Article:

Sainati, T, Locatelli, G orcid.org/0000-0001-9986-2249 and Smith, N (2019) Project financing in nuclear new build, why not? The legal and regulatory barriers. Energy Policy, 129. pp. 111-119. ISSN 0301-4215

https://doi.org/10.1016/j.enpol.2019.01.068

Project financing in nuclear new build, why not? The legal and regulatory barriers

Tristano Sainati, Giorgio Locatelli, Nigel Smith

Paper accepted on “Energy Policy”, 30 January 2019

ABSTRACT

This paper investigates the legal barriers to apply project finance for building nuclear power plants. Countries such as the UK, Turkey and emerging economies (i.e. Malaysia and Indonesia) are increasingly seeking to attract private investors for nuclear projects using project finance. This is an innovative approach, and until now the only cases registered are Hinckley Point C in the UK and Akkuyu in Turkey. This paper scrutinises the mismatches between the requirements of project finance and nuclear law. Nuclear law introduces specific requirements affecting the security interest of private lenders, hindering the bankability of nuclear projects on a non-recourse basis. The paper emphasises that the performance-based regulatory approach is more compatible with project finance compared to the prescriptive based one. Furthermore, the paper examines the gaps between nuclear and holistic energy law, looking at the financing of energy infrastructures. Improving nuclear law enables to apply project finance to nuclear power plants, facilitating their deployment. Consequently, nuclear law plays a central role in promoting sustainable energy mixes characterised by reduced carbon emissions.

KEYWORDS: nuclear law, energy law, project financing, Special Purpose Vehicle (SPV), Special Project Entity (SPE), sustainability

1. Introduction

There is a growing interest in energy law. Energy law scholars advocate the need for a holistic and cohesive energy law to improve the quality of decision-making of both judges and policymakers (Heffron et al., 2018; Talus, 2014). Traditionally, energy law was a heterogeneous field composed of sub-domains such as petroleum law, nuclear law, and others. The conception of energy law as a holistic and autonomous legal domain is relatively recent (Bradbrook, 1996), whilst its sub-domains have a long tradition. Energy law scholars identified common principles to enhance the consistency of the different sub-domains, as well as to guide the development of energy law toward a coherent evolution (Heffron & Talus, 2016b).

Nuclear law concerns the management of nuclear power and can be considered as a sub-domain of energy law. But if nuclear law is mainly concerned with nuclear safety and security, energy law has a broader focus. This paper assesses the dichotomy between nuclear law and energy law. In particular, it focuses on the application of a popular financing approach called Project Financing (PF). This financial method is widely applied to all types of power infrastructure with the exception of the nuclear sector. This paper identifies the major inconsistencies between the objectives of holistic energy law in comparison with nuclear law. The paper identifies the barriers of PF induced by nuclear law. Overcoming these barriers would narrow the gap between nuclear law and the holistic energy law.

Section 1.1 defines energy law, introducing the underlying principles and historical stages of development. Section 1.2 defines nuclear law, describes its focus and compares its stages of development compared to the holistic energy law. Section 2 introduces PF and highlights the requirements conflicting with nuclear law, namely: the completion risk and the security interest of lenders. Section 3 describes the aspects of nuclear law conflicting with the requirements of PF. Section 4 concludes with the applicability of PF to nuclear law. The understanding of PF enables the gap between nuclear law and energy law to be assessed. Energy and Policy Law

Energy law focuses on the management of energy resources (Heffron & Talus, 2016a). In particular, *"the allocation of rights and duties concerning the exploitation of all energy* resources between individuals, between individuals and the government, between governments *and between states"* (Bradbrook, 1996).

Energy law relates to energy policy, both law and policy address the trade-off between economics, politics and the environment; these trade-offs are also known as the energy trilemma, or triangle (Heffron, 2015). The economic aspects include the development of the electrical energy market, the trade in energy resources, and the financing of energy infrastructure. The political aspects focus on the country's energy security. Meanwhile, the environmental aspects focus on climate change (e.g. greenhouse emissions), as well as, air, water and ground pollution. Both law and policy are applicable internationally, nationally and at lower territorial level, e.g. regions, cities, etc. Governments formulate their energy policy based on a strategy that is then reflected in the energy law. Energy law incorporates standards, legal principles and mandatory provisions that regulate the production and supply of energy (Heffron et al., 2018).

In the last two decades, there has been a growing interest in energy law as an autonomous and recognisable domain of law (Heffron et al., 2018). The term energy law is relatively recent, and it was in traduced by Bradbrook's seminal paper in 1996 (Bradbrook, 1996). Legal thinking requires normative structures around developed legal domains, like criminal law, tort law, criminal law, etc. Heffron advocates for a holistic corpus of energy law enhancing the consistency and integration of legal norms, principles (Heffron & Talus, 2016b). Holistic energy law facilitates coherent jurisprudence that improves the quality and efficiency of court judgments. Holistic energy law favours the so-called "energy justice", which concerns the equitable aspects of energy management, including the affordability of energy for the society, as well as the environmental sustainability (Heffron & McCauley, 2017). Holistic energy law also enables more effective decision-making for policymakers (Heffron & Talus, 2016b). The creation of a holistic legal domain is also justified by the unique nature of energy law, which is intrinsically interdisciplinary and spans technological, socio-economic, political and environmental areas. Energy law requires consistency across all these areas justifying the development of a holistic legal domain (Heffron et al., 2018; Talus, 2013, 2014).

The recognition of energy law as a holistic domain is a relatively new concept, as most of the existing legal domains have long-lasting traditions. Similarly, the concepts of energy justice, environmental sustainability and the emphasis on climate change are all relatively recent ideas and concerns (Sovacool & Dworkin, 2014; Sovacool et al., 2016). Conversely, the sub-domains of energy law have a longer tradition and have evolved relatively independently. For example, the laws concerning fossil fuels and mineral extractions (e.g. lex Petrolia and lex mineralia) are relatively old and evolved separately from nuclear law, or the law regulating the electricity markets (Daintith, 2017; Talus, Looper & Otillar, 2012; Belyi & Talus, 2015). Fuel extraction and energy production are characterised by a variety of technologies, each with its own techno-economic features, and environmental implications. Furthermore, the management of energy resources is also country-specific, meaning that different countries have different policies that are reflected in their energy law. For example, some countries rich in minerals and fossil fuels focus on the extraction of oil & gas resources in order to foster their economic development. Conversely, other countries focus on energy security, developing policies that mostly concern on the diversification of the energy mix and fuel suppliers. Meanwhile, other countries concentrate on reducing greenhouse emissions by promoting low-carbon technologies. Since energy policy is country specific, energy law varies. Furthermore, both energy law and energy policy are deeply interrelated with other domains, such as environmental law, or the industrial policy (Talus, 2013; Heffron, 2015). These overlaps with other domains make it harder to define the scope of energy law.

To overcome the challenges coming from a dis-homogeneous energy law, scholars advocate for the creation of common energy law principles, which are not country or technology specific (Bradbrook, 1996; Heffron & Talus, 2016b). These main principles would constitute the basis for further integration of sub-legal domains of energy law. Under this perspective Heffron et al. propose seven main principles: (1) national resource sovereignty, (2) access to modern energy services, (3) energy justice, (4) prudent, rational and sustainable use of natural resources, (5) protection of the environment, human health & combatting climate change, (6) energy security and reliability, and (7) resilience, (Heffron et al., 2018). Overall, these principles should guide energy law and policy (Heffron et al., 2018).

To arrive at this holistic stage of development, energy law encompassed five main stages, as summarised in Table 1; these five stages highlight the trend in energy law. Internationally, the current priority to move towards a low carbon energy system. This idea of evolution is better described by the concept of JUST transition that is shared between climate, environmental and energy justice. JUST is the acronym made up of Justice, Universal, Space and Time; these are the four dimensions describing the facets of current energy law transitions (Heffron & McCauley, 2018). Three main forms of justice characterise JUST transition: distributional, procedural and restorative. JUST transition is universal in the sense that it is intrinsically recognised and it is internationally accepted. JUST transition takes place at multi-space levels, i.e. international, national and local. Time is a critical aspect of JUST transition as it brings the sense of urgency introducing chronological targets.

The maturity of the energy law varies across countries. Similarly, each sub-legal domain has its focus considering both the main principles of energy law and their stages of development. This paper considers the nuclear law as part of energy law. In particular, it assesses whether nuclear law is consistent with the general trend in energy law. To do so, the research focuses on the use of PF since it enables to clearly distinguish the stages of development of energy law compared to nuclear law.

Stage	Period and Background	Main focus of energy law
Stage 1	During the 19th and 20th century, the main source of energy production was coal. The health and safety aspects of the coal extraction were the main issues that energy law had to tackle.	Safety
Stage 2	After WWII particular attention was given to the geopolitical security of energy sources, in order to avoid future war conflicts.	Energy security
Stage 3	During the Cold War and after the oil crisis of 1970, the main focus was directed towards economic development. Neoclassic economics theories pushed some states toward the liberalisation of energy production.	Economic development
Stage 4	The early 2000s until recent times. Energy law focused prevalently on the promotion and support of energy infrastructure, attracting private investors.	Energy infrastructure development
Stage 5	From 2015 approximately, there was growing attention toward a more suitable and equitable energy impact into the society and environment, including the emphasis on climate change	Energy Justice

Table 1: The five stages of development, based on (Heffron & Talus, 2016a)

1.1 Nuclear law as a component of holistic energy law

This research focuses on nuclear law for the civil use of nuclear energy. With this respect, nuclear law can be considered as a branch of energy law (Handrlica, 2018). A formal definition of nuclear law is: *"the body of special legal norms created to regulate the conduct of legal or* natural persons engaged in activities related to fissionable materials, ionizing radiation and *exposure to natural sources of radiation"* (IAEA, 2003a). Nuclear law is based on eleven principles: nuclear safety, nuclear security, responsibility, permission, continuous control, compensation, sustainable development, compliance, independence, transparency, and international co-operation (IAEA, 2003a, 2010b). The main objective of nuclear law concerns the safe and secure management of nuclear material. In particular, the scope of nuclear law lies on nuclear safety, nuclear security, nuclear safeguards and nuclear liability.

Compared to the five stages of development of energy law, nuclear law seems to remain at the first stage of development: safety. The emphasis on nuclear safety and security is justified by the nature of nuclear technology, and its potentially detrimental effect on people and the environment. Major accidents such as Chernobyl in 1986 and Fukushima in 2011 demonstrated the potential for catastrophic effects from nuclear accidents, which in turn impacted heavily on the development of nuclear law (Heffron, 2013; IAEA, 2002). Furthermore, some intrinsic features of nuclear technology match some principles of energy law (e.g. energy security), which does not need to be codified in the nuclear law (Heffron, McCauley & Sovacool, 2015). For example, the nuclear energy favours energy security, because nuclear fuel is relatively cheap (per amount of energy produced) and energy intensive (in volumetric terms) meaning that it is possible to supply and store vast amounts of fuel from multiple suppliers (Corner et al., 2011; Watson & Scott, 2009). Another example concerns environmental sustainability because nuclear energy can replace coal or gas as a baseload technology reducing greenhouse emissions. Therefore, nuclear law does not need to emphasise the sustainability of nuclear energy.

Despite its potential, the generation of electricity by nuclear energy is controversial, and while some countries promote it, for example France and South Korea others exclude it due to public opposition relating to radioactivity, potential accidents, location of plants, (Esposto, 2008), including. Ireland, Italy and Austria. Meanwhile, before the Chernobyl accident, many countries promoted the use of nuclear energy (Adamantiades & Kessides, 2009). However, major nuclear accidents such as those at Three Mile Island 1979 and Chernobyl 1986 had severe detrimental effects for the nuclear sector (Hayashi & Hughes, 2013). Before these accidents, nuclear law was primarily focused on economic development, in line with the Stage 3 of energy law. However, after the occurrence of these accidents, the focus shifted swiftly towards the nuclear safety and security aspects. After Chernobyl, many countries (e.g. Italy and Spain) abandoned, or suspended, their nuclear programme, along with major investments in research and development. For some years the development of nuclear programmes stalled even though a notable exception, South Korea continued. This was the case until the so-called "nuclear renaissance" of the early 2000s. However, the Fukushima accident had a major impact on public acceptability, and comparably to Chernobyl, it either stopped or slowed down the development of nuclear energy worldwide.

Nuclear law is still mainly focused on nuclear safety and security. The major accidents stopped the evolution of nuclear law; indeed, it had regressed from stage three (economic development) to stage one (safety). The extensive focus on nuclear safety and security has major implications on the economics of Nuclear Power Plants (NPPs), which are extremely challenging projects exacerbated by the prescriptiveness of safety norms and standards (IAEA, 2010b, 2003a, 2002; Heffron, 2013).

However, recent examples, particularly in the UK, showed a growing interest in attracting private investors to consider investing in nuclear power using PF (IAEA, 2014). PF has been widely used in all other types of energy infrastructure, including coal, CCGT and wind (Wang & Tiong, 2000; Kann, 2009; Esty, 2008). The wide use of PF in energy infrastructures is associable to stage 4 (Section 1.1 – Table 1), which deals with energy infrastructure development.

In the nuclear sector, the early attempts of PF include Hinkley Point C in the UK and Akkuyu in Turkey (IAEA, 2014). These nuclear projects are applying, for the first time in history, a nuclear development PF, which has about thirty years of experience in other energy infrastructures. Remarkably, in the nuclear sector, PF is not directly applicable to many jurisdictions because nuclear law is still outdated and act as a major obstacle to PF.

This paper identifies the barriers to PF derived from the mandatory provisions of nuclear law. This first step concerns the necessity to improve nuclear law, making it more consistent with the future development stages of the holistic energy law. Improving nuclear law would give effect to the concept of JUST transition characterising the current trend in energy law (Heffron & McCauley, 2018). In particular, improving the nuclear law would make deployment of NPPs more feasible in some countries, reducing the carbon emissions worldwide.

To investigate the barriers of PF derived from nuclear law, it is crucial to consider the technicalities of both PF and nuclear law. PF requires the confidence of private investors who are assured by favouring banking, security and bankruptcy law. These aspects are discussed in Section 2.

2. The Project Financing of energy infrastructure

Several authors have propounded the idea of using PF (Finon & Roques, 2008; Barquin et al., 2010) in the nuclear industry. NPPs are capital intensive projects that require the support of policy and decision makers (IAEA, 2006a). Because of the higher investment risk, the cost of financing NPPs is higher than Coal plants or Combined Cycle Gas Turbine (CCGT) (Taylor, 2016).

