University of Sussex

&

&

& &

&

&

Emily Cox, Phil Johnstone and Andy Stirling
Science Policy Research Unit (SPRU)
University of Sussex
Original version: 21/09/2016. This version: 28/11/2016[1]

With current controversies around the Hinkley Point C project simply one further specific twist in the plot (Ruddick & Grierson 2016), the story of UK nuclear power is a fascinating one. Albeit in many changing ways, the UK Government has long professed to be planning to build up to 16 GWe of new nuclear electricity generation capacity - a proportional level of support for new nuclear power unparalleled in any other liberalised energy market (World Nuclear Association 2016e; Kee 2015). Despite many challenging developments, these general attachments show no sign of easing.

With many alternative (arguably preferable) strategies available for delivering economically viable, politically and technically secure, low-carbon energy services (Liebreich 2016; National Audit Office 2016; Environmental Audit Committee 2006; IRENA 2016; Frankfurt School-UNEP 2016), it is difficult satisfactorily to explain the historic intensity of these commitments solely in terms of officially-

elite cultures spanning disparate technological systems and penetrating some of the highest and deepest parts of the UK State and strategic national industry (Stirling 2014; 2016). By reference to an established body of analysis in political science and institutional theory (Grover & Peschek 2014; Fraenkel 2010; Glennon 2014; Temples 1980; Wedel 2014; Skogstad 2008; Feenberg 1999; Söderbaum 2004; Stone 2002; Jordan 1990), the study argues that such a LJKŜy₴YŜy₴yˇYˇλ∃Kű ōŜ űŜℕYˇŜŘ I· ΨŘŜŜLJ ƛyŎdzYˇōŜyŎè Ŏ₴YˇLJtŜÈ℗

In illuminating the importance of these undeclared non energy-related drivers in official UK commitments to civil nuclear power, the findings of this study may be judged to hold some policy salience in this important policy area. The fact that these evidently formative factors have for so long remained so remarkably under-discussed in wider UK energy debates, might be thought to extend this significance beyond the energy field alone: also raising important questions about nuclear commitments more widely ς and the general condition of UK politics and democracy.

Of course, some other western democracies are also planning new nuclear power as part of their electricity ∃Ŝy$ℕl·úλy∃ Yˇλ Ѐ℗ .dzú ůKŜ ¦Y λă dzyλIjdzŜ λyˇă2 l·ÔúλØŜfѐ LJdzℕădzλy∃ ădzÕK l·yˇl·Yˇōλúλ2dzã ₮2ℕYˇ 2₮ Ψ ⓫ (Vaughan 2009). Elsewhere in the world, other important and fast-growing economies are also undertaking nuclear programmes that are even bigger in absolute terms (IAEA 2015b). But ς in cases like China (World Nuclear Association 2016b; Guo & Guo 2016) and India (Garg 2012; World Nuclear Association 2016c) ς this typically takes place against the backdrop of significantly larger rates of growth in other energy technologies (Chabot 2016; Frankfurt School-UNEP 2016; IEA 2015c). So, compared to other European countries [2] ς and with the prevailing general picture around the world [3], the relative scale of UK commitments to nuclear power by contrast with other low-carbon energy options, does remain quite strikingly distinctive. And, as we discuss further in section 6a, other ambitious nuclear new build plans around the world are also understandable in relation tl

(IEA 2015b; IEA 2015a)

Nor does the particular history of UK civil

Grierson 2016). However for reasons that remain unclear at the present moment, the new UK G

Of course, the background picture sketched here is complex and begs many questions. These can be interpreted from many different standpoints ς in ways that will be addressed in detail in this paper. It will remain possible to approach the variabilities and uncertainties from divergent evaluative perspectives and draw contrasting interpretations over the general pros or cons of nuclear power. Indeed, to raise such questions need in no way be taken to imply a blanket negative position on nuclear power. It is perfectly possible to advocate or accept a case for nuclear power as part of a low-carbon electricity supply mix, and yet at the same time ask about the distinctive intensity of the UK position. Indeed, understanding this pattern might be thought especially salient for nuclear proponents, seeking to understand the conditions under which their favoured technology might prosper (Guyer & Golay 2015). But when all the above factors are considered together, it is difficult not to conclude that the distinctive intensity of UK government commitments to civil nuclear power is at least a phenomenon that requires some kind of attention and explanation. And, as we shall see, the more that is known about the historical, political, economic and technological background, the more salient such questions become. It is therefore not the posing of such questions that would be partisan, but their denial or avoidance.

