding exported fossil fuels, there seems to be consensus about the feasibility of phaseout.

The technological characteristics of the sociotechnical energy regimes have coevolved with security regimes over time. This means that creating more synergies between energy transition policies and security and defence policies is needed. The Estonian country case illustrated an interesting example of coevolution by solving the conflict between the operation of the air surveillance radars and wind power by constructing more efficient radars – although this was a result of a rather long process that also involved tension and conflict. In Finland, the public rhetoric since 2022 has largely framed a synergistic relationship between wind power and national security, and has aimed to speed up wind power permitting, indicating perhaps a cultural–institutional coevolution between security and energy regimes (cf. Grin et al., 2010). With respect to Norway and Scotland, it was harder to observe coevolution of energy and security regimes before 2022. Some examples in the UK may be the gradual changing of the defence regime to better account for climate change and the specific ties between civic and military nuclear power (Dorfman, 2017; Johnstone and Stirling, 2020). However, many political efforts since 2022 have been oriented toward better fitting together the energy and security regimes. In many European countries, the landscape shock of 2022 when Russia invaded Ukraine has led to a realignment pathway (plans to develop green hydrogen and small modular nuclear reactors) and a technological substitution pathway (expansion of wind and solar power) (cf. Geels and Schot, 2007).

The *actor* dimension is connected to the power to advance or hinder things (i.e., "power to"), dependencies between actors (i.e., "power over"), and the power of coalitions of actors ("power with") (Avelino, 2021). This study of the energy–security nexus shows the interdependencies of actors, where sometimes security actors have power over energy actors when the question is vital to national defence – such as the effect of wind power turbines on air surveillance. However, most of the time the energy sector actors have had the power to ensure economic reasoning prevails. The Finnish case, interestingly, also revealed the power that politicians possess over civil servants, by hindering discussion about the geopolitical risks of energy imports from Russia prior to 2022. It is also important to note that different actors had differing perceptions of the energy–security nexus and the power of actors. One potential reason for this was the division between those that belong to the inside "energy elite" (see Ruostetsaari, 2010, 2017) and those outside it. Those on the outside are not, for instance, aware of any informal interactions that take place.

Although the case countries have long traditions of climate and energy policymaking across different ministries, often such processes have not involved actors in defence or foreign affairs, except in Estonia. Generally, the countries studied in this

book were mostly relying on informal interaction between the ministries responsible for energy and for security and defence. This was argued to work well in small country contexts. It has also meant that the role of security actors has remained rather implicit in energy transitions. Sometimes, such actors – for example ministries of defence – have slowed down energy transitions due to valid concerns about the impact of wind turbines on air surveillance radars. At other times, security actors have been excluded from energy policymaking, with argumentation related to the market orientation of energy policy or the avoidance of "securitizing" energy policy (Kivimaa, 2022). The country analyses also showed that it was important to include private sector actors in discussions at the nexus of energy transitions and security. For instance, energy business actors are likely to have more up-to-date and accurate information about the range of security issues that energy transitions involve and what the solutions could be – but security-sensitive government information cannot be disclosed to them unless they are included in such discussions. Yet, some business actors may also have (too) strong roles in energy policymaking, as illustrated, for instance, by Eesti Energia (see Chapter 5 for details). This links to the role of the state in the energy sector, discussed later in this sub-section.

Actors connect to *institutions* and the arrangements constructed to govern the interplay between energy and security. The country cases portrayed examples of institutions at this interface, for instance, security-of-supply organizations coordinating stockpiles of fuels and emergency protocols in case of electricity system disruptions. These institutions, however, seemed to be rather narrow in focus, typically excluding broader military security or geopolitical concerns. Some case countries did not even have some of these institutional structures in place. What the energy transition entails is rethinking security of supply within the context of the increasingly electrifying energy system with a larger share of intermittent renewable energy, which makes stockpiling difficult. Therefore, new institutional structures are needed around technologies and business models that consider what energy security means in the context of a new decarbonized energy regime. With regard to the electricity sector, it is vital that such institutions also reach across country borders to enable positive collaboration in the supply and transmission of electricity.

As noted, in the case countries informal institutional arrangements were more common than formalized arrangements across the energy–security nexus. This may be important in the sense that institutions exert influence, guiding behavior and perceptions. Societal actors may have been less aware of/prepared for security risks facing the energy infrastructure – affecting energy availability and prices to end consumers – when such questions were not part of formal institutional arrangements and, hence, not openly discussed. This could be seen in the reactions to the 2022 energy crisis in Europe. The findings also showed that informal rules at the intersection of energy and security regimes have at times hindered energy transitions.