For nuclear programmes, the financing is a major challenge, especially when compared to other infrastructure sectors, for example conventional power projects, waste, and transportation. PF can be utilised to overcome this challenge. In PF, the public provides limited and indirect forms of financial support (e.g. public concessions, financial guarantees and other similar measures), enabling the private sector to finance and develop infrastructure and deliver public services (Esty, 2008). The liberalisation that took place during the '80s in Europe paved the way towards a novel financial and contractual techniques attracting private investors (Yescombe, 2013). The most significant technique is represented by PF (Vinter, Price & Lee, 2013). PF is *"the financing of the development or exploitation of a right, natural resource or other asset where the bulk of the financing is to be provided by way of debt and is to be repaid principally out of the assets being financed and their revenues."* (Dentons, 2016)

Early examples of PF can be traced back to the Renaissance. The development of the railway infrastructure in the UK in the 18th and 19th century further developed PF (Finnerty, 2011). However, it is only in the last 20-30 years that PF evolved due to the worldwide deregulation and liberalisation of public infrastructural services. Some of the modern financial techniques can be traced back to securitisation which was first introduced in the '70s in the US by the "Government National Mortgage Association" (Ginnie-Mae) (Ketz, 2003). Since then, securitisation inspired new ways of exploiting PF in risky projects like off-shore platforms in the North Sea in the '90s, or power plants in the US in the '80s[1]. In the '90s the Private Financing Initiative (PFI), in the UK, and other options became a part of the overall assessment of Public-Private-Partnerships, PPP (Bing et al., 2005). The PFI was adapted to a broad range of infrastructures, including roads, prisons, schools, hospitals, power plants and others (National Audit Office, 2006).

PF is often compared to corporate finance. In PF, the debt is lent to an incorporated entity representing the project called Special Purpose Vehicle (SPV), or Special Purpose Entity (SPE), i.e. *"a fenced* organization *having limited predefined purposes and a legal personality"* (Sainati, Brookes & Locatelli, 2017). In corporate finance, lenders, lend money to the project sponsors. This has at least two key implications.

Firstly, corporate finance is a form of "on-balance sheet financing", and the project debt is considered in the sponsors' accounting statements. Lenders provide funds to the sponsors and not to the project directly. PF is instead an "off-balance sheet financing" as the debt to finance the project is not revealed on the accounting statements of the sponsors[2]. PF represents, therefore, a major opportunity for the sponsors who can expand their borrowing capacity, with limited repercussions on their credit metrics (Dailami & Leipziger, 1998; Esty, 2003).

Secondly, in corporate finance, the capital is subject to the financial risk of the sponsors overall, and not to each project independently. If the sponsor bankrupts, lenders might lose their capital. Sponsors are usually large utilities that have differentiated investments and assets. Their credit risk depends on their multiple activities, investments and contractual obligations. For example, an utility might own different power plant technologies, such as coal, nuclear, CCGT, etc. In case of liquidation of the sponsor, lenders can have recourse to its assets to recover part or all

[1] One of the first laws devoted to project finance were: finance for independent power projects ("IPPs"), and the Private Utility Regulatory Policies Act (PURPA) 1978

[2] This statement is generally valid. However, SPVs might have special accounting treatment in some jurisdictions. For example, it could be mentioned in the footnotes of the accounting statements.

of their lent capital. Therefore, corporate finance is often "collateralised" that is to say the debt is backed by collaterals provided by the borrower, or sponsor (Gatti, 2018).

In PF, the SPV is the borrower on behalf of its sponsors (Nevitt & Fabozzi, 2000). The SPV has no assets when debt is lent and is a brand-new incorporated vehicle for the specific project; legal known as a "Man of Straw". Because of the "bankruptcy remoteness", the SPV reflects the credit risk of the project and not of its sponsors (Wood, 1995). From the lenders perspective, the SPV has no assets to be used as collateral (Gatti, 2018); therefore, PF is a form of "non- recourse finance, or limited recourse finance" (Finnerty, 2011). In practice, to make PF bankable, lenders might require collaterals, leading to "semi-recourse" finance (Vinter, Price & Lee, 2013). Additionally, in PF, the debt is "artificially" secured using contracts and concessions safeguarding future cash flows from operation making the project business critical for PF.

These two features would be particularly beneficial for the sponsors of NPPs. However, these advantages for sponsors are somehow counterbalanced by a higher risk exposition of lenders. Therefore, a legitimate question might be: Why would lenders provide debt to the SPV, with no or limited collateral at a lower cost? The answer lies in the concept of bankability.

2.1 Bankability of PF transactions

Bankability concerns the acceptability of risk balance between the project investors (Finnerty, 2011). To be "bankable" PF transactions require a sustainable balance of risk between lenders, sponsors and other critical project stakeholders (Flyvbjerg, 2013); together with the rigour of non-recourse revenue generation.

In PF, lenders provide the most significant portion of the capital (i.e. 70-95%); therefore, they usually constitute the most significant and conservative investors (Gatti, 2018). For these reasons, the research focuses on the lender's perspective of in bankability requirements for PF.

In the literature, the bankability is addressed by (1) bank syndication, (2) accurate due diligence, (3) governance, and (4) reputation of sponsors.

Firstly, PF lenders are often organised in syndicates of banks (Gatti, 2018), i.e. consortia linking different financial institutions (Nevitt & Fabozzi, 2000). The syndication of banks has specific governance mechanisms simplifying the negotiation and administration of syndicated loan. Bank syndication allows banks to share and diversify the financing risks.

Secondly, due diligence allows better scrutiny of the projects (Vinter, Price & Lee, 2013; Delmon & Delmon, 2010) enhancing the Front-End Engineering Design (FEED) creating the preconditions for better projects (Artto, Ahola & Vartiainen, 2016; Merrow, 2011). Lenders of large capital sums are usually conservative investors (Nevitt & Fabozzi, 2000) influencing many project aspects including the selection of both technology and suppliers. Lenders favour proven technologies and stable contests in terms of economy, policy and law (Gatti, 2018).

Thirdly, PF transactions are based on a coherent nexus of enforceable instruments producing the governance structure for the project. Lenders are the main financiers, and they have significant trading power as they require pervasive controlling powers toward the activities and performances of the SPV (Vinter, Price & Lee, 2013). Sometimes, lenders appoint shadow directors to the SPV’s board of directors having special veto power on critical decisions regarding changes of the project plan or budget. Additionally, lenders often impose independent auditors and technical assessor for the acceptance of project deliverables. These governance measures provide further confidence to lenders, enabling the financing of the project.

Finally, reputation is a key intangible asset supporting PF. The sponsor's misconduct affects their reputation in limiting their ability to further obtain non-recourse financing (Vinter, Price

& Lee, 2013; Gatti, 2018). Sometimes sponsors would rather be at a loss in a venture in order to maintain their reputation, which is critical for PF.

In summary, these four aspects explain why in certain circumstances PF can be inexpensive for sponsors and relatively secure for lenders. Moreover, the notion of enforceability is paramount in PF because part of the collateral lies on future cash flows generated by the project and secured by contracts, concessions and similar enforceable instruments. The legal context plays a vital role, concerning PF the most relevant branches of law are: banking, insolvency and security, corporate, contract, tort, and construction law.

2.2 Requirements of PF

This section focuses on the essential requirements for PF considering two main aspects: (1) the completion risk, and (2) the security interest. The features of nuclear projects clash with these fundamental requirements; this is why the article focuses extensively on them.

Firstly, lenders have a negative attitude toward construction risk concerning: site acquisition and access, permits, risks relating to the EPC Contractor, construction cost overrun, revenue during construction, delay in completion, inadequate performance on completion, and third-party risks (Yescombe, 2013). From the lenders' perspective, the project is bankable if future cash flows (or other forms of guarantee) are secured. In the nuclear sector, the most critical stage is the construction phase because the cost amounts to billions of dollars with no positive cash flows causing maximum lock-up in the project. Some types of infrastructure can generate partial earnings during the construction phase, e.g. a hospital can begin its procedures in specific wings, while other areas have not been completed yet. NPPs do not generate any revenue until all the facility is fully built, commissioned and approved by an independent safety authority called Regulatory Body (RB).

Lenders privilege projects characterised by limited completion risk (Tiong Robert L. K., 1995; Gatti, 2018), e.g. known technology, limited size projects, established and experienced contractors, etc. Usually, all these characteristics do not apply to NPP projects (Barkatullah & Ahmad, 2017; Boyd, 2008). In general, lenders attempt to transfer the completion risk from the SPV to experienced contractors. Usually, Turnkey - Engineering Procurement Construction (TK-EPC) contracts (Clough et al., 2015; Hughes, Champion & Murdoch, 2015; Jr et al., 2014; Uff, 2013) are often used as a prime contract between the SPV (i.e. the client) and a qualified EPC company (i.e. the main contractor) (Vinter, Price & Lee, 2013). As TK-EPC contracts favour the maximum transfer of completion risk from the SPV to the main contractor (or prime contractor). Additionally, construction performance is typically secured by insurance, performance bonds and similar instruments (Finnerty, 2011). However, it is impossible to completely exclude the competition risk, especially in large projects (Merrow, 2011). Construction contracts (including the TK-EPC) have provisions limiting the damages that can be claimed by the contractor. For example, in the Olkiluoto 3 (OL3) NPP project, the maximum penalty clause, for delay, was reflected by the 10% of the project budget, so even though the project was several years overdue and severely over budget, the penalty clause will remain consistent (Ruuska et al., 2011, 2009). Moreover, in the UK the contracts and construction law exclude the use of penalties for the contractor (Uff, 2013; Hughes, Champion & Murdoch, 2015).

In practice, it is extremely difficult to transfer entirely the completion risk from the SPV (client) to contractors also because of the nature of construction procurement and the contracting network. In large infrastructural projects, there are hundreds of companies involved. The prime contract between the client and the main contractor is further into subcontracting chains. The lower contracting levels are decoupled from the prime contractor consistently with the doctrine of privity in contracts (Furmston, 2017). Procurement processes favour the creation of subcontracting chains, leading to a complex and remote[3] contractual network. In such cases, each contractor transfers most of the risks "back to back" from its client to its subcontractor(s) (Jr et al., 2014; Hughes, Champion & Murdoch, 2015). Accordingly, some critical provisions contained in the sub-contracts mirror the prime contract, i.e. between the client and the prime contractor. This shifts the completion risk from the client to remote contractors who are not able to transfer the risks to any other actor. The completion risk is quickly dispersed in hundreds of small sub-contractors leading to complex risk patterns. For example, a small subcontractor might cause economic damage significantly more substantial than its capitalisation, leading to its bankruptcy. In such a scenario, the project would be delayed, or even stopped, in order to replace the sub-contractor. Additionally, litigation between contractors creates further delays as well as cost overruns. The underperformance of the project would hit back the SPV and the lenders, making the contractual remedies ineffective. Furthermore, for the doctrine of priority in contracts (Furmston, 2017) there would be no contractual obligations between the underperforming subcontractor and the SPV.

In light of this, it is clear that lenders are particularly averse in financing projects characterised by relevant completion risk. This negative attitude to completion risk conflicts with nuclear projects as further discussed in Section 3.2.

Secondly, PF has links with insolvency law, particularly concerning the so-called "security interest". "A security interest gives a creditor prior propriety rights over an asset – the collateral –which enables the creditor to realise the collateral to pay the secured debt ahead of most other unsecured creditors of the debtor. The security interest is a separatist on insolvency, i.e. the collateral does not fall into the pool available for unsecured creditors. A

[3] The term "remote" is a legal term widely used in many branches of law, including contract, tort, criminal, etc. In this context, the term refers to the contractual distance between the client and the subcontractors that effectively undertake the construction works.

security interest is primarily a protection against the insolvency of the debtor since normally if the debtor remains solvent the creditor has no need for *the priority propriety right. […] the* essence of security is that the creditor, if unpaid, can force a sale or other realisation on the propriety and use the proce*eds to pay the secured debt ahead of other creditors"* (Wood, 2007). In PF, little or no collateral is available for securing the project debt. The delivering infrastructure is a tangible asset, available only at the end of the construction period. The effective guarantees for lenders lie on the enforcing instruments either by securing the revenues streams (e.g. off-take contracts) or by providing a temporary monopoly to the SPV (e.g. public concessions). Therefore, these intangible assets can be considered an indirect form of collateral for the debtor that falls under the definition of security interest.

Insolvency law is country dependent. Wood classifies the insolvency law regimes showing the strong correlation between the legal traditions and the insolvency framework (Wood, 2008, 2007). Common law jurisdictions (particularly the UK) provide a deregulated context favouring security interest. Conversely, Napoleonic and Islamic jurisdictions don't favour the security interest. Roman-Germanic are mixed jurisdictions as they partly support the security interest (Wood, 2008).

The security interest is a particularly complex topic, and different jurisdictions can be compared by a multiplicity of factors. Wood (Wood, 2008, 2007) compared different jurisdictions adopting several legal tests, some of the most relevant for PF include:

1. The scope of security considers which class of assets can be covered by the security interest.
2. Perfection focuses on whether the creditor must have "full public possession and delivery of the assets" in order to have security on it.
3. Secured debt considers whether it is possible to secure future and dynamic assets as opposed to real and static ones.
4. Security trustee considers whether it is possible to employ the instrument of Trust.

5. Transfer deems whether the transfer of assets can take place by novation or it requires ownership with consequences on the owner balance sheet. Novation is the act of amending contracts, i.e. substitute the contract (or part of it) with a new one.
6. Enforcement contemplates a variety of aspects and procedures associated with the execution of the security interest. For instance, enforcement considers whether, during the liquidation, the enforcement of security requires a public auction, the involvement of the court, a public administrator, or other mechanisms.
7. Priority toward unsecured creditor focus on the extent to which it is possible to rank ahead of secured creditors against unsecured ones.
8. Costs and taxes consider the general cost of creating security, by carefully viewing taxes, legal expenses and administrative fees.

A strong security interest is essential in PF (Wood, 1995). If the security interest is weak lenders are not able to secure their debt and subsequently reluctant to lend the money to the SPV. Other banking and insolvency aspects relevant for PF are:

- The ability to transfer contracts with limited prescriptions and publicity requirements;
- Favourable insolvency policies for secured creditors.

Particularly important is the insolvency law regulating the bankruptcy and liquidation processes, leading to alternative routes such as private "work-outs", judicial reorganisations or liquidations (Wood, 2007; Finch & Milman, 2017). Equally relevant are the insolvency policies distinguishing between various approaches, i.e. set-offs vs close out and settlement nettings (Wood, 2007).

Deregulated contexts favour PF because lenders can introduce sophisticated mechanisms to secure their capital with no (or limited) physical collateral (Wood, 2007). When PF transactions are negotiated, lenders have strong bargaining powers as they are lending a vast capital to a brand new company (i.e. the SPV) without having collateral or capabilities (Fabozzi, 2012; Sainati, Brookes & Locatelli, 2017). In a deregulated context, lenders can counterbalance their risk exposition with controlling powers and rights, making projects bankable. Equally important is the ability to time and cost-effectively enforce contractual obligations (Vinter, Price & Lee, 2013).

3. The impact of nuclear law on project financing

The accidents of Three Miles Island and Chernobyl (IAEA, 1992) raised a global concern toward the safety of NPP and the cross-boundary effects of nuclear accidents. The enhanced safety requirements, imposed after the accidents, increased the NPPs' construction period and costs (Moreira, Gallinaro & Carajilescov, 2013; Koomey & Hultman, 2007).

Nuclear law lies in international and domestic legal and regulatory frameworks. Internationally, two main institutions spear the concerns about safety and security by promoting the ratification of multilateral conventions, as well as bilateral treaties, i.e. the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA) a branch of the Organisation for Economic Co-operation and Development (OECD). Furthermore, other regional institutions such as the European Union promote the development of international law. The international nuclear law is relatively consistent in its principles and approaches, due to the vast corpus of international nuclear law that covers aspects such as (Nuclear Energy Agency OECD, 2017): nuclear safety and radiological protection, emergency response and management, radioactive waste management and decommissioning, environmental protection, nuclear security and physical protection, non-proliferation, safeguards, liability and compensation for nuclear damage, and export control and international trade. Domestically, each country establishes nuclear laws, including the creation of institutions such as RBs (IAEA, 2003b). Domestic nuclear law includes detailed administrative rules and regulatory provisions (IAEA, 2002).

Therefore, nuclear law is made up of hard and soft laws focusing on nuclear-related matters (IAEA, 2010b). Nuclear law includes (IAEA, 2002, 2010b):

1. International law composed of conventions and bilateral treaties;
2. Domestic law dedicated explicitly to the nuclear-related matters;
3. Technical regulations issued by tailored administrative bodies;
4. Non-binding guidelines.

Domestic law and the regulatory framework are often classified by two archetypical approaches, namely: prescriptive based, and performance-based. The prescriptive based approach is founded on detailed mandatory requirements using explicit tests limiting the uncertainty of licensing processes. Examples are the French and the Finnish licensing processes (Bredimas & Nuttall, 2008; IAEA, 2012; Locatelli et al., 2011). The performance-based approach (also called goal setting) is based on general principles and objectives. The performance-based approach provides greater flexibility to demonstrate the achievement of the safety objective. Performance-based licensing processes are often complemented by extensive non-mandatory guidelines to reduce the uncertainty and ambiguity related to the regulatory decision-making. One of the best examples of performance-based approach is provided by the British licensing process (Bredimas & Nuttall, 2008; IAEA, 2012).

Nuclear law is a crucial determinant of every nuclear programme (IAEA, 2001, 2010a). The RB is a critical stakeholder (IAEA, 2007) having four main responsibilities: (1) Regulating the nuclear activities, (2) licensing NPPs, (3) Inspecting (4) enforcing[4] uncompliant behaviours. Once the RB is ready to fulfil its functions, the first NPPs can initiate the licensing, a pre-requisite for construction and operation. Licencing is the administrative process where the RB (and other institutions) assesses the safety of a NPP design. If successful, the applicant becomes licensee by obtaining a nuclear license defined as a *"legal document issued by the regulatory* body granting authorization to perform specified activities relating to a facility *or activity."* (IAEA, 2016)

Licensing plays a central role in the regulatory control of NPPs, and it is a critical barrier for PF. The licensing process impacts mostly on the construction phase of the NPP, which also coincides with the most critical phase for PF as it affects the completion risk directly.

[4] Civil administrative proceedings and fines as opposed to criminal ones that exclusive to the judiciary

Overall, nuclear law plays a fundamental role in the feasibility of PF in the nuclear sector. The previous sections described some of the most critical requirements for PF: (1) low completion risk, and (2) strong security interest for lenders. These requirements conflict with specific features of NPP projects, derived from the legal and regulatory framework: (1) prescriptive regulatory requirements, (2) extensive completion risk, and (3) limiting nuclear liability regime. Each of these three features is further discussed in the following subsections.

3.1 Prescriptive regulatory requirements

The licensing process can impose provisions conflicting with the legal requirement of PF; in particular: (1) ownership requirements, (2) indivisibility between operator and licensee, (3) capabilities required for the operator/licensee, and (4) financial requirements. These requirements can be limiting for PF when codified explicitly, consistently with the prescriptive-based regulatory approach (Bredimas & Nuttall, 2008; Sainati, Locatelli & Brookes, 2015; IAEA, 2010c).

Firstly, ownership requirements[5] are justified for safety and security reasons. Ownership requirements focus on nuclear-related assets including the NPP, the nuclear site, the intellectual propriety, and the nuclear fuel. Typically, the "real assets" can be owned exclusively by the operator/licensee; meanwhile, the intellectual propriety has a separate regime; the ownership is often shared between the reactor vendor and the operator. Ownership requirements affect directly, and indirectly, the security interests of lenders. Directly, lenders cannot use any nuclear asset as collateral for their loan. Lenders cannot own nuclear assets or sell them because only the operator/licensee is entitled to own them. This is a crucial difference with other energy infrastructure. Usually, any type of investor can own a power plant with no or very limited restrictions. Conversely, in prescriptive based jurisdictions, the ownership of NPPs requires the

[5] Typically, the ownership requirements are introduced by domestic laws and regulations. For example, in the USA, ownership requirements are stated by the Section 104d of the Atomic Energy Act of 1954, and by the implementing regulations: Section 50.38 of Title 10 of the Code of Federal Regulations (10 CFR).

compliance of prescriptive norms that are assessed by the RB for safety and security reasons. Typically, the owner of the NPP is the operator/licensee of the facility. Indirectly, ownership requirements might constrain the ownership of the operator/licensee to national companies, as some countries (e.g. the USA) forbid foreign investors to cover positions of control of the utility/ SPV or even the operating of NPPs. In PF, the deputy operator/licensee is the SPV. The ownership and control of SPV is a matter of paramount importance for the security interest of lenders. Ownership requirements affect the ability of lenders to redeem the project in insolvency situations. As a result, ownership requirements alone are a critical barrier to PF from the lenders perspective.

Secondly, indivisibility between the operator and the licensee can be another obstacle for PF. Internationally, nuclear laws are based on the principle that the nuclear operator is the nuclear licensee (IAEA, 2006b, 2002). In most PF schemes, the operator and the licensee (or concessionaire) are separate entities. From the perspective of lenders, the SPV shall not be affected by any significant risk, including the operational ones. The relationship between the operator and the SPV is formalised by the Operation and & Maintenance contract. This argument is critical because the operation of NPP involves greater risks (e.g. technical and political risks) compared to other types of power plants (Miller & Lessard, 2001). The inability to separate the role of the licensee to the operator affects the security interest of lenders (Section 3.1).

Thirdly, capabilities required for the operator/licensee (IAEA, 2010c) could inhibit the adoption of PF in nuclear. In PF, the SPV is the deputy to be the operator/licensee. However, the SPV has no assets, capabilities or expertise at the time it is incorporated. The explicit and prescriptive requirements focusing on the capabilities for the licensee exclude the possibility to use the SPV as operator/licensee, which constitutes a significant impediment for PF.

Finally, financial requirements focus on the finical solidity of the operator/licensee (IAEA, 2002). Financial requirements can include:

- The operator/licensee shall not bankrupt because of the critical safety responsibilities. In case of bankruptcy of the operator/licensee, the state undertakes the responsibility of the NPP. However, this would be a last resort solution, and the financial requirements aim to make this scenario remote;
- The financial requirements include specific plans for the decommissioning. Usually, the legal and regulatory framework imposes a long-term plan aiming to create a decommissioning fund during operations. Financial requirements conflict with the finical solidity of the SPV, which is the deputy operator/licensee in PF. Regardless of the amount to be paid to for the decommissioning fund, the operator/licensee must demonstrate its financial solidity. However, SPVs are characterised by a vast debt and limited collateral for the investors, i.e. high financial leverage. The high financial leverage conflicts with the most basic financial requirements.

In summary, the prescriptive regulatory requirements can be a barrier for PF. The requirements forbid the SPV to be the operator/licensee, i.e. the capabilities required for the operator/licensee, and the financial requirements. This happens because the SPV is a newly incorporated company with no assets or capabilities. Furthermore, the prescriptive requirements affect directly the security interest of lenders (section 3.1). Without the support of lenders, PF is unlikely to take place.

3.2 Extensive completion risk characterising nuclear projects

Usually, PF is suitable for those projects characterised by limited completion risk (Section 2.2). However, all recent NPPs developed in, high-income countries, demonstrate a significant completion risk (Heffron, 2013). For instance, the OL3 project suffered severe delays and over budget due to licensing problems (Ruuska et al., 2009). The construction site was shut several times by the RB. The RB also forced the reconstruction of the base slab due to the inconsistency to prescriptive regulatory requirements concerning the porosity of the concrete. The NPP called FL3 in France employed the similar technology of OL3. Similarly, FL3 suffered major delays and over budget also due to licensing problems (Ruuska et al., 2011). Recently Westinghouse was bankrupt due to an over-budget NPP located in the US (Michael & J, 2017). All these examples highlight the completion risk in NPP projects derived from the legal and regulatory framework.

In summary, NPP projects are affected by a significant completion risk, making them difficult to be financed on a PF basis. The obstacle is particularly critical if considered in conjunction with the other barriers discussed in Sections 3.1, 3.3.

3.3 Limiting nuclear liability regimes characterising nuclear projects

Internationally, the nuclear sector is characterised by a unique liability framework taking the name of "nuclear liability regimes". Historically, the first nuclear liability regime was the Price-Anderson Act of 1957. Starting from the early stages of nuclear development, several countries started implementing ad hoc "nuclear liability regimes" (IAEA, 2010b; Nuclear Energy Agency OECD, 2017). The accidents of Three Miles Island and Chernobyl fostered the expansion of nuclear liability regimes worldwide. Internationally two main regimes evolved, one associated with the OECD (which was mainly connected to Europe during the early stages of development), and the second associated with the IAEA as summarised in Table 2. Recently the IAEA and the OECD promoted a further harmonisation between the two regimes, resulting in a third, harmonised nuclear liability regime.

OECD Nuclear Liability Regime	IAEA Nuclear Liability regime
Paris Convention on Nuclear Third Party Liability 1960	Vienna Convention on Civil Liability for Nuclear Damage 1963
Brussels Convention Supplementary to the Paris Convention 1963	Protocol amending the Vienna Convention on Civil Liability for Nuclear Damage 1997
Protocols amending the Paris + Brussels Supplementary Conventions 2004	Convention on Supplementary Compensation for Nuclear Damage 1997
Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention 1988	

Table 2: International conventions establishing nuclear liability regimes (Heffron, Ashley & Nuttall, 2016)

Regardless of the international differences, the three regimes have in common at least seven main principles: (1) strict liability, (2) channelling the liability to the operator, (3) limitation of liability in time, (4) limitation of liability in amount, (5) mandatory insurance, or other financial security, (6) jurisdiction and (7) applicable law (Heffron, Ashley & Nuttall, 2016).

In all nuclear liability regimes, the nuclear operator/licensee is strictly and exclusively responsible for nuclear accidents. The nuclear liability is alleviated by limitations in time and amount. These principles are designed to favour legal certainty in case of nuclear accidents, allowing clear and efficient compensation for citizens and businesses. Nuclear liability regimes substitute the traditional provisions available in tort provisions to the ad hoc provision, which are exclusive to the nuclear sector (IAEA, 2002).

The strict and exclusive liability of the nuclear operator/licensee introduces a further constrain limiting the applicability of PF. As described in Section 3, a fundamental design principle of PF is the ability to de-risk the SPV. In PF, the SPV acts as the operator/licensee, who cannot transfer the risk of nuclear accident to other stakeholders. In practice, the risk is partly shifted to mandatory insurances, and it is limited in time and amount. However, the strict and exclusive liability reduces the flexibility in transferring the nuclear risks to external contractors. As a consequence, the SPV and lenders must bear part of the nuclear risk, particularly in countries where the limitations in amount, exceed the minimum requirements introduced by the international nuclear regimes. A remarkable example is Japan where the Fukushima accident demonstrated the inconsistency between the amount guaranteed by the international regimes and the actual damage of the nuclear accident. Consistently, the third- party liability regimes constitute a further obstacle towards PF in the nuclear sector. This barrier is synergic with the barriers introduced in the previous Sections 3.1-3.2.

4. Discussion and conclusion

PF is widely applied in the energy infrastructure with exception of the nuclear sector. The paper examined the barriers introduced by nuclear law, as well as understanding the characteristics of NPPs. Financing a NPP on PF basis it is possible, but the following barriers inhibit the application of PF to NPPs: (1) prescriptive regulatory oversight, (2) vast completion risk, and (3) limiting nuclear liability regimes. These three barriers conflict with two PF requirements:(1) low completion risk, and (2) strong security interest for lenders.

The pervasive role of nuclear law is inconsistent with the PF requirements of having a deregulated context, particularly on matters such as ownership, control, insolvency, contracting and financing. The pervasive role of nuclear law is a significant barrier, particularly when it is based on prescriptive mandatory requirements. Conversely, performance-based regulatory systems are deemed to be more flexible and can better suits PF compared to prescriptive ones.

It is possible to overcome or at least mitigate these barriers by hindering PF in the nuclear sector. Firstly, a strong banking law, and in particular a strong security interest, is required. This aspect does not relate to nuclear law, but it is essential in PF. Secondly, a flexible licensing process such as the performance-based approach is more suitable for PF. The traditional prescriptive based approach could impose critical obstructions for PF, particularly concerning the (1) ownership requirements, (2) indivisibility between operator and licensee, (3) capabilities required for the operator/licensee, and (4) financial requirements.

It is unlikely that PF in the nuclear sector is employed as a pure form of non-recourse financing in the short term but in a prescriptive based framework. Most likely, the PF transactions would require the support (in the financial sense) of actors such as the Government in the form of credit enhancement such as credit guarantees schemes. This is consistent with the Hinkley Point C (HPC) in the UK, which is the first attempt of PF in the nuclear sector (Černoch &

Zapletalová, 2015; IAEA, 2014). HPC is characterised by two main forms of public support. Firstly the contract for different secures at a fixed price of the electricity generated for 30 years (Taylor, 2016; GOV.UK, 2016). Secondly, a public fund guarantees the project leaders against the default of the SPV (National Audit Office, 2015). The public support is befitting also because the application of PF to NPP is relatively recent and would require some prior experience to convince private investors, who are primarily concerned by completion risk, especially since the track record of nuclear project performance in the past has been mediocre.

The impediments of PF in the nuclear sector have implications for energy law and its consistency. In order to be an autonomous and holistic legal domain, energy law would require consistency between different sub-domains. Generally, the seven principles characterising energy law (Section 1.1) should apply to nuclear law. The practical application of these principles relays extensively on the stages of development of energy law, which are: stage 1 – safety, stage 2 - energy security, stage 3 - economic development, stage 4 - energy infrastructure development, and stage 5 - energy justice. While most energy technologies are found between stage 4 and 5, nuclear law seems to be focused almost exclusively on safety and security, which is yet the first stage of the stages of development of energy law. This focus is justified after the major nuclear accidents that occurred, including Chernobyl in 1986 and Fukushima in 2011. However, the international trend in energy law does not seem completely reflected in nuclear law. To enhance the consistency within the holistic energy law, nuclear law should progress toward the later stages of development of energy law.

For instance, energy law should evolve to favour the development of nuclear infrastructure, in line with stage 4. Amending the nuclear law does not mean compromising on critical matters such as nuclear safety and security. Conversely, amending the nuclear law would reflect a more holistic and balanced set of objectives including the smooth development of energy infrastructure, which would be facilitated with small and ad hoc changes meanwhile not compromising, affecting the nuclear safety and security. For example, this paper assessed the feasibility of PF in the nuclear sector by identifying the challenges to overcome, particularly in relation to nuclear law. Overcoming these challenges would strengthen the consistency within the sub-domains composing energy law. Additionally, enabling PF in nuclear would promote a low carbon energy technology, therefore promoting the JUST transition of energy systems.

Enabling PF in nuclear is a practical improvement to nuclear law. It is also a pragmatic example showing how a branch of energy law can affect at least two (out of seven) principles of energy law, namely: (1) protection of the environment, human health & combatting climate change, (2) energy security and reliability. Firstly, overcoming the barriers to PF would promote the development of NPPs, reducing the carbon footprint of energy production. Secondly, nuclear is a dispatchable, reliable and secure technology to produce power and electricity, which is often not deployed for financial constraints. The empowerment of these (and others) energy law principles is interdisciplinary. For instance, nuclear technology provides intrinsic potential in terms of carbon emissions, reliability and energy security. However, without a synergic integration with the financing mechanisms, and the legal system, this potential is hard to materialise.

This paper advocates to further integration between energy law, and other disciplines, to overcome the practical impediments to JUST transition. Further researches can highlight the barriers to JUST transition for other infrastructure as well as the gaps between energy law and the other disciplines, such as finance, engineering and social sciences. The identification of these barriers and gaps it is a critical step to improve energy law and to enable the JUST transition.

5. References

Adamantiades, A. & Kessides, I. (2009) Nuclear power for sustainable development: Current status and future prospects. Energy Policy. 37 (12), 5149–5166.

Artto, K., Ahola, T. & Vartiainen, V. (2016) From the front end of projects to the back end of operations: Managing projects for value creation throughout the system lifecycle. International Journal of Project Management. 34 (2), 258–270.

Barkatullah, N. & Ahmad, A. (2017) Current status and emerging trends in financing nuclear power projects. Energy Strategy Reviews. 18, 127–140.

Barquin, J., Glachant, J.-M., Leveque, F., Franziska, H., et al. (2010) Security of Energy Supply in Europe: Natural Gas, Nuclear and Hydrogen. Edward Elgar Publishing.

Belyi, A.V. & Talus, K. (2015) States and Markets in Hydrocarbon Sectors. Springer.

Bing, L., Akintoye, A., Edwards, P.J. & Hardcastle, C. (2005) The allocation of risk in PPP/PFI construction projects in the UK. International Journal of Project Management. 23 (1), 25–35.

Boyd, D. (2008) Financing new build. Nuclear Engineering International. 53 (651), 34–39.

Bradbrook, A.J. (1996) Energy Law as an Academic Discipline. Journal of Energy & Natural Resources Law. 14 (2), 193–217.

Bredimas, A. & Nuttall, W.J. (2008) An international comparison of regulatory organizations and licensing procedures for new nuclear power plants. Energy Policy. 36 (4), 1344–1354.

Černoch, F. & Zapletalová, V. (2015) Hinkley point C: A new chance for nuclear power plant construction in central Europe? Energy Policy. 83, 165–168.

Clough, R.H., Sears, G.A., Sears, S.K., Segner, R.O., et al. (2015) Construction Contracting: A Practical Guide to Company Management. John Wiley & Sons.

Corner, A., Venables, D., Spence, A., Poortinga, W., et al. (2011) Nuclear power, climate change and energy security: Exploring British public attitudes. Energy Policy. 39 (9), 4823–4833.

Dailami, M. & Leipziger, D. (1998) Infrastructure project finance and capital flows: A new perspective. World Development. 26 (7), 1283–1298.

Daintith, T. (2017) Against 'lex petrolea'. The Journal of World Energy Law & Business. 10 (1), 1–13.

Delmon, J. & Delmon, V.R. (2010) International Project Finance and PPPs: A Legal Guide to Key Growth Markets. Kluwer Law International.

Dentons (2016) A guide to project finance. [Online]. Available from: https://www.dentons.com/en/insights/guides-reports-and-whitepapers/2013/april/1/a-guide-to-project-finance.

Esposto, S. (2008) The possible role of nuclear energy in Italy. Energy Policy. 36 (5), 1584–1588.

Esty, B.C. (2008) Modern Project Finance: A Casebook. 1 edition. New York, John Wiley & Sons.

Esty, B.C. (2003) The economic motivations for using project finance. Harvard Business School. 28, 1–42.

Fabozzi, F. (2012) Project Financing 8th Edition: Written by Frank Fabozzi, 2012 Edition,. Euromoney Books.

Finch, V. & Milman, D. (2017) Corporate Insolvency Law: Perspectives and Principles. Cambridge University Press.

Finnerty, J.D. (2011) Project Financing: Asset-Based Financial Engineering. John Wiley & Sons.

Finon, D. & Roques, F. (2008) Financing Arrangements and Industrial Organisation for New Nuclear Build in Electricity Markets. Competition and Regulation in Network Industries. 9 (3), 247–281.

Flyvbjerg, B. (2013) Quality control and due diligence in project management: Getting decisions right by taking the outside view. International Journal of Project Management. 31 (5), 760–774.

Furmston, M.P. (2017) *Cheshire, Fifoot, and Furmston's Law of Contract*. New Edition, Seventeenth Edition. Oxford, New York, Oxford University Press.

Gatti, S. (2018) Project Finance in Theory and Practice: Designing, Structuring, and Financing Private and Public Projects. 3 edition. S.l., Academic Press.

GOV.UK (2016) Hinkley Point C - GOV.UK. [Online]. 2016. Available from: https://www.gov.uk/government/collections/hinkley-point-c [Accessed: 19 June 2017].

Handrlica, J. (2018) Nuclear law revisited as an academic discipline. The Journal of World Energy Law & Business.

Hayashi, M. & Hughes, L. (2013) The Fukushima nuclear accident and its effect on global energy security. Energy Policy. 59, 102–111.

Heffron, R.J. (2015) Energy Law: An Introduction. Springer.

Heffron, R.J. (2013) Nuclear new build in the United States 1990–2010: A three state analysis. Technological Forecasting and Social Change. 80 (5), 876–892.

Heffron, R.J., Ashley, S.F. & Nuttall, W.J. (2016) The global nuclear liability regime post Fukushima Daiichi. Progress in Nuclear Energy. 90 (Supplement C), 1–10.

Heffron, R.J. & McCauley, D. (2017) The concept of energy justice across the disciplines. Energy Policy. 105, 658–667.

Heffron, R.J. & McCauley, D. (2018) What is the 'Just Transition'? Geoforum. 88, 74–77.

Heffron, R.J., McCauley, D. & Sovacool, B.K. (2015) Resolving society's energy trilemma through the Energy Justice Metric. Energy Policy. 87, 168–176.

Heffron, R.J., Rønne, A., Tomain, J.P., Bradbrook, A., et al. (2018) A treatise for energy law. The Journal of World Energy Law & Business. 11 (1), 34–48.

Heffron, R.J. & Talus, K. (2016a) The development of energy law in the 21st century: a paradigm shift? The Journal of World Energy Law & Business. 9 (3), 189–202.

Heffron, R.J. & Talus, K. (2016b) The evolution of energy law and energy jurisprudence: Insights for energy analysts and researchers. Energy Research & Social Science. 19, 1–10.

Hughes, W., Champion, R. & Murdoch, J. (2015) Construction Contracts: Law and Management. 5 edition. Routledge.

IAEA (2014) Alternative Contracting and Ownership Approaches for New Nuclear Power Plants. [Online]. Available from: http://www-pub.iaea.org/books/IAEABooks/10733/Alternative-Contracting-and-Ownership-Approaches-for-New-Nuclear-Power-Plants.

IAEA (2006a) Basic infrastructure for a nuclear power project. [Online]. Available from: https://www-pub.iaea.org/MTCD/Publications/PDF/TE_1513_web.pdf.

IAEA (2007) Considerations to launch a nuclear power programme. [Online]. Available from: https://inis.iaea.org/search/search.aspx?orig_q=RN:38101964.

IAEA (2006b) Fundamentals safety principles. [Online]. Available from: https://www-pub.iaea.org/MTCD/publications/PDF/Pub1273_web.pdf.

IAEA (2010a) Governmental, Legal and Regulatory Framework for Safety.

IAEA (2003a) Handbook on nuclear law. [Online]. Available from: https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1160_web.pdf.

IAEA (2010b) Handbook on Nuclear Law: Implementing Legislation. [Online]. Available from: https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1456_web.pdf.

IAEA (2003b) Independence in regulatory decision making. [Online]. Available from: https://www-pub.iaea.org/books/iaeabooks/6845/Independence-in-Regulatory-Decision-Making.

IAEA (2010c) Licensing Process for Nuclear Installation. [Online]. Available from: https://www-pub.iaea.org/books/iaeabooks/8429/Licensing-Process-for-Nuclear-Installations.

IAEA (2012) Licensing the First Nuclear Power Plant. [Online]. Available from: https://www-pub.iaea.org/books/iaeabooks/10356/Licensing-the-First-Nuclear-Power-Plant.

IAEA (2001) Nuclear power programme planning: an integrated approach. [Online]. Available from: https://www-pub.iaea.org/books/IAEABooks/6277/Nuclear-Power-Programme-Planning-An-Integrated-Approach.

IAEA (2002) Regulatory control of nuclear power plants Part A (textbook). [Online]. Available from: https://www-pub.iaea.org/books/iaeabooks/6565/Regulatory-Control-of-Nuclear-Power-Plants.

IAEA (2016) Safety Glossary. [Online]. Available from: https://www.iaea.org/resources/safety-standards/safety-glossary.

IAEA (1992) The Chernobyl Accident. [Online]. Available from: https://www-pub.iaea.org/MTCD/publications/PDF/Pub913e_web.pdf.

Jr, T.J.K., Mastin, J.M., Robey, R.G. & LLP, S., Currie &.Hancock (2014) Smith, Currie and *Hancock's Common Sense Construction Law: A Practical Guide for the Construction* Professional. John Wiley & Sons.

Kann, S. (2009) Overcoming barriers to wind project finance in Australia. Energy Policy. 37 (8), 3139–3148.

Ketz, J.E. (2003) Hidden Financial Risk: Understanding Off-Balance Sheet Accounting. John Wiley & Sons.

Koomey, J. & Hultman, N.E. (2007) A reactor-level analysis of busbar costs for US nuclear plants, 1970–2005. Energy Policy. 35 (11), 5630–5642.

Locatelli, G., Mancini, M., Sainati, T. & Sallinen, L. (2011) The licensing processes influence on nuclear market. In: Proceeding of the19th International Conference on Nuclear Engineering (ICONE). 2011 Chiba, Japan. p.

Merrow, E.W. (2011) Industrial Megaprojects: Concepts, Strategies, and Practices for Success. 1 edition. Hoboke, N.J, John Wiley & Sons.

Michael, S.A. & J, A.M. (2017) Westinghouse Chapter 11 Bankruptcy: National Security Also an Issue. Natural Gas & Electricity. 33 (11), 8–13.

Miller, R. & Lessard, D. (2001) Understanding and managing risks in large engineering projects. International Journal of Project Management. 19 (8), 437–443.

Moreira, J.M.L., Gallinaro, B. & Carajilescov, P. (2013) Construction time of PWRs. Energy Policy. 55, 531–542.

National Audit Office (2006) Good Practice Briefing for PFI PPP. [Online]. Available from: https://www.nao.org.uk/report/good-practice-briefing-for-pfi-ppp/ [Accessed: 14 January 2017].

National Audit Office (2015) UK Guarantees scheme for infrastructure. [Online]. Available from: https://www.nao.org.uk/report/uk-guarantees-scheme-for-infrastructure/ [Accessed: 14 January 2017].

Nevitt, F.J. & Fabozzi, P.K. (2000) *Project Financing:* 7th edition. London, Euromoney Books.

Nuclear Energy Agency OECD (2017) Compendium of International Legal Instruments in the Field of Nuclear Energy.

Ruuska, I., Ahola, T., Artto, K., Locatelli, G., et al. (2011) A new governance approach for multi-firm projects: Lessons from Olkiluoto 3 and Flamanville 3 nuclear power plant projects. International Journal of Project Management. 29 (6), 647–660.

Ruuska, I., Artto, K., Aaltonen, K. & Lehtonen, P. (2009) Dimensions of distance in a project network: Exploring Olkiluoto 3 nuclear power plant project. International Journal of Project Management. 27 (2), 142–153.

Sainati, T., Brookes, N.J. & Locatelli, G. (2017) Special Purpose Entities in Megaprojects: Empty Boxes or Real Companies? Project Management Journal. 48 (2), 55–73.

Sainati, T., Locatelli, G. & Brookes, N. (2015) Small Modular Reactors: Licensing constraints and the way forward. Energy. 82, 1092–1095.

Sovacool, B.K. & Dworkin, M.H. (2014) Global Energy Justice. Cambridge University Press.

Sovacool, B.K., Heffron, R.J., McCauley, D. & Goldthau, A. (2016) Energy decisions reframed as justice and ethical concerns. Nature Energy. 1 (5), 16024.

Talus, K. (2013) EU Energy Law and Policy: A Critical Account. OUP Oxford.

Talus, K. (2014) Research Handbook on International Energy Law. Edward Elgar Publishing.

Talus, K., Looper, S. & Otillar, S. (2012) Lex Petrolea and the internationalization of petroleum agreements: focus on Host Government Contracts. The Journal of World Energy Law & Business. 5 (3), 181–193.

Taylor, S. (2016) The Fall and Rise of Nuclear Power in Britain: A History. UIT Cambridge.

Tiong Robert L. K. (1995) Risks and Guarantees in BOT Tender. Journal of Construction Engineering and Management. 121 (2), 183–188.

Uff, J. (2013) Construction Law. 11th edizione. Sweet & Maxwell.

Vinter, G.D., Price, G. & Lee, D. (2013) Project Finance. 4th Revised edition edition. Sweet & Maxwell.

Wang, S.Q. & Tiong, L.K. (2000) Case study of government initiatives for PRC's BOT power plant project. International Journal of Project Management. 18 (1), 69–78.

Watson, J. & Scott, A. (2009) New nuclear power in the UK: A strategy for energy security? Energy Policy. 37 (12), 5094–5104.

Wood, P. (2007) The Law and Practice of International Finance. University Edition edition. London, Sweet & Maxwell.

Wood, P.R. (2008) Maps of World Financial Law. 6th edition edition. London, Sweet & Maxwell.

Wood, P.R. (1995) Project Finance, Subordinated Debt and State Loans. London, Sweet & Maxwell.

Yescombe, E.R. (2013) Principles of Project Finance. Academic Press.