So, the key questions are:

1) Exactly why have official UK nuclear commitments remained so disproportionate and persistent when contrasted with many other comparable countries over the years?
2) Why has this support extended so relatively widely (by international comparisons), across such an otherwise divided political spectrum?
3) Why have these attachments proven so resilient in the face of such repeatedly serious economic and political disappointments in the domestic nuclear sector?
4) Why have contemporary international market trends and policy initiatives in other countries evidently tended to exert such little influence on UK Government energy strategies?

Despite their broad salience, these questions are all the more remarkable, for being so relatively neglected in UK policy literatures (Toke 2013). This is so, equally in policy documents themselves and in academic analysis or even some critical commentaries (Atherton 2014). Official policy rationales refer to evaluative frameworks

u 1 72.024 327.89(e)4(n)-14(rie)5(s)]] TJET0.9024 3.es

served in some quarters to suppress the kind of active critical NGO engagements that were experienced in the past (Rudolf 1984; Wittneben 2012; Yearley 1987) and which continue to be evident in many countries (Deutsche Welle 2011). Although there are exceptions (Ecotricity 2016; BBC News 2011), some of the most visible and effective challenges to UK civil nuclear policy in recent years have come from within environmental movements based in Germany and other countries (World Nuclear News 2015; Neslen 2015) and sometimes driven by overseas branches of organisations that also operate in the UK in ways that are less actively critical of nuclear power (Reuters 2015).

So, conventional responses to the internationally-distinctive persistence and intensity of elite UK nuclear commitments, tend to take this overbearing official bias for granted. Analysts may disagree with the stated policy rationales. But so strong is the UK policy climate under which criticism of nuclear is taken to be unacceptable, that it is more expedient simply to accept these at face value, resigned to an understanding that the real motivations lie in deeper and less be

Based on the picture sketched above concerning the distinctive intensity and persistence of UK policy attachments to civil nuclear power, a very simple question lies at the heart of this study. How can we best understand the drivers of this apparently anomalous pattern of commitment to nuclear power, as distinct from available viable alternative bases for low carbon energy strategies? In asking this, this research relates to a wider ESRC-funded project as part of a European research consortium concerned with investigating a more general question about the ways in which sociotechnical systems (Geels 2002) of all kinds

As justified in the last section, the central question in this study, concerns how best to understand the evidently internationally-unusual intensity of UK policy commitments to civil nuclear power. So, the aim is to comprehend the course of high-stakes developments in elite policy making involving highly structured interests. First and foremost, then, the main focus of any attempt like this is on the dynamics of power.

But power is a very tricky business. And this is so, in many different senses of this phrase ς no less in ʤyŘŜℕăűIꞏyŘʎyƎ űKIꞏyΎʎΎIꞏŎűʎ2y℗ C2ℕ ʎű ʎă ʎyKŜℕŜyű ů2 űKŜ ŘʎăűʎyŎűʎØŜ ΨŘ2ʤzōfŜ KŜℕΎŜyŜʤzűʎÒΩ ʎΎă2ŎʎIꞏf ℕŜăŜIꞏℕÒK (Giddens 1984), that power is not just at the object end of academic enquiry, but can also condition the subject. Power of different kinds can not only drive, steer and constrain the kinds of actions that are taken, but shape the understandings that inform and respond to these actions ς the sorts of assumptions that tend to be made, those interpretations that are prioritised and even which questions are asked (and not asked) in ostensibly neutral analysis. Not least, these pressures in policy analysis can tend to discourage too much attention to power itself ς perhaps 2ΎƎℕ2ʤzyŘă ʎă ű22 Ŏ2ΎLJfŜÈΣ ű22 ŘʎŦŦʎÒʤzfűX 2ℕ ƨʤzăű ű22 ʎΎLJ2fʎűŜ ű2 űIꞏf℩ about (Stirling 2015). If credibility is to be maintained in conventional policy debates, particular pressures bear against representations of power dynamics that might be caricaturŜŘ ű2 ℕŜLJℕŜăŜyű I· ΨŎ2yΩLJℕIꞏÔè űKŜ2ℕèΩ (Sunstein 2014; Runciman 2016; Fredheim 2016; Jewell 2015). ² ʎűK ʎű f2yƎ ℕŜÒ2Ǝyʔ̆ăŜŘ űKIꞏű űKŜ ø2ℕŘ ΨLJ2øŜℕΩ K2fŘă I· Ř2ʤzōfŜ ΎŜIꞏyʎyƎ ʎΎűKŜ LJKℕIꞏăŜ ΨyʤzŎfŜIꞏℕ LJ2øŜℕΩ (Woods 2006), an understanding of the dynamics of political and economic power around long-lived, large-scale technological infrastructures, is particularly pronounced in this field (Stirling 2014).

A large literature on variously-named general socio-LJ2fʎűʎŎIꞏf LJKŜy2ΎŜyl· I·ℕ2ʤzyŘ á é (Hecht 2010), á é (Loeb 1986)Σ á é (Patterson 1977) IꞏyŘ yʤzŎfŜIꞏℕ á é (Jasanoff & Kim 2009) explores how the global nuclear sector is a particular arena within which these conditioning effects by power are especially intense, pervasive ς and under-attended to in mainstream policy debate (Temples 1980). So it could be that such pressures are implicated in the noted relative dearth of critical scrutiny for the central question of this present study? This remains to be substantiated. Either way, it is for the moment, doubly important to frame this enquiry with careful consideration for the nature of the dynamics of power.

Arguably " " (Dahl 1957) and " " (Cerbaro 2011), power is surely " " (Martin 1971)℗ ¦ yŘ2ʤzōűŠŘfê I·ŎűʤzIꞏffê I· ŘʎØŜℕăŜΣ Ŏ2ΎLJfŜÈ IꞏyŘ Řèyl·ΎʎÔ á é 2Ŧ ă2ŎʎIꞏf LJKŜy2ΎŜyl· (Massumi 2009), it can be addressed in many notoriously diverse ways. For instance, vigorous debates persist ʎΎLJ2fʎűʎŎIꞏf ăÔʎŜyŎŜ 2ØŜℕ ŘʎŦŦŜℕŜyŎŜă ōŜűøŜŜΎØʎŜøă 2Ŧ á é (Harrison et al. 2015)Σ á é (Arendt 1970)Σ X 2ℕ ØIꞏℕʎ2ʤzăfê LJ2øŜℕX áX ΦΦé (Smeed et al. 2009)Ŧ áX Xé (Abensour 2011); áX Xé (Spencer-Wood 2004)Ŧ áX Xé (Mansbridge 2001) ς and so on. Significant distinctions ŎIꞏΎōŜ ŘℕIꞏøΎōŜűøŜŜyʔ̆ʎyŘă 2Ŧ LJ2øŜℕ IꞏăY á é (Foucault 1977) 2ℕ á é (Bohman 2016); á é 2ℕ á é (Lukes 2005)Ŧ á é 2ℕ á é (Nye 2004)Ŧ á é (Massumi 2015) or á é (Galbraith 1993)Ŧ Iꞏō2ʤzű á é 2ℕ á é (De Certeau discussed in Feenberg 1999, p.112)Ŧ á é 2ℕ á é (Agamben in de la Durantaye 2009, p.234)Ŧ á é (Guzzini 2009) 2ℕ á é (Galbraith 1996)Ŧ Iꞏō2ʤzű á é 2ℕ á é (Collins 2004). Without the space here to ŘŜűIꞏʎf űKŜ ăLJŜÕʎŦʎÔ ʎΎLJfʎÒIꞏűʎ2yã 2Ŧ ŜIꞏŎK 2Ŧ űKŜăŜ ó2ℕ 2űKŜℕăúΣ I·ff űKŜăŜ á é (Bachrach & Baratz 1962)

can be seen in principle to be potentially relevant to this inquiry. All represent aspects of ways in which interests and commitments in nuclear power (as distinct from alternative infrastructures) are constituted,

(Certomà & Tornaghi 2015; Grin et al. 2011; Fischer & Newig 2016). h₮ Ŏ₴ȡz№ăŜΣ ǿKI·ű Y˙I·ë Ŏ₴ȡzyű I·ă ΨI·ΞŜyŎëΩ ʎy˙ this view may also be much more complex and transcendent than often assumed (Knappett & Malafouris 2008; Latour 2005; Callon 1991; Feenberg 1999). But perhaps most significant in this regard, are various kinds of elite social agency, for instance including: advocacy coalitions (Weible et al. 2011); knowledge networks (Stone 2002); policy networks (Skogstad 2008); and policy communities (Jordan 1990). Crucially, these elite networks often span even the broadest notion of what might count as a Ψă₴Ŏʎ₴űŜŎKyΛŎI·f №ŜΞʎY˙Ŝ Ω. Indeed this can be a diagnostic functional characteristic of deeper and more extensive forms of this phenomenon like power elites (Wedel 2014) and shadow networks (Söderbaum 2004). Either way, such configurations of agency and their onward linkages Y˙I·è Ψ№KʎÎ₴Y˙ʎŎI·ffëΩ Ŏ₴yŦfI·úŜ I·yŘ ădzōŘʎØʎŘŜ úKŜ dzădzI·f ₴yű₴f₴ΞʎŜă ₴₮ №ŜΞʎY˙Ŝă (Ernstson 2008; Steinberg 2008; Galloway & Thacker 2007) ς defying conventional prior assumptions about neatly-partitioned ΨfŜØŜfăΩΣ ΨăŎI·fŜăΩΣ ΨăèăúŜY˙ăΩ, ΨăŜŎű₴№ă Ω ₴№ŜΞʎY˙ŜăΩ (Stirling 2016; Stirling & Arora 2015).

It is in this way, that hypotheses about the nature of incumbency can avoid undue fixation with structure, anad also address agency. But there is a still further (and for present purposes, final) broad kind of answer that might be looked for to the question of why UK Governments remain so persistently attached to nuclear power. This moves beyond the potentially-

incumbency are recognised to span public, private and academic sectors, including (crucially) the highest levels of government, civil service and corporate ownership. Mediated by opaque elite networks and agency, these are nonetheless embodied in ς and conditioned by ς many kinds of structure cross-cutting typical notions of individual sociotechnical regimes. {2Σ I·fűK2ʤ∃K űKŜ KčLJ2úKŜǎλă 2Ŧ I· ΨŘŜŜLJ ɤyŎʤYˉōŜyŎè Ŏ2YˉLJfŜÈΩ λă y2ØŜf I·yŘ innovative in precisely the terms presented here, it is nonetheless grounded in a considerable body of prior empirical research specifically focusing on the UK, as well as on other geopolitical settings.

As such, it can be argued at least for the purposes of prima facie hypothesis development, that a concept of Ψdeep incumbency

As outlined in general terms in the introduction and discussed in the previous section, the hypotheses considered for this study are drawn by reference to diverse frameworks for understanding different notions of incumbency variously developed in political science (Baumgartner & Leech 1998; Pierson 2000), political economy (North 2006b), policy analysis (Roe 1994), management science (Chandy & Tellis 2000), organisation theory (Tushman et al. 1985), institutional theory (Steinmo et al. 1992), multilevel governance (Young et al. 2008), practice theory (Shove 2003), energy policy (Finon & Midttum 2005), innovation research (Walker 2000), technology studies (Unruh 2000) and transition management (Geels 2004). With each hypothesis informed by a number of frameworks, each displays different strengths and weaknesses. A few are quite obvious. Many are relatively well explored in othe.69 57 e. ee-6(ly)-3(A fe)6(2(ea)4(lat)-3 lik4(re)4(d)-14(w)-2(d)-7(i)-2(l8(s)56(re

A third and final step relevant to this stage of the methodological design

constitute the critical juncture when these dependencies are visible. This will be the pivotal proposition in

To test this final proposition (discussed in section 8), we created a timeline for all major policy initiatives, reports, commercial developments and campaigning activities relating to UK civil nuclear energy, nuclear new-build, nuclear propulsion and nuclear submarines manufacture, from the mid-1950s until the inception of this paper at the beginning of 2015. Firstly, systematic Google searches were carried out by adding the word

tackle climate change). Yet over a succession of four distinct very large announced programmes following this pattern, the envisaged level of new build has either not materialised at all, or remained very far short of what

As is amply demonstrated by current high-profile policy controversies over the replacing of the existing UK Trident ballistic missile submarine fleet (Dorman 2016; Beale 2015; North West Evening Mail 2016; Edwards 2014; Mortimer 2015b), the retention of nuclear-propelled submarines has also long been seen by both major

the world was strongly emphasised when she stated:

(Thatcher quoted in Jack, 2016).

Enthusiasm for Trident continued under Prime Minister John Major in the 1992. By this time any remaining Parliamentary debate around the topic was confined to whether to

order to construct, operate and maintain this infrastructure, is a very demanding undertaking ς especially for a country that is in other respects increasingly losing its manufacturing base (Meek, 2014) or seeing this become tangled in the capabilities of other countries (ibid.) So, with these capabilities so central to the credibility of one of the most treasured aspects of British political identity, anxieties are growing.

Accordingly, rhetorics have intensified ăđzₙₙ2đzyŘʌyƎ ůKŝ Ŏ2yűʌy℔zŀ·ůʌ2y´2₸ ůKŝ ¦ YΩă ŀ·ű-sea deterrent, and its relation to British identity on the world stage. For instance, politicians expressing criticisms of this technology are fŀ·ōŜffŜŘ ŀ·ă ŀ· ΨyΥ·ůʌ2yΥ·f ăŜŎđzₙₙλúê ůKₙₙŜŀ·úΩ ōè members of the Government (Mortimer 2015b). Prominent members of the British military declare ůKŀ·ű ăđzŎK LJ2fₙₙλÔʌŀ·yã Y´ŀ·è Kŀ·ØŜ ű2 ōŜ ₙₙŜY´2ØŜŘ ōè ŀ· á é ăK2đztŘ they come to power (Mortimer 2015a). Politicians who question the tactical logic of Trident are accused of á é (Mason & Asthana 2016). Despite the nuclear weapons issue continuing to be contested in various forms over recent èŜŀ·ₙₙăΣ ʌú ʌă y℔ø Ŏ2yãʌŘŜₙₙŜŘ á é to contemplate opposition towards Trident (Peter Mandelson and Neil Kinnock quoted in BBC News, 2016). The opposition of the current leadership to Trident renewal is one of the most frequently cited issues in the rebellion of the Parliamentary party, that is currently held to threaten the entire future of the British Labour Party (Walker & Stewart 2016) That the recent vote in Parliament on constructing a new fleet of nuclear submarines for the ŘŜfₙₙØŜₙₙè 2₸ ůKŝ ¦ YΩă áŘŜűŜₙₙŜyűé was carried with a majority of 355 (Mason & Asthana 2016), show how entrenched these commitments are ς spanning British Party divides.

Another point to make with regard to the sustaining of Trident and the associated British nuclear engineering skills base, is that in recent years, developments in non-nuclear options for submarine propulsion have raised the question as to whether conventional submarines could be used as an alternative to the very expensive and complex nuclear propulsion systems. Indeed, in recent years there have been important breakthroughs in different forms of diesel-electric and fuel cell submarines ó hΩ / ŀ·ffŀ·ƎKŀ·y´нлмпú. However it was concluded by the MoD in the Defence White Paper 2006 thatϒ á

¢é (HM Government 2006: 38). Similar to the conclusions reached by the Royal Navy in 1950, nuclear propulsion is still widely regarded in expert circles as being a superior technology in its own right because of ůKŝ ŎKŀ·ₙₙŀ·ŎűŜₙₙăűʌÔă ǿKŜₙₙŜōè á[t]

é

(UCL IEPL Australian submarine options report 2013: 12). It is for these kinds of reason that, as Ian Jack (2016) observes á

The superiority of nuclear propulsion over conventional submarines designs is also recognised internationally. For example, Singh (2016) outlines that á

Planalto 2014).

Having established that UK policy commitments to civil and military nuclear infrastructures are each very strong, it remains to explore whether and to what extent these imperatives might be linked. One first perspective on this picture, is to consider the international context. Here it has already been noted how

deliberately phasing out civil nuclear power. On the military side, Figure 3 also shows all countries in the world that ŏI·y˝ōŜ ŏI·úŜƎ2ℕλăŜŘ I·ă Ƙ2fŘλyƎ ű₭Ŝ ăűI·údză 2₮ I· ΨϒI·ƨ2ℕ ℕŜƎλ2y1·f LJ2ǿŜℕΩ 2ℕ I·ō2ØŜT 2ℕ ǿKλŎK KI·ØŜ ōŜŜy˝ ℕŜŏ2ƎyłăŜŘ 2₮₣λŎλI·ffè 2ℕ dzy2₮₣λŎλI·ffè I·ă ōŜλyƎ I· Ψy₫zŎfŜI·ℕ ǿŜI·LJ2yã ăűI·úŜΩT 2ℕ ǿKλŎK KI·ØŜ I·ŎIjdzŀℕŜŘ yI·ûλ2yI·f capabilities in nuclear-propelled submarines (Nolte 2010). Finally in the centre (picking up on an important feature of the discussion in the last section), Figure 3 shows countries that enjoy the geopolitical status of being permanent members of the United Nations Security Council.

Despite the many complexities and ambiguities, the evidence summarised schematically in Figure 3 does suggest a number of possible general patterns in international military and civil nuclear commitments. Before discussing these, several particular caveats are necessary. First, there is the somewhat arbitrary figure of 6 D ² Ŝ ₮2ℕ úKŜ LJℕŜŎλăŜ fŜØŜf 2₮ ₮ℕY˝fè LJfI·yŷŜŘ yŜø yƒzŎfŜI·ℕ ōdzλfŘ I·ú øKλŎK ű2 ŘℕI·ø I· Řλăűλyŏûλ2y˝ōŜűøŜŜy˝ΨfI·ℕƎŜΩ 2ℕ ΨY˝2ŘŜℕI·úŜ 2ℕ ăY˝I·ffΩ ŎλØλf yƒzŎfŜI·ℕ LJℕ2Ǝℕ I·Y˝YˆŜaφ b2ű fŜI·ăűΣ űKλă LJI·èă y2 I·úûŜyûλ2y˝ú2 úKŜ ăŎI·fŜ 2₮ ŜyŜℕƎy or finance markets in the country in question. Nor does it attend to the ambiguities and conditionalities in which scales of plans are often expressed. But this figure does nonetheless offer a valid broad illustration of a basic difference between plans amounting to a scale not far different from a single modern large scale power station (with twin reactors rated at 3.2 GWe) and markedly large programmes representing some multiple of this scale. Likewise, the distinction drawn by the German Institute of Global and Area Studies (GIGA) ōŜűøŜŜy˝ΨY˝I·ƨ2ℕ ℕŜƎλ2y1·fΩ I·yŘ other levels of military power (Nolte 2010), is also a function of many different variables. Yet it nonetheless serves usefully to identify those countries around the world that find themselves most motivated and able to invest most heavily in military capabilities of all kinds. And, of course, all the categories employed in this picture are subject to change over time. So attention is required to retrospective circumstances and prospective possibilities.

All this said ς and despite the summarised evidence being only circumstantial ς features of this picture may prompt avenues worthy of further interrogation. For example, there is a clear broad correlation between general military and civil nuclear status. Of the 23 countries (among a total of 195] states in the world) ranked λy˝YˆfűűI·ℕè űŜℕY˝ă I·ű ű₭Ŝ fŜØŜf 2₮ ΨY˝I·ƨ2ℕ ℕŜƎλ2y1·f LJ2ǿŜℕΩ 2ℕ I·ō2ØŜΣ I·ff ōdzű ûǿ2 ó ! dzăűℕI·fλI· I·yŘ 9ƎèLJûú ΚI·ØŜ historically developed at least someti4 9.96l3C035B≥2600003017D>5(s)53b3.96l3C03 TJETBT1 0 0 1 72.024 497.71 Tm[(in)-3(v)6(e)-7

(comprising China, France, Russia, the UK and USA). And the significance of this is underscored in the discussion in the last section of strong policy statements in Brazil, explicitly linking these issues.

Perhaps reflecting strong military perceptions of the uniquely credible status of nuclear-propelled submarines

The discussion in previous sections has established that there are strong grounds for asking about linkages between clearly-established UK policy commitments to civil nuclear power on the one hand and military nuclear capabilities on the other. This in turn forms a basis for posing particular questions about extant patterns of economic overlap and organisational involvement spanning both sectors. Before examining this evidence, however, it is important to note that this raises some quite unique sensitivities. A notional separation between civil and military nuclear activities is arguably one of the most intensively-performed regulatory functions in the world (IAEA 2016a).

¢KŜ ΰIٖăٔ 2ŦIٖŦŦΛNYٔλyƎ ΰKλă ăŜLJIٖNIٖΰΛ2yٔλă dzyŘŜNΰIٖٔŜyΣ Ŧ2NλyƎăΰIٖyŐŜΣ ōề ă2YٔŜ 2Ŧ ΰKŜ ø2NfŘΩă f2yƎŜăΰ-standing and highest-profile intergovernmental technology-regulatory bodies (World Nuclear Association 2016f): the International Atomic Energy Agency (IAEA 2015a) and Euratom (European Commission 2014). The focus of this

This chimes with other sporadic remarks from

ɛ [11]

This same Parliamentary inquiry also pointed out the opportunities for transfer of capabilities between the two sectors (HoC 2009).[12] A report by the British American Security Information Council (2012) into nuclear skills and technology capabilities also noted the opportunities which could arise from exploiting these linkages more fully, for instance through technology transfers and spin-offs.[13] Furthermore, leading industry figures participating in interviews for the present project also clearly noted the linkages they see to exist. One stated ŭKl·ú ά́ώhάzℕ Ŏ2ϒĹJl·y̌ès Kl·ă operations in both civil and defence. There is considerable movement of people ōŜúøŜŜy̌ō2ŭKέ ȯÕ2ŘŜ лмΣ нлмрύΦ !y2ŭKŜℕ ăl·ƛŘϒ ά¢KŜ f2ƎƛŎ ƛy̌Y2Øƛy∃ ώ2άzℕ ōάzăƛySăăß ƛyű2 ŎƛØ℀f ø l·ă ōl·ăŜŘ 2y̌ŭKŜ ăèySℕ∃ƛŜă øKƛŎK ŜÈƛăú l·yŘ øKƛŎK Ŏ2άztŘ ōŜ ŜÈĿJf2ƛúŜŘΦ ¢KŜℕŜ l·ℕŜ f2úă 2Ŧ ĿJfl·ŎŜă øKŜℕŜ ŭKl·úΩă y2ű èŜú ōŜƛy∃ optimised, sometimes for technical reasons, but more often than not for reasons of behaviour, inertia etc.ɛ (code 02, 2015).

What seems clear, then, is that despite international regulatory pressures to perform a separation between civilian and military nuclear activities, there are in fact many synergies. Notwithstanding their sensitivity, these are not only explicitly documented in the public domain, but are also authoritatively documented to form a key part of corporate strategies in this field ς including plans for quite radical levels of growth. Indeed, in policy debates on the military side, there is a repeated refrain that synergies between military and civil nuclear activities are underexploited (HoC 2009).

research and development and skills and training provision across military and

ăʤžăűIꞏλyIꞏōfŜ℗έ óhÈŦƵℕŘ 9ǑƵyƵYꞏλǑă нлмоϒ омύ℗[17] In private discussions, informed individuals are also not reticent about noting the formative effects of these linkages. One senior figure in the civil nuclear sector told this study: άά¢KŜè IꞏℕŜ ăèyŜℕƎλăűλǑT űKŜ YꞏλfΩűIꞏℕè ōIꞏăŜ ƘIꞏă IꞏføIꞏèă fŜIꞏyű KŜIꞏØλfê ƶyꞏűKe fact that there are civil people IꞏℕƶʤyŘ℗έ óǑƵŘŜ лоΣ λyűŜℕØλŜø нлмрύ℗

However, it is important to note that these kinds of linkage can also present challenges. For instance, the MoD and parts of the military supply industry have expressed concerns that a vibrant civil new build program could attract skilled individuals from the defence sector, thus acting as a drain on key skills and capabilities[18]. Such risks are amplified by general concerns regarding the poor state of the nuclear skills base in the UK (BIS 2013; Cogent 2011; DECC 2015).[19]

pointed out that, in the context of the strategic decision in the 2005 Defence Industrial Strategy to retain all the capabilities unique to submarines and their nuclear reactors, the sector remains dependent on a continuous flow of MoD business to maintain capabilities and preserve skills (NAO 2008).[22] Here, one senior figure in the civil sector told us:

. (Code 3, 2015)[23]

From the discussions above (and the extended quotes in the endnotes), then, it is clear at least on the military side that there are strong formative pressures acting to reinforce UK government commitments to maintaining a civil nuclear power industry. In short, without a healthy industrial base of nuclear engineering companies and skills and training organisations to fulfil at least second tier roles in new nuclear power programmes, the UK could not realistically hope to maintain its cherished status as a militarily-credible nuclearcred,em[(m)4(ili)3(ta)t second(à

One crucial way to interrogate the emerging findings that

LexisNexis©

(2016)

This by no means stands for concrete evidence, however it nonetheless emphasises the significant increase in activities surrounding nuclear power in the crucial period of study. Such processes are notoriously difficult to investigate, especially in any rigorously critical fashion. To illuminate the background to this policy turnaround, we therefore conducted a t

The picture is therefore again very clear. The otherwise unexplained and unprecedented reversal in UK civil nuclear policy occurred in precisely the same short time interval as an equally unprecedented ς and well-documented ς crisis in UK military nuclear policy. Indeed, just this kind of unique reversal in civil nuclear policy is repeatedly and openly acknowledged in the military policy literature to present a significant part of a solution to the perceived crisis in key military capabilities occurring at that time. Observed even by proponents ƻŦ ŎʎØʎf yʊzŎfŜI·ℕ LJƻØŜℕ úƻ ΚI·ØŜ ōŜŜyʹŘʊzŜ úƻ I· ʊăŜŎℕŜúʎØŜ LJℕƻŎŜăăɛ ƻLJŜℕI·úʎyƎ ʊōŜΚʎyŘ úΚŜ ăŎŜySŜăɛ I·ú ûΚŜ ΚʎƎΚŜăû political levels, then, the 2003-6 reversal in UK energy strategy is thus very strongly circumstantially associated with evidently massive concurrent pressures asserted by military nuclear interests.

Given the clarity of the policy documentation on the military side in this period, it is quite remarkable that the significance of these pressures is virtually entirely unacknowledged the civil nuclear policy debates ς either at the time or subsequently. Whatever the formative influences may have been, the acknowledged secrecy of ¢ƻyê .fI·ʎℕΩă yʊzŎfŜI·ℕ ŘŜŎʎăʎƻyʹLJℕƻŎŜăă ʎyʹнллp YʹŜI·yã úΚI·ú ŜØʎŘŜyŎŜ I·ă úƻ ŎI·ʊzăŜă Yʹʊžăΰ ySŎŜăăI·ℕʎfê óʎyʹI·ōăŜyŎŜ ƻŦ first hand testimony) remain little more than circumstantial. Yet there are a few further specific ways in which the evident importance of military policy drivers in this period can be resolved to a further level of detail that offers to clarify the picture somewhat beyond this. These emerge when attention is given to quite how much of the literature reviewed earlier in this study in establishing general influences of military on civil nuclear policy, actually fall into the exactly the period of 2003

policy consultations, highlighting the importance of a shared skills pool for the military and civilian nuclear sectors (KOFAC submission to the Energy Review, 2006) and made the positive case for nuclear power in the ăŜŎ2yŘ yŧzŎťŜI·ℕ Ŏ2yăʤzfűI·úʎ2yʹʎyʹнллт LJ2ʎyűʎyƎ 2ʤzű úKI·ű ά ! ŦŦ2ℕŘI·ōʎŧʎúè ʎyʹúKŜ ŎʎØʎf I·yŘ ŘŜŦŜyŎŜ ăŜŎű2ℕă ŎI·yʹōŜ

As highlighted from the outset, the main purpose of this paper has been to explore systematically a hitherto virtually unaddressed possible reason for the otherwise unexplained intensity of official UK policy attachments to nuclear power ς and especially the unprecedented reversal of a brief interruption to these commitments in the period 2003-6. This possible contribution to understanding these events is, that it is perceived imperatives to maintain national UK capabilities to design, build and operate nuclear-propelled submarines, that have exercised a crucially formative influence on the intensity of parallel policy commitments to civil nuclear infrastructures. The potential importance of this particular factor is all the greater, because it remains so undiscussed in debates over UK energy policy.

It is not the purpose of this study (nor does length permit us) to offer a similarly detailