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Månsson, André

Published in:
Energy Research & Social Science

DOI:
[10.1016/j.erss.2014.10.004](https://doi.org/10.1016/j.erss.2014.10.004)

2014

[Link to publication](#)

Citation for published version (APA):
Månsson, A. (2014). Energy, conflict and war: Towards a conceptual framework. *Energy Research & Social Science*, 4, 106-116. <https://doi.org/10.1016/j.erss.2014.10.004>

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1

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LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Energy, conflict and war: Towards a conceptual framework

André Månsson, Environmental and Energy Systems Studies, Lund University, P.O. Box 118,
SE-221 00 Lund, Sweden

Email: Andre.Mansson@miljo.lth.se

Phone: +46 46 222 4130

Abstract

It is widely recognised that the presence of some fossil fuels and their transport routes can affect the risk of conflicts. Other parts of the energy system and contextual conditions (social, economic or political factors) also matter for such conflicts, but which and how is not as well researched. This paper develops a framework that links characteristics of energy systems with contextual conditions that if combined increases the risk of conflict. The framework also provides a brief theoretical background as well as examples of previous energy conflicts.

Examples of energy system characteristic that can affect the risk of conflicts include geographical concentration of primary resources, the number and diversity of exporters on the international energy market, vulnerability of infrastructure to attacks, vulnerability of users to disruptions and externalities related to interconnections with other systems. Contextual conditions include, among other, the rationale of actors to engage in conflict under various circumstances. The capacity of humans and societies to adapt to change should be analysed together with the characteristics of the energy system that place stress on actors. The framework can serve as a tool to identify ‘hotspots’ and, develop more robust energy policies and strategies to anticipate and prevent conflicts.

Keywords: Conflict, Energy, Resource, Security

1. Introduction

Previous research has shown that there can be various connections between energy and conflicts [1-3]. It has generally focused on one single factor as a cause of conflict, whether geopolitical, environmental or economic. It is also common to restrict analyses to only one energy carrier or resource, particularly oil, e.g. [4-7]. Integrated assessments that cover several factors are less common. Moreover, researchers tend to focus on one domain at a time, e.g. either interstate or intrastate conflict, while interactions between domains are seldom analysed [8]. This approach is useful for understanding many historic and contemporary energy conflicts, e.g., those related to competition for oil. However, such approaches do not allow the analysis of how risks of different conflicts may evolve under broader changes in energy systems or contextual conditions. A case in point is Colgan [5] who developed a framework that is very useful to understand the links between oil and international armed conflict. For assessing many future challenges, e.g., climate change induced conflicts and energy system transitions, the scope of such frameworks need to be extended.

A narrow focus restricts the possibility to detect different forms of conflicts and policy trade-offs and is also less useful for broader assessments of how the future may unfold. Furthermore, different theoretical points of departure may influence the choice of which factors to evaluate and their relative weight and interpretation. This can result in diverging views on how the risk of conflicts may develop and can be managed [9, 10]. The diverging views are not a problem *per se* and can in fact provide input necessary for analysing complex issues. However a structured approach that integrates different theoretical perspectives and a broader set of aspects may be useful.

Energy systems are constantly evolving. and will continue to change in response to improved energy efficiency, new electricity demands, increased use of renewables and

unconventional fuels, increased demand in emerging economies and scarcity of conventional fossil fuels at low cost. Energy systems have long-term investment cycles that can cause technological lock-in. Therefore, decisions made today on how to develop existing energy systems will affect, and to some degree even determine, the features and structure of future energy systems.

In this paper, a framework is formulated that addresses the characteristics of energy systems and contextual conditions that, if combined, increase the risk of conflicts. The framework focuses on the underlying structures and patterns that make conflicts possible and hence enable them to take place, as this enables the framework to be used to analyse different energy systems and contexts. Three different severities of conflicts are addressed here: violent conflicts (war and other armed conflicts with casualties), social instability (e.g. manifested as social unrest) and political disputes (political conflicts manifested mainly through economic means).

One strength of the proposed framework is the broad range of factors it covers and the separation and clustering of factors related to energy system and context, which enables the framework to be used as a tool in the analysis of historic and contemporary conflicts, but also of changes in energy systems and/or contextual conditions. For example, in an explorative scenario study of future energy systems, the development of a certain pathway can be analysed under different assumptions of contextual conditions to anticipate hotspots and robust strategies. The framework can also be a starting point for comparative studies and to investigate some of the questions raised in a previous paper in this journal [11], e.g. on the differences between how “depletable” and renewable resources contribute to social or military conflict. This paper contributes to several strands of literature, including that on resource conflicts, energy system analysis and socio-technical foresight.

2. Theory and approach

Different theoretical approaches provide different insights of why conflicts occur and subsequently which factors that may explain the risk of conflicts. Different theories also focus on different actors. Realism is one of the dominant theories of international relations. It contains several sub-sets but the anarchical “self-help” system of states is a unifying assumption. Conflicts related to power struggles and/or incompatible security interests can partly be traced back to the lack of trust of other states intentions. Lebow [12] found that interstate wars during the past 350 years has mainly been related to (material) interest, security, standing and/or revenge. He thinks that such underlying motives are weakening which should make future interstate wars less likely.

Geopolitics emphasise the importance of understanding spatial differences concerning resources, geographical placement etc. to explain international affairs and how geography can render comparative advantage [13]. The subfield of “Critical geopolitics” particularly exposes how geography have shaped existing power structures, foreign policy interests and imperialist behaviour of hegemons [14, 15]. Controlling global resource flows, as well as the stability and obedience of resource extracting states can therefore be important for the hegemon [15]. This perspective on hegemony can also be found in Marxism, a theory that describes how production is organised and assumes a struggle between wealthy states in the core and periphery states, see e.g. [16].