Examples include the dissonance between how decarbonization and energy markets relate to security (in Finland and Norway) and the idea that markets best deliver energy security (in the UK). In effect, informal institutional structures have carried the responsibility of coherence – or lack of coherence – between energy and security policies. Whereas informality may often work well, it also means that there is a lack of accountability and transparency on behalf of the decision-makers and the public administration. Given the seriousness of both climate change and broader security concerns for societies, formal institutionalization of this interface in support of resilient zero-carbon energy transitions is required.

The institutional aspect of the energy–security nexus also connects to the role of the state in the energy regime and the energy transition (see Johnstone and Newell, 2018). Within the four country cases, the role of the state varied in the countries' energy–security nexuses. In Norway, it was the strongest, due to large government ownership of energy production (hydropower and fossil fuels) and almost exclusive ownership of electricity transmission and production. This is not necessarily most conducive to zero-carbon transitions, because the Norwegian state also has an interest in maintaining fossil fuel production, which provides economic security for the country. It also means that energy transitions are mostly advanced by large regime actors, such as Equinor, the largest fossil fuel producer in Norway. Another example comes from Estonia, where Eesti Energia functioned as state-owned monopoly until 2014, producing electricity from oil shale and being very influential on Estonian energy policy (albeit since then it has begun to orient toward the energy transition). In Finland, energy production and transmission have not been owned by the state to the extent they are in Norway. The Finnish state has, however, played an active role in advancing the energy transition, although changes in the government and voices of antitransition could change this. This means, among other things, that the actions of private sector actors can also be beneficial for the energy–security interface. Private ownership of energy production can be more conducive than state ownership to advancing the transition. Moreover, in Finland, the expansion of renewable energy and electrification has been associated with improved security, due in part to the lack of domestic fossil fuel production. On the other hand, high private sector dominance can also be unconducive to zero-carbon developments. The Scotland/UK case shows that high private ownership of, for instance, transmission network capacity may slow the prerequisites for energy transitions, while state actors, such as the Office of Gas and Electricity Markets (Ofgem), have also been rather reluctant to advance the energy transition. Therefore, it seems that balanced roles of public and private as well as regime and niche actors work best for both the advancement of zero-carbon transitions and the security of the sociotechnical energy system. Table 9.2 summarizes the key aspects in the case countries' energy–security nexuses.

Table 9.2 *Summary of country findings regarding technologies, actors, and institutions*

	Estonia	Finland	Norway	Scotland/the UK
Technologies	Wind power niche expansion hindered by their effects on defence radars. Destabilization of oil shale regime slow due to risk of Russian reactions, economic security in the region, and security of supply. Desynchronization from Russian energy network a long-term energy security process. Emerging attention on critical materials.	Wind power niche expansion hindered by their effects on defence radars. Russian energy company as investor in a new nuclear power development (halted in 2022). Peat (part of fossil energy regime) framed as important for energy security, while actual contribution low. Emerging attention into critical materials and security of critical infrastructure since 2022–2023.	Economic security and geopolitical influence tied to fossil fuel exports. Most attention in security terms to the safety and risks related to hydropower dams. Some tensions around expansion of the wind power niche – a question of antiwind power movement. Security of critical infrastructure an emerging concern from 2022.	Nuclear power opposed due to security of infrastructure reasons (by Scotland). Critical minerals (required by renewable energy) a concern for some time in the UK, increasing focus from 2022. Wind power seen to improve energy security, but Chinese prefabrication work has raised some concern. Military safeguarding fossil fuel supply routes.
Actors	From dispute to cooperation between ministries in charge of energy and of defence. The network operator Elering described as "quasi-security police." Divergence in how expert interviewees perceived interaction between energy and security actors. Consensus between political parties on importance of oil shale post-2022.	Defence and foreign affairs ministries not part of coordinated climate and energy policymaking. Energy elite actors have emphasized competitiveness over geopolitics. The Power Pool was found to be the most efficient actor network coordinating part of the energy–security nexus. Long tradition of public–private collaborations.	Interconnections between energy and security actors were largely not seen as important prior to 2022. Large state ownership of hydropower, oil, and gas installations creates tight state–business relations. NVE coordinates power supply preparedness and cybersecurity. Antiwind power movement actors questioning "energy sovereignty."	Large role of and reliance on private sector actors (and markets) in energy markets and security. Defence sector actors have had traditional roles in safeguarding fossil fuel trade routes but are also considering impacts of climate change. Selected (rather fragmented) fora, where energy and security actors meet.

Table 9.2 *(cont.)*

	Estonia	Finland	Norway	Scotland/the UK
Institutions	An informal approach to interministry coordination has dominated, leading to potentially ad hoc problem-solving. Lack of formal institutions at the energy–security nexus (esp. before 2022). Military spending 2.1 percent of GDP (2022).	A collaborative governance model has created networks supporting energy–security policy coherence, but no one has been assigned responsibility for the whole energy–security nexus. Military spending 1.7 percent of GDP (2022).	Heavily institutionalized role of oil and gas income; related four ministries in the energy–security nexus not sufficiently coordinated. Insufficient institutional structures for the energy–security nexus. Military spending 1.6 percent of GDP (2022).	Lack of formal energy and security policy mandate prevents Scotland's coordination of energy–security nexus, but partly divergent institutions from the UK via spatial planning powers. Military spending 2.2 percent of GDP (2022).

9.5 Further Insights for Sustainability Transition Studies

The invasion of Russia in Ukraine had a large external impact on energy policy in the EU and its member states in 2022 (Kuzemko et al. 2022). The resulting actions of the European Commission led to the halting most of the coal, oil, gas, and electricity flows from Russia to Europe. This reduced the availability of energy in European countries and resulted in skyrocketing prices of electricity, heat, and petrol. The event can be described as a security-related "landscape shock" for the European energy regimes.

The findings from the case countries show that before 2022, energy and security experts had differing perceptions of Russia as a landscape pressure on the energy sector. These ranged from perceiving a substantial risk to remarks about low risk and good energy collaboration. While the views of the experts were mixed, broadly most energy experts in Finland, Norway, and the UK had relatively few concerns and viewed the energy collaboration positively. Estonian energy experts – and security experts in all case countries – tended to have a more cautious perspective.

The annexation of Crimea in Ukraine by Russia in 2014 caused a small landscape shock, where the Russia risk was brought to the fore more strongly in the case countries. However, this had relatively little impact. It did not result in markedly improved coherence between energy and defence policies. In turn, the substantial landscape shock in 2022 resulted in more consensus regarding perceptions of Russia in the case countries. This affected regime and niche development in two ways. On the one hand, it created increased support for the expansion of renewable energy. On the other hand, it also formed a stronger consensus about continuing to use fossil fuels in countries where domestic sources were available, especially in Estonia and Norway. The two-pronged impact of the 2022 events means, perhaps, a lack of overall direction for the energy transition. It may also limit the expansion of the energy niches that continue to compete with the fossil fuel-based energy regime.

Viewing a large powerful country as a landscape pressure emphasizes the perspective that, in transition studies, landscape is not merely about physical elements or events but also largely about how landscape factors are perceived by different actors. In this formation of perceptions, that is, socially constructing landscape pressures, regime actors are likely to be more influential than niche actors or other marginal actors. This is well represented in the Finnish case before 2022, where concerns existed but the dominant energy–political logic was that Russia was a partner beneficial to Finland's energy trade and the economy and not a security concern for its energy regime. The view of the landscape being based on perceptions, therefore, connects actors and agency to the conceptualization of the landscape. This has been pointed out previously by Antadze and McGowan (2017), who mentioned how actors interpret the landscape for the use of niches and regimes.

Events and pressures related to large countries also connect to how governments in these countries can put intentional pressure on other actors (cf. Morone et al., 2016). The actions by the Russian state toward Ukraine and the rest of Europe, as well as the sanctions placed by the European Commission in response, represent intentional attempts to create landscape pressure on energy and security regimes. The difference between countries as source of landscape pressure and other landscape developments, such as climate change or pandemics, is that a country can be both an actor via its government and act as a landscape pressure on sociotechnical regimes in other countries.

The country cases also showed how the history and culture of countries, as well as the subculture of particular regimes, shape the ways in which landscape pressures are perceived and interpreted. This is particularly evident in the analysis of Russia as a landscape pressure on the case countries of this book. Estonia had more uniform and risk-oriented perceptions of Russia as a landscape pressure for its energy sector than the other countries, due to its relatively recent regained independence and history as part of the Soviet Union. Likewise, Finland's orientation to not discuss geopolitics around energy was guided by the history of "Finlandization" following World War II (e.g., Arter, 2000). Johnstone and McLeish (2022) describe a similar occurrence where the wider cultural context built from memories and expectations around the potential of another war have an impact on the sociotechnical landscape.

The empirical energy context highlights the complex and multifaceted nature of sustainability transitions, emphasized in the recent literature. Instead of a relatively straightforward transition where niches expand and stabilize to replace an old sociotechnical regime, the real-world empirical context draws attention to reconfiguration and restabilization (Laakso et al., 2020; Sillak and Kanger, 2020). As noted, the aftermath of 2022 saw two somewhat contrary tracks: the restabilization of fossil energy regimes (in Estonia and Norway) and the expansion of niche energy development. Therefore, the country cases do not show a simple regime decline coupled with niche expansion, but rather a reconfiguration of the energy regimes to include both old and new in a new configuration of the sociotechnical system. Scotland may be an exception to this, stating in its energy transition plan from 2023 that "extraction of fossil fuels is not consistent with our climate obligations, [and] is not the right solution to the energy price crisis" (Scottish Government, 2023, p. 97). It, therefore, takes a longer-term approach to positive security involving the phaseout of fossil fuels.

The restabilization of industries benefits from dominant industrial actors' active counteractions to destabilization. For instance, Sillak and Kanger (2020) note that restabilization strategies include reinforcing territorial ties via existing resources and infrastructure, increasing societal embedding by emphasizing established

cultural meanings, and reinforcing existing policy–industry alliances. These strategies were observable in relation to the Estonian oil shale and Finnish peat industries. The cases in this book showed also that a large landscape shock may create greater consensus around regime restabilization than previously existed.

This book has highlighted the need to strongly consider security and geopolitics as areas that are increasingly relevant for sustainability transitions research but have typically been ignored. The book's empirical cases showed how security and defence policy influence both niche development and regime decline in the energy sector. A similar finding was made earlier by Kester et al. (2020); they argued that security concerns hinder niche development in the mobility sector. A further argument this book makes is that unfolding sustainability transitions also affect security and defence regimes by changing the technological operation, actor–constellation, and institutional structures of sociotechnical systems. These types of effects should be analyzed or anticipated ex ante where possible and revised during the course of transitions.

As noted, the focus on security also emphasizes the role of the state in sustainability transitions (see Johnstone and Newell, 2018; Silvester and Fisker, 2023). Whereas the role of the state ranges from hindering to advancing transitions, the analyses in this book showed two things relating to security and defence, both sectors that are typically the responsibility of state governments. First, policy incoherence resulting from political incoherence (see Kivimaa, 2022) and the differing values and worldviews of different government ministries mean that the same state can simultaneously advance and hinder a transition. Second, despite security being a responsibility of the state, private sector actors' activities, expertise, and knowledge are vital in complementing states in their duties at the nexus of security and sustainability transitions.

9.6 Final Remarks

With this book, I aimed to introduce the fascinating world of security studies and international relations to researchers, energy sector experts, and those interested in sustainability transitions. It can be especially useful to apply certain concepts from security studies, such as securitization, positive and negative security, and referent objects, to transition studies too. In terms of the energy–security nexus, one can conclude that the referent object, that is, that which is to be secured, ranges from the nation state and broader society via the energy system to individual citizens (while the citizen dimension is less commonly explored it is important for positive security and just transitions). The analyses showed that new security concerns can both accelerate niche expansion and slow down regime decline, depending on context. Therefore, uniform conclusions cannot be made about this link.

I also hope with this book to open a new research agenda that brings security studies and geopolitics into the sustainability transitions scholarship. Based on my analysis and previous work touching on this interface, the following research questions arise. First, what are the ways in which security shapes the emergence of new niches and what roles do militaries play in the uptake of new technologies? Some insights have been provided in the energy and mobility contexts (e.g., Kester et al., 2020) but further research would be beneficial both in the context of new sectors and to deepen the analyses of energy and mobility niches. Second, how are established sociotechnical regimes tied to security and the military–industrial complex, and what needs to take place to open such multiregime lock-ins? We have some insights from the UK context (e.g., Johnstone et al., 2017), but new research is needed across the Global North and the Global South. Third, what are the ways in which sustainability transitions are linked to conflicts and peace-building? Again, there is a limited number of studies in selected contexts (Fischhender et al., 2021; Kester and Sovacool, 2017), and more globally encompassing studies are needed. Fourth, how do transitions link to war and the role of the state? Some interesting openings have been made in this regard (Ford and Newell, 2021; Johnstone and McLeish, 2022; Johnstone and Newell, 2018), but further research is needed, especially in contemporary contexts. Finally, the research in this area also needs to connect to positive security and just transitions, to explore the myriad ways in which security and justice are intertwined.

Security studies have presented a question regarding "security from what threats?" Based on the analysis of this book, technical aspects have dominated the thinking around energy system security. Before 2022, an economic understanding of energy security prevailed and the geopolitical dimension was often ignored (Dyer, 2016). It is only recently that increased attention has been paid to, for instance, military and terrorist threats (i.e., human risks) to critical infrastructure. Also, climate change and security-of-materials supply (i.e., nature-based risks) have increased in importance.

Another question posed in security studies has been "security for what values?" The analyses of this book have shown that economic and market-based values have tended to dominate sociotechnical energy regimes, whereas environmental values have mainly been covered via attention to climate change, with biodiversity and the threat of nature loss largely ignored. Hard security values have also often been absent, but have been increasing in magnitude since 2022. Soft security has been similarly absent but has also received increasing attention via just transition efforts and emerging discourse on societal resilience during the last few years.

The analyses of this book showed the policy interface around energy transitions and national security and defence has often been incoherent and pursuits toward coherence have been based on informal institutional coordination and depoliticized

settings. Further, the empirical experiences indicate that the political dimension, in achieving or not achieving policy coherence, is vital. Across Europe there was a shift in political frames as a result of the events of 2022, with much more potential for coherence between energy transition and security policies than before, but also the risk of again giving increased support to fossil fuel-based energy regimes. This means that policymakers and other actors need to make conscious and ambitious efforts to improve coherence and integration between energy transition policies and security and defence policies.

The search for resilience, strategic autonomy, and technology sovereignty in the EU, its member states, and elsewhere in Europe is perhaps an example of such efforts. These recent policy developments also connect the practice of sustainability transitions, in particular the EU Green Deal, with debates on security and justice. Policies to advance resilience and strategic autonomy must consider how these impact the advancement of sustainability transitions, not only nationally but globally, and what the implications of such pursuits on global security and justice are. Further research is needed in this area. This also raises the need to coordinate sectoral policies, such as energy or industrial policies, not only with defence policies but also with foreign and development policies – linking to changing energy and climate diplomacy.

The topic of this book is also connected to broader discussions on climate security. The zero-carbon energy transition has an important role to play for future climate security by reducing greenhouse gas emissions. There are, however, also other connections. For instance, new sociotechnical energy systems need to be built so that this critical infrastructure is resilient to the increasing impacts of climate change, such as storms, droughts, flooding, heatwaves, and fires. The energy transition and climate change together create increased pressure on land use and alter global trade and supply chains.

For some time, human-induced climate change has been considered by NATO and large countries' militaries as an existential threat, something that changes the operational capabilities of militaries and that needs to be mainstreamed to the operation of militaries and defence forces. Such attention indicates that the threat is real. There are also examples in the ways in which zero-carbon energy policies and defence policies are becoming more integrated with each other, evidenced, for instance, in a NATO-funded workshop that Chatham House co-organized with the Finnish Environment Institute in September 2023. At the same time, the discussions held in this workshop revealed that much is still to be done: thinking about how more concretely to mainstream climate security in NATO and its member countries; developing alternative technologies and fuels for operations; and considering the justice implications of climate change mitigation and adaptation.

I end by noting that improved policy interplay between energy transition, defence, and security policies requires institutional change. One part of such institutional change should be redefining what energy security means in the context of a new kind of decarbonized energy regime. For instance, energy security in the context of renewable energy and electrification-based transitions can imply securing cross-border electricity interconnections, distributed smart grids, improved electricity storage, and international energy collaboration; preparing for disturbances; tightening public–private cooperation; and establishing new business models around demand response. Energy efficiency was usually not connected with energy security in the case countries, although reduced energy demand would improve security of supply and lessen pressures around sourcing technological components and critical materials. Policymakers and others need to create better links between questions of energy efficiency and of security.