There is an ongoing debate within political economy if it is the feasibility of rebellion (e.g. opportunity for finance from resource extraction) or political motives (e.g. insufficient political rights) that is the main explanation for outbreaks of intrastate conflicts. Collier and Hoeffler [17, 18] advocate the former explanation but their approach and conclusions have been questioned; particularly the framing of rebels as ‘the bad guys’, rather than the

oppressing states, and their reductionist approach [19]. Previous research has also found that it can be useful to study domestic politics to understand international conflicts since domestic conflicts can attract external actors and leading politicians can be more or less prone to engage in conflicts with neighbouring states, see e.g. [4, 5, 7, 8].

Environmental security scholars analyse how environmental factors can affect security [20]. The extraction and use of energy can degrade the environment. Environmental degradation is mainly a problem if it exposes individuals or societies to stress beyond their capacity to cope or to adapt to environmental change [21]. Such situations can result in scarcity of renewable resources and trigger ‘ecological conflicts’ [22]. Political ecology scholars study connections between environment and political processes such as how demand for resources in wealthy countries can contribute to political conflicts in producer countries between those who control, and profit from the production, and the local population [23]. Development studies complement the perspectives found in environmental security and political ecology as it frames the lack of access to food and energy, not only externalities, as a threat that can restrain what people can do (i.e. constrain capabilities [24]), affect development and contribute to conflicts, see e.g. [25].

It may be useful to have a framework to identify which insights the different theories provide and how they can be used in combination to better understand energy conflicts. However, there is no agreement on what constitutes an energy conflict or how energy interacts with conflicts. Ciută [10] identified three broad groups of relationship between energy and conflicts (energy as a *primary cause*, *secondary cause* or *means* in a conflict). This study use Ciută’s definition of energy conflict and take it as a starting point to develop a framework that includes contextual conditions and energy system characteristics that increase the risk of conflict, and the theoretical background. Three levels (international, national and

local) and three severities of conflicts (violent, social instability and political disputes) are addressed in this paper.

The conceptual framework is descriptive and intended to structure the analysis of empirical material and thereby bridge the gap between theory and observations of how energy systems can affect the risk of conflicts. This was done through extending a typology that describes how a socio-technical energy system and conflicts are connected. Each category includes a spatial domain where the conflict is likely to occur (as this affects the choice of level of analysis), contextual conditions that promote or prevent a situation developing into a conflict (i.e. political, economic and social conditions) and characteristics of the socio-technical energy system that enabled the conflict to occur (the socio-technical energy system is used in a broad sense including both physical parts of energy supply chains and surrounding institutions). Examples of historical conflicts are provided in order to illustrate the respective category.

3. Links between energy and conflicts

Energy can be the primary cause and objective in a conflict, an instrument that is used as a means in a conflict or a secondary cause (see Figure 1). In the first category, the end goal of a conflict is primarily for the participants to improve their own security by securing some part of the energy system, i.e. energy is an objective in a conflict. These conflicts are closely related to issues of legitimacy, e.g. states that try to secure access to energy resources and in the process violate the sovereignty of other states.

In the second category, the energy system is used as a means by an actor to impair the security of other actors and achieve other, non-energy related, objectives. One example is

energy exporters that deliberately restrict export volumes to gain political leverage over importers.

In the third category, the energy system is partly the cause of a conflict, as it has destabilised a society and thereby contributed to, or exacerbated, a conflict. For example, the exploration, production or use of energy can have side-effects that cause environmental stress. Typically, these conflicts are unintended from the point of view of the energy producers and users.

It should be noted that these are descriptions, and in some cases interpretations, at the meta-level. Some conflicts may be explained by several of the proposed categories or interactions between them. One example is a state that uses force to maintain control of an energy system (first category), exploit the control by extorting another state (second category) and reduce that state's security of supply (third category).

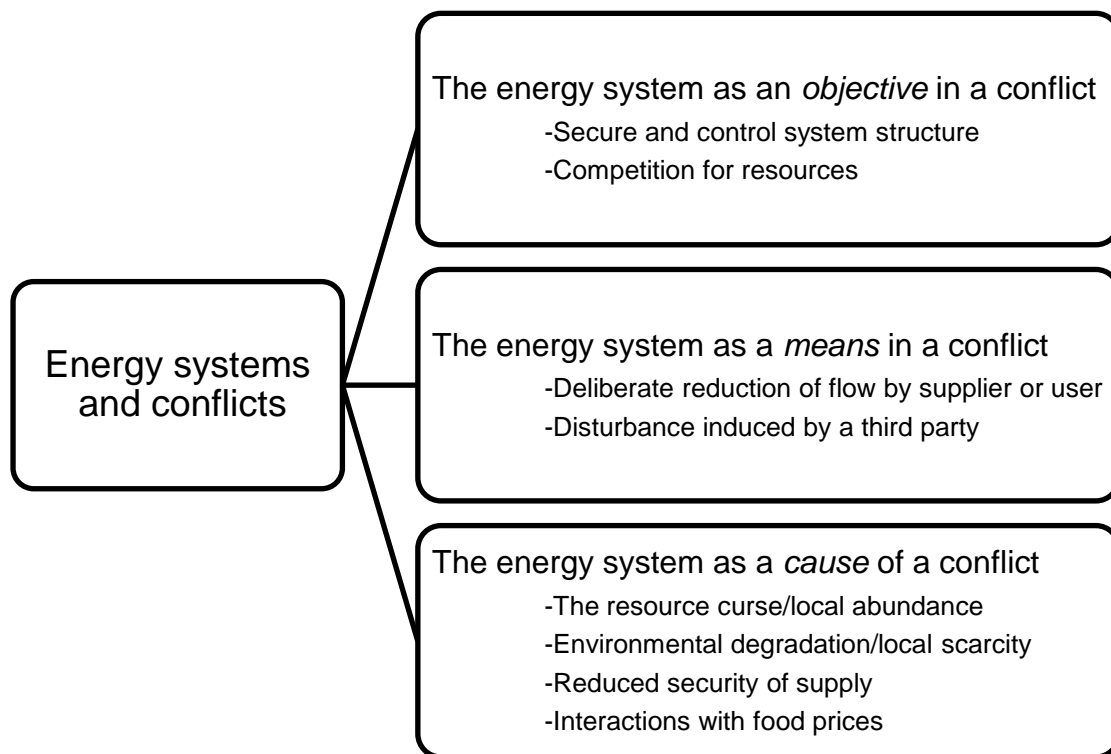


Fig. 1. Typology of links between energy systems and conflicts.

3.1 The energy system as an objective in a conflict

Potential energy resources are abundant but the geographical distribution of concentrated point sources, e.g. fossil resources, is unevenly spread over the globe and the substitutability between primary energy resources is often low in the short term [26, 27]. The infrastructure used to transport energy is sometimes also geographically concentrated and may have inherent (spatial) bottlenecks, e.g. the Strait of Hormuz. As energy has an economic value as a commodity and also constitutes a vital input for creating prosperity and wealth, some actors may try to secure vital parts of the energy system or some of its inherent features. However, attempting this may cause or trigger conflicts with other actors. This raises the question of territorial legitimacy, i.e. who is allowed to do what at a given time and place. States are

generally assumed to be sovereign and have a monopoly on the use of force within their territory, but conflicts can still occur between states, for example when another state defies sovereignty or in areas where borders are disputed.

Depending on the motive of the actor, two groups of conflicts can be distinguished: i) conflicts in which actors try to secure or control international energy flows to improve their own (national) security and ii) when competition for resources leads to a conflict between the competing actors. It should be noted that these motives are not mutually exclusive, i.e. some conflicts could be, and have been, explained by both of these motives and/or interactions between them.

3.1.1 Secure and control system structure

Actors can try to influence international energy flows, or the structure of the markets, in order to maintain or increase their own security. A violent conflict can emerge between actors that have diverging underlying interests. The U.S. military deployment in the oil rich Middle East region is one example and it has been interpreted as a pursuit of securing exports and an open international oil market which benefits U.S. national security¹ [2, 5, 16, 28, 29].

To control or influence global energy flows may require the capability to project power in multiple regions. Such capabilities are typically associated with a global hegemon that possesses the military power to conduct operations in multiple regions, e.g. naval forces capable of securing vital sea lanes. Therefore, there can be a conflict of interest between the hegemon and periphery states concerning, for example, how the global energy market should be structured, as it may be in the interests of the hegemon to preserve the present structure,

¹ U.S. as a guarantor of free flow of oil can be illustrated by the Carter doctrine. It stated that free movement of Middle East oil was in the interests of USA and an attempt from an outside force to gain control of the region would be repelled by any means necessary.

whereas periphery states may want to change it². However, the means employed differ, as a hegemon can obtain approval from the international society to use force.³ In contrast, periphery states may have to resort to other means to achieve their objectives, such as upstream investments or long-term contracts that provide control of foreign production and divert flows away from the open world market (see e.g. Sun et al. [32] on China's sovereign wealth fund investments).

Both hegemons, the British Empire and the US, have aspired to control global energy flows [33]. During the 19th century the UK, a previous international hegemon, was a major producer and exporter of coal, at that time the most important source of (thermodynamic free) energy. Later, as oil gained importance in the energy mix, the UK also established a presence in the oil-rich Middle East region, a diplomatic and military engagement that the US took over as the global balance of power shifted over the Atlantic [34]. It is likely that different factors motivated the US to undertake military involvement in the Middle East and their relative importance may have changed over the years [2]. Some factors suggested are the maintenance of free trade and an open oil market [2, 16], the demonstration of a hegemonic position [28] and making sure that oil is priced in dollars in order to protect the dollar's supremacy as the world reserve currency [29].

Characteristics of the energy system that can increase the risk of conflicts in this group are geographical (spatial) concentration of high-grade resources, trade routes and transportation infrastructure, and the perception of a strategic resource, e.g. limited availability of substitutes for an energy carrier in the short term and vulnerability to disruptions. In addition to the energy system it is also necessary to address how the international society can develop,

² Buzan [30] argued that if the status quo is a liberal world economy, the hegemon will try to preserve the system as a security objective. On contrast, periphery states will pursue a mercantilist strategy to increase their security, possibly also changing the structure of the system or their relative position within it.

³ The behaviour of the hegemon is especially important in shaping norms. In turn, norms determine what is considered acceptable behaviour. Wendt [31] classified the cultural relationship between states as enemy (Hobbesian), rival (Lockean) or friend (Kantian).

particularly its polarity, the balance of power between states and power transitions between hegemon, in order to analyse the possible future development of such conflicts. These contextual conditions have changed throughout history and can change again in the future [35].

3.1.2 Competition for resources

Uninterrupted access to energy can be important for the prosperity and survival of states, as it is needed to power the military [36], and to enable growth of the economy [37]. Apart from being perceived as strategic and vital, energy resources also have economic value and can provide a stream of revenue for producers. These various reasons increase the competition for resources and, according to some, can increase the risk of violent conflicts between states [38, 39]. Examples from WWII include Hitler's attempt to control Caucasian oil-fields in order to power Germany's military, and Japan's occupation of neighbouring countries in order to gain access to the resources required to build a strong military [40].

Forecasts of the likelihood of future 'resource wars' between states are sensitive to assumptions on state rationale. Shortly after the First World War, Bakeless [41] pointed to the increase in population and the rise of industrialism as causes of increased struggle for raw materials. He argued that the cause of a resource war originated from competition for scarce resources and that it outweighed the potential of industrialism to preserve peace, through internationalisation and financial interdependence. Under the 'industrial growth paradigm', resource wars were depicted as inevitable⁴. In contrast, Wright [43] argued that it is competition over political power that can cause war, whereas economic competition is more likely to encourage cooperation. This divide in assumptions concerning the rationale of actor's behaviour is still visible. Liberals tend to assume cooperation through institutions and

⁴ Whether or not trade between countries increases or decreases the likelihood of conflict is academically debated by liberals, neo-Marxists and realists (see Li and Reuveny [42] for an overview of arguments and research).

building of regimes as the logical outcome during times of both affluence and scarcity, e.g. [44-46]. In contrast, realists assume reliance on self-help and, as a consequence, resource wars can be a rational response to resource scarcity [38, 39, 47, 48].

Renewable resources typically do not appear in conflicts related to resource competition [1, 49]. This can be explained by renewable resources utilising flows instead of stocks, having high upfront costs and currently being used locally to a higher degree than non-renewables, which limits the export capacity. Furthermore, with the exception of hydropower, renewable resources tend to be dispersed and require a large land area as the energy density is low, making it difficult and costly for an intruder to seize and maintain control of resources and production technology. However, some researchers argue that this may change due to depletion of fossil resources, which they predict will increase the competition for renewable resources and trigger conflicts related to appropriation of land [50, 51]. This could result in tensions between states and with local actors, e.g. indigenous people.

In terms of the energy system, the risk of conflicts increase if there is a disparity between supply and demand, e.g. domestic scarcity, and vulnerability to disruptions, e.g. low price elasticity of demand increase the incentives for interstate resource wars [52]. The strategic importance of oil and gas, and the subsequent risk of conflict, could decrease if domestic substitutes were available and the vulnerability of societies to disruption was lower. However, estimating whether competition for resources will motivate actors to resort to violence also require addressing contextual conditions, particularly assumptions on actor rationale and co-existing conflicts (e.g. border disputes).

3.2 The energy system as a means in a conflict

The vulnerability of societies to disruptions of energy flows has enabled the energy system to be used as political leverage to achieve other, non-energy-related objectives. Using the energy system as a means in a political conflict requires a combination of spatial features, e.g. bottlenecks that can be attacked, and temporal features, e.g. vulnerability to short-term disruptions.

Depending on the motive of actors, two categories of conflicts can be distinguished: i) deliberate reduction of flow by the supplier or user, and ii) disturbance induced by a third party, e.g. a terrorist attack on the energy system with the intention of damaging the interests of producer, consumer and/or transit countries.

3.2.1 Deliberate reduction of flow by supplier or user

Deliberately decreasing the flow of energy, also known as the ‘energy weapon’, is commonly associated with major energy exporters exploiting the dependence and vulnerability of importers in order to gain political leverage and influence domestic or foreign policy decisions. The opposite situation, i.e. one or a group of importers boycotting a producer, can also occur. A case in point is the US-led embargo on oil exports from Iran. Irrespective of whether the exporter or importer wields the energy weapon, it is likely that the states in question have an asymmetrical bargaining power and a previous political dispute such as in the Russian-Ukrainian gas crises of 2006 and 2009 [53] (see e.g. Larsson [54] for an analysis of the reliability of Russia as an energy supplier).

If the energy weapon is to be efficient, it is not sufficient for producers to consolidate control over resources and transit routes, since the targeted state also needs to concede. This seldom occurs after observable threats have been implemented [55]. Dependence on imports from a few suppliers can still influence political decisions if the supplier possesses the

capability and means to harm an importer, even without actually implementing the threat. In contrast, liberal researchers argue that bilateral or multilateral, i.e. complex, interdependence can create mutual understanding and increase gains for all parties, which should reduce the likelihood of conflict [56]. Thus, whether the energy weapon is perceived as a threat by importers partly depends on assumptions of exporter rationale, e.g. whether the exporter seek absolute or positional advantage in relation to other states.

Characteristics of the energy system that enable the energy weapon to be used are bottlenecks such as geographical concentrations of infrastructure, import/export dependence, low market diversity or liquidity, and vulnerability to disruptions. This implies that both supply and demand side factors need to be considered when assessing the prospects for the energy weapon. Furthermore, it is easier to consolidate control over flows if the structure of the market is regional rather than global, since the latter would probably require acceptance from the international society or a hegemon. This also implies that contextual conditions need to be analysed, since it is more difficult in a multipolar world it to gain acceptance for use of the ‘energy weapon’ on global flows, as no single actor can set the agenda (see Lesage et al. [57]). However, a regional power can still have the capability to influence regional flows.

3.2.2 Disturbance induced by a third party

A strategically important and vulnerable energy system can be an attractive target for hostile action, as limited efforts to disturb the flow can result in disproportionately severe consequences. This can mainly be explained by other systems being dependent on the energy system, such as interconnections that can trigger a cascade effect.

Disruptions to flow can materialise differently and occur either interstate or intrastate. An example of the former is an enemy during a war campaign that specifically targets energy

installations, or economic embargos, such as the UK-imposed oil embargo of Rhodesia [58] and when the League of Nations threatened Mussolini with an oil embargo in response to Italy's invasion of Ethiopia [59]. Unlike the energy weapon (see section 3.2.1), these embargos were issued by a third party, i.e. neither the importer nor exporter of energy. Another form of conflict is intrastate, involving non-state actors such as terrorists that sabotage energy infrastructure⁵. This has occurred in Columbia, Iraq and Pakistan, among others [60].

The interstate and intrastate conflicts are different in terms of actors but have similarities in terms of the characteristics of the energy system which affect the attractiveness of the system as a target. A robust and resilient system is a difficult target when the desired outcome is to cause a disruption. In contrast, an energy system that has inherent vulnerabilities, such as chokepoints that can be attacked, is more attractive. Historically, this has been associated with physical infrastructure bottlenecks such as pipelines and power grids with high energy density, see e.g. [61]. However, depending on how it is implemented, the increased reliance on computer systems to control energy systems, e.g. smart grid-technology, carries the possibility for remote virtual attacks on software that can cause disturbances of similar severity to physical attacks [62].

3.3 The energy system as a cause of conflict

Although it may be unintended from the point of view of energy producers or users, some features of the energy system can destabilise a society and cause or exacerbate an existing conflict. This type of relationship has been referred to as a 'threat multiplier' [63] or 'threat catalyst' [64], since the causality is not necessarily that conflict happens, but that the likelihood of its occurrence and/or its severity increases. A threat multiplier or catalyst acts by

⁵ Toft et al. [60] identified four different incentives for terrorists to target energy installations: attack feasibility, intimidation, symbolism and concerns for stakeholders.

increasing stress on individuals and societies. If the adaptive capacity is too low, the outcome can have negative consequences, such as discontinuities that are difficult to anticipate in advance.

Four different categories of destabilisers that are combinations of economic, political and/or physical factors can be distinguished: i) local abundance of resources, also known as the ‘resource curse’, ii) environmental degradation that causes scarcity of renewable resources, iii) reduced security of supply that causes knock-on effects (e.g. economic instability), and iv) interactions with food prices that have adverse effects on food security. The scale of these conflicts has historically been mainly local and has affected human security, but some could potentially expand to a national or even international scale.

3.3.1 Local abundance of resources – the resource curse

For both states and humans, local abundance of non-renewable resources can sometimes be a curse rather than a blessing e.g. as witnessed in Iraq where oil wealth funded Saddam Hussein’s regime rather than providing wealth and justice to its citizens. There are different explanations of why abundance can increase the risk of conflicts. Some researchers focus on how the functionality of the state and its institutions is affected by dependence on energy wealth. According to Collier and Hoeffler [17], there are two common state-centred explanatory models, one based on economic aspects (also known as the ‘Dutch disease’), the other on political aspects, such as lack of good governance in some resource-abundant states. A third model focuses on weak and poor states in which natural resources can be extracted by artisanal miners, subsidise belligerents and thereby fuel violent intrastate conflicts, see e.g. [49, 65-67].

States that are dependent on revenues from resource extraction can experience lower economic growth and develop less diversified economies, as revenues from resource export increase the currency exchange rate and make manufacturing of goods less competitive on the world market [68]. As the currency appreciates, imports also become less expensive. This increases the exposure to macroeconomic fluctuations, such as volatile commodity prices. If the resource is non-renewable, depletion and/or increased extraction costs may also restrict future revenues⁶. When export revenues rapidly decrease, the state suddenly faces a situation of low competitiveness on the world market and increasingly expensive imports, a situation that may destabilise the state.

Concerning political aspects, if resource wealth is distributed unequally it increases the likelihood of weak institutions, corruption, violations of human rights and poor development of democratic systems [17]. An underlying problem is the regime's lack of accountability to the population, if government services are subsidised by resource revenues rather than paid for by citizens [71], for example through taxation. This hampers the development of democratic institutions. Thus, energy wealth can enable authoritarian political systems which may benefit national security objectives at the expense of human security; for example, suppressing human rights to maintain a stable state. Previous research has also found that oil wealth can make states more autonomous, increase their room of manoeuvre in foreign politics and increase the risk of violent conflicts with neighbouring states [4, 5]. Resource nationalism can also be promoted as a way to strengthen domestic popularity and power of politicians. In some previous cases this has led to nationalisation or expropriation of resources and assets of foreign energy companies, thus promoting political disputes with the home governments of the foreign companies, see e.g. [72-74].

⁶ The quantity of export revenue depends on economic factors, i.e. the difference between market price and production cost, and volumetric factors, i.e. the difference between production volume and domestic use, see [69, 70].

The argument that high resource wealth per capita may hinder economic development and/or cause domestic instability has been questioned by several authors [17, 75-77]. In the case of oil, it has been proposed that the relationship between resource wealth per capita and civil war has an inverted U-shaped [17, 77], i.e. intermediate dependence has a higher correlation with civil war than low or high dependence. A possible explanation is that high revenues provide funding for a strong military sector, which makes rebellion unfeasible [17], and low dependence restricts incentives for rebellion as well as opportunities for funding.

States that are poor but financially dependent on primary resources, i.e. where a high share of GDP comes from extraction of primary resources but per capita income is low, are more likely to experience violent intrastate conflicts [77]. This is made possible by small-scale artisanal mining, production with low entry barriers and resources that are geographically accessible (e.g. onshore) and 'lootable', so that local belligerents can use them to fund other activities and thereby intensify or prolong a conflict [49, 65-67]. Domestic disagreement over how to distribute the resource revenue can also increase the risk of conflicts in weak states[78].

Local abundance of resources, at least by itself, does not provide an explanation of why states are, or become, unstable, and it is therefore important also to address contextual conditions, such as the political and economic situation. It is worth considering the level of the analysis, since a state-centric or human focus can provide different insights. For example, a state can consider declining export revenues to be a threat to its stability, while its citizens may be more concerned about the lack of democratic institutions, a situation that can be maintained through export revenues.

3.3.2 Environmental degradation

Extraction, distribution and use of energy can degrade the environment, which can lead to scarcity of renewable resources. Although unintentional, these side-effects can have short-term or long-term effects that can stress a local society and, if the adaptive capacity is low, trigger ‘ecological conflicts’ [22]. A historic example is Easter Island (mid-16th century) where deforestation caused shortage of trees and due to lack of substitutes, living standards worsened, prosperity fell and violent conflicts broke out [79]. The Niger Delta illustrates a more recent example where environmental degradation has contributed to local populations’ discontent and protests against foreign oil extracting companies [80].

Some conflicts may occur locally in close proximity to the energy system, e.g. political disputes about how to manage water⁷, land and other natural resource. There can also be a temporal delay and spatial distribution between cause and effect which make the question of responsibility uncertain. In the case of climate change, Welzer [84] suggested that this disconnect can amplify global asymmetry, since there are temporal and regional differences concerning responsibility, impact and adaptive capacity.

The neo-Malthusian assumption is that environmental degradation reduces subsistence and living conditions, since in the longer term the ingenuity and adaptive capacity of humans is unable to compensate for the decline in Earth’s carrying capacity. There are varying arguments as to why this may trigger a conflict. One explanation is that people respond to the stress by migrating, which can trigger negative social effects in areas that receive an influx of migrants if there is insufficient capacity to handle the migrants [1, 42]. According to Hassani-

⁷ Shared water resources with potential transboundary impacts, e.g. constructing hydropower dams, have typically resulted in interstate cooperation in the past [81]. Intrastate water scarcity can be more difficult to manage and affect marginalised population adversely [82, 83].

Mahmooei and Parris [85], a change in relative distribution for a particular group is more likely to trigger conflicts than absolute scarcity⁸ as it can exacerbate power asymmetries.

Environmental stress, such as scarcity of renewable resources, is generally not the sole cause of a conflict, but rather a threat multiplier that affects individuals at a local domain [20]. However, environmental degradation has been disruptive for entire societies which did not have sufficient adaptive capacity [86, 87]. It has also been argued that future climate change can threaten national and global security [88-90]. The time perspective makes the analysis difficult, since the magnitude and regional impacts of climate change are uncertain, as is the future adaptive capacity of humans. Slettebak [91] argued that in the short term, “bad weather” can even reduce the risk of violent conflicts, as it directs attention away from other, more conflict promoting-factors. The long term relationship between environmental degradation and conflicts is uncertain.

Characteristics of energy systems that could increase the risk of ecological conflicts are primarily high environmental load, e.g. pollution and water use, and distributional effects caused by externalities, i.e. one state or group in society reaps the benefits from producing or using energy, while another has to bear the costs. It would be helpful to take account for possibilities to develop adaptive capacity to respond to stress, to assess the risk of future conflicts.

3.3.3 Reduced security of supply

Security of supply, or available, accessible and affordable supply of energy at all times, is an important factor to facilitate wealth and economic growth in industrialised economies [27, 37, 92]. A low level of supply security does not in itself destabilise a society, but involuntary

⁸ Homer-Dixon [1] distinguishes between three different origins of resource scarcity: reduced supply (e.g. environmental degradation), increased demand (e.g. population growth) and reduced relative access for some group (e.g. institutional factors).

reductions may do so if individuals or the society as a whole are unable to adapt smoothly. Co-occurrence of low security of supply or reforms to phase out fuel subsidies and involvement of poor people in social unrest has been observed in India, Indonesia and Nigeria [93-95].

Economic growth can be restrained if the ratio of energy costs to income increase since the price elasticity of demand is low in the short term [96]. As a consequence, discretionary spending is reduced as more money is spent on purchasing energy during a price increase. Sudden price hikes are therefore more negative for the macroeconomy than a gradual increase in the cost of energy, to which it is easier to adapt [97]. A case in point is the recessions that succeeded the oil price hikes during the 1970s. However, increases in oil prices during the past decade have also been linked to reduced economic growth in some countries [92, 98].

An economic depression may trigger civil unrest if it increases the discrepancy between individual's expectation of development and the environment's capability to meet these expectations, see Gurr [99]. The demography of the population affects the risk of civil unrest, since it is primarily frustrated youths, lacking economic opportunities, who rebel [100]. Government institutions can also be affected by reduced tax revenues. Consequently, it has been argued that potential future scarcity and price increases for energy could cause social instability in societies that are unable to adapt [101-103].

The capacity to adapt to higher prices differs between individuals within a society. Low-income groups are the most severely exposed, since a proportionately larger share of their budget is spent on basic necessities, such as food and energy. In societies with wide income distribution, energy price increase can therefore have distributional effects since those subject to energy poverty typically belong to the marginalised part of the population [104].

Assessments of conflicts related to low security of supply needs to address exposure to, and likelihood of, a price trend break, i.e. unexpected and rapidly increased cost of energy or price volatility. Energy users with high variable costs (e.g. fuel cost) are more exposed to price fluctuations than those with high fixed costs. In terms of contextual conditions, the capacity to adapt or transform to a situation with lower security of supply should be addressed (see e.g. Stirling [105]).

3.3.4 Interactions with food prices

Food prices are linked to energy prices, a relationship that can be observed as prices move in tandem. Energy and food prices displayed a trend break and started to increase in the first decade of the 21st century, affecting the number of undernourished in the world [106]. High food prices can pose a threat to food security and trigger violent ‘food riots’ in vulnerable societies when interacting with socio-political factors [25, 107, 108], as illustrated during the world food price crises (2007-2008) [25] and ‘Arab Spring’ (2010) when one of the most important destabilising factors was high food prices [108, 109]. The links between food prices and energy are complex, since energy is both an important input factor in modern agriculture, making energy costs a driving factor in food production cost [110], and is also interlinked with demand factors. In particular, increased demand for biofuels has caused some upward pressure on average food prices and reduced stock levels of crops⁹. This has made the supply less elastic and increased market price volatility in the short term. It has been attributed to two interrelated dimensions [114]. First, biofuels increase the competition for feedstock if they are produced from agricultural products, as is common for first-generation biofuels. Second, they

⁹ Other drivers of higher food prices are: trade restrictions, productivity slowdown, adverse weather conditions, changes in the composition of diets and financial speculation [111]. The most important factor contributing to the recent increase in food prices is debated, higher energy prices [112] as well as increased use of biofuels [113] has been proposed to offer the main explanation. The relative importance of different factors may change over time.

increase overall demand and competition for agricultural resources, resulting for example in land rent increases and making all land use more expensive [115].

Contextual conditions that restrain food security and can increase the risk of food riots include injustice, inequality, political repression, high levels of poverty and urbanised regions with high population density [25, 116]. Poor countries with high import dependency on staple foods are therefore particularly vulnerable [117].

4. Conceptual framework

In the three categories described above, conflicts were depicted as being linked to the energy system as objective, means or cause. This section addresses the level of analysis useful to study a conflict (section 4.1), different contextual conditions (section 4.2) and characteristics of energy systems that can increase the risk of conflict (section 4.3), see Table 1 for an overview.

Table 1 Framework connecting conflicts with contextual conditions and energy system characteristics.

Link between energy and conflict	Level of analysis	Contextual conditions that can increase the risk of conflict (examples)	Energy system characteristics that can increase the risk of conflict (examples)	Theoretical background	Previous conflicts (examples)
Secure and control system structure	International	Actor with hegemonic ambitions, unipolar structure and/or consent from the international society.	Geographical concentration of strategically important resources and transit chokepoints, low price elasticity of demand.	Realism, Marxism, (critical) Geopolitics	U.S. military involvement in Persian Gulf, Gulf War (1990-1991), US invasion of Iraq (2003)
Competition for resources	International, National	Border dispute, consent from the international	Geographical concentration of vital resources, no/low	Realism, Geopolitics	Japanese occupation of neighbouring

		society, access to resources is perceived to be vital for state interests and survival.	accessibility to international trade or high market price, low price elasticity of demand.		countries and attempts of Germany to control Caucasian oil-fields (WWII), Iran-Iraq War (1980-1988), Iraq-Kuwait War (1990)
Deliberate reduction of flow by supplier or user – ‘the energy weapon’	International, National, Local	Asymmetrical bargaining power, hostile foreign relations.	Geographical concentration of infrastructure, import/export dependence, low market diversity and liquidity, regional market, vulnerability to disruptions.	Realism, Geopolitics	Russian-Ukrainian gas crises (2006, 2009)
Disturbance induced by a third party	(International), National, Local	Embargo/consent from international society or presence of terrorism.	Infrastructure chokepoints, energy system vulnerable to disturbances, interdependent systems.	Geopolitics, Political economy	Columbia, Iraq, Pakistan
The resource curse - local abundance	National, Local	Low diversity of domestic economy (i.e. high share of GDP from extraction of primary resources), poverty (low GDP per capita), weak institutions.	Local resource abundance (i.e. low extraction/production cost), declining or volatile market price, declining export volume, low entry barriers for producers, ‘lootable’ resources.	Political economy	Angola, Iraq, Iran, Libya, Venezuela, Yemen
Environmental degradation - local scarcity	(International), National, Local	Low adaptive capacity, societal heterogeneity and distributional effects, i.e. changes in relative access to resources.	High environmental load, e.g. emissions and water use, benefits and costs are borne by different groups and/or states.	Environmental security, Political ecology	Easter Island (mid-16 th century), Nigeria
Reduced security of	National, Local	Low adaptive capacity (economy/society	Increased cost of energy, volatile prices, exposure to	Development studies	Nigeria, India (2008-2009,

supply		dependent on cheap energy).	price increase.		2010-2011)
Interactions with food prices	(International), National, Local	Energy intensive food production, import dependency for staple foods, poverty/high share of income spend on purchasing food, high population density.	High energy prices, use of fertile land and agricultural crops.	Development studies	World food price crises (2007-2008), Arab spring (2010)

4.1 Level of analysis

Different levels of analysis expose different issues. International security can be affected by conflicts related to state behaviour and their interest in certain resources perceived to be of vital or strategic importance. However, international conflicts can also arise from changing or metastable conditions in the international system of states, such as local conflicts that magnify and make discontinuity in trends more apparent. This is related to interconnections and interdependencies between systems at regional or global scale, for example relationships between energy and food prices.

National security can be threatened by conflicts between or within a state. Conflicts between states can be related to a state using, or trying to use, energy as a means in a conflict, or to situations in which securing a feature of the energy system is an objective for a state. These conflicts can pose a threat to the interests or even survival of an exporting, transit or importing state. Conflicts within a state can occur in states that are resource-rich or resource-poor, if 'energy' has destabilised the state and thereby contributed to internal instability. In resource-rich states, this situation is associated with the 'resource curse' and in resource-poor states with rising prices for energy and/or food. In contrast, it is unlikely that resource-rich

states are destabilised by higher world market food prices, as they can be compensated by higher energy export revenues.

Besides exposure to conflicts between states, individuals may also be threatened by local conflicts related to environmental degradation, reduced security of supply or increased cost of food. Even if these conflicts are local, the driver does not have to be close in time and space. For example, the cause of environmental degradation can originate at a remote location (and time) but destabilise and contribute to local conflict. It is of particular importance to have sufficient capacity to adapt to change to prevent such conflicts.

4.2 Contextual conditions

Contextual conditions adopted in the framework describe social, economic and political factors relating to societies or individuals. The economic factors (e.g. economic diversity and development, and import dependency for energy and food) are important in conflicts where the energy system is an objective or means, since these determine whether conflict can be seen as resulting from rational behaviour. In conflicts where the energy system is a cause, the economic factors affect the capability of actors to respond to a situation in order to prevent it from developing into a conflict, i.e. it affects the adaptive capacity. However, these material conditions *per se* do not determine whether conflict will arise in a certain situation. Social and political factors (e.g. interests, norms and values) can affect behaviour and the tendency to resort to violence or seek a cooperative solution. For example, norms and values agreed by the international society contribute to shaping perceptions of territorial legitimacy, which affects what states consider to be legitimate behaviour. The trajectories towards increased globalisation and U.S. relative power have both been questioned [118]. It is beyond the scope of this paper to investigate the likelihood and consequences of such development. However, if such scenarios would materialise it is likely that several of the factors highlighted in the

framework would be affected, including foreign relations and the development of the international society.

4.3 Characteristics of the energy system

The characteristics of the entire socio-technical energy system, from supply of primary resources to final energy use, and its interactions with other systems determine the risk of conflicts. Characteristics of four parts of the energy system are summarised below: i) primary resources, ii) international energy markets, iii) infrastructure and iv) demand and final energy use. Interactions with other systems are then addressed.

One important characteristic of primary energy resources is their asymmetrical geographical distribution, i.e. in relative terms resources are abundant locally, but scarce globally. This affects incentives for actors, such as states, to accumulate and control resources over time and space. Low production costs, in relation to the market price, enable excessive resource rents. It is primarily a problem for non-renewable resources. However, local scarcity of renewable resources, caused by environmental degradation, can result in conflict if it induces stress in a society beyond its coping capacity.

Concerning international energy markets, the number and diversity of exporters, combined with the export volume and liquidity, shape a state's incentives to secure its own upstream supply of energy. This implies that access to a well-functioning upstream market reduces the incentive to use force in the competition for resources. It also reduces the incentive and possibility to use the energy weapon as can be illustrated with the current international oil trade that has institutions for global pricing to increase transparency and financial liquidity and a small but important share of physical delivery organised through the spot market. If these factors deteriorate or scarcity is perceived as a viable threat the risk of

conflict can increase. A further issue related to international energy markets is price level and volatility. These factors directly affect revenues for exporting countries and supply security.

Infrastructure is characterised by vulnerability to hostile attacks, bottlenecks and (spatial) concentration, which affects incentives to use the energy system as a means in a conflict. The increased use of computer systems and interdependencies with other systems enables not only physical, but also virtual, attacks.

End use characteristics that affect the risk of conflicts include: i) capacity to respond to a disruption (e.g. availability of substitutes) and ii) the severity of the disruption (e.g. cascading effect caused by interdependent systems). At the use and demand side, if societies and economies are vulnerable to disruptions, securing access to resources and maintaining uninterrupted flows are more likely to be perceived as a strategic objective. Therefore, vulnerability to disruptions increases the incentive to engage in a conflict in which the energy system is an object. Furthermore, vulnerability to disruptions renders more effective conflicts in which the energy system is a means. If economies, and subsequently societies, were less dependent on secure access to certain resources, e.g. breaking the prevailing petroleum regime in the transport sector, the motivation to use force to 'secure supply' could weaken substantially.

Finally, the energy system itself can affect the risk of conflicts through dependencies with other systems. The production, and cost, of food is one such system which is interdependent with the energy system. Another system is the natural environment, which can be degraded, reducing its carrying capacity. These relationships between systems enable perturbations, such as increased food prices, to spread and impact upon large geographical areas.

Some of the factors adopted depend on the energy resources as there are inherent differences between different renewables, conventional as well as unconventional fossil fuels and fissile material for use in nuclear power. Other factors are less dependent on the resources and more on the design of the infrastructure and end use technologies. It is therefore fruitful to not only analyse how different energy resources affects the risk of conflicts but also other parts of the energy system.

5. Discussion

In this study, different connections between energy systems and conflicts were examined and used to construct a conceptual framework. This framework demonstrates that conflicts related to energy systems do not occur in isolation, but in a political, economic and social context. The contextual conditions provide the main explanation for the underlying causes of conflicts. However, the characteristics of the energy system affect the incentive to engage in conflict. Therefore, analyses and forecasts of conflicts ought to include both the contextual conditions and the characteristics of the energy system. It can be useful to adopt an interdisciplinary approach in order to comprehend such different aspects. The proposed framework contains more varieties of conflicts, energy system characteristics and contextual conditions than previous frameworks, and partly builds on these. This enables analysing the risk of conflicts for different energy systems and contexts.

Characteristics of the energy system that affect actors' incentive and/or means needed to engage in a conflict, e.g. bottlenecks in infrastructure and transport systems, represent examples of important characteristics to evaluate. For such characteristics, predictions on the likelihood of conflict are sensitive to assumptions about actor rationale (e.g. norms and values). There are other characteristics which describe the system's interconnections and interdependencies with other systems. In this group, predictions of the likelihood of conflicts

are sensitive to assumptions about the capacity of humans and societies to adapt to change, for example environmental degradation (section 3.3.2) and food price increases (section 3.3.4). Because of these relationships, it can be useful to position the issues in the food, water and energy nexus (see e.g. Bazilian et al., [119]) and estimate both how threats to security and capacity to respond can develop.

Concerning contextual conditions, this paper shows that economic factors are important. Economic factors affect whether conflict can be a rational behaviour, and actor capability to respond to a situation, in order to prevent it developing into a conflict. On the other hand, social and political factors affect behaviour and actor's tendency to resort to violence or seek a cooperative solution.

It should be noted that there are also interactions between the different links and factors used as explanatory variables in this study. For example, securing the structure of the system can be a prerequisite to using the energy system as a political tool (decreased or disturbed flow). Another group of interactions is between the energy system and contextual factors. The context can affect the development trajectory of the energy system, e.g. energy policies, but the opposite can also apply. For example, in previous studies 'resource scarcity' has been proposed as a factor that will affect the international society. However, the outcome of the analysis differ since depending on the theoretical perspective, resource scarcity is assumed to increase collaboration [44-46] or the risk of conflict [39, 47, 48].

A future area of research can be to analyse a large sample of conflicts to test the validity of the framework, analyse frequency of the different categories and how different energy conflicts have evolved over time. Also, since the risk of future conflicts is the subject of academic debate [120], an important area for further studies could be to apply the framework to e.g. scenarios of future energy systems, in order to provide a more holistic view of how to

design future energy systems and limit the risk of conflicts. In scenario studies, a certain pathway can be analysed under different assumptions of contextual conditions in order to identify ‘hotspots’ and robust development pathways. This could provide insights to policymakers and enable better informed decisions.

Acknowledgements

This paper benefited from comments and discussions with a large number of people; in particular Bengt Johansson, Daniel K. Jonsson, Lars J. Nilsson and Hannes Sonnsjö. The author also wishes to thank the three anonymous reviewers for their valuable comments and the Swedish Energy Agency for financial support (project No. 33646-1).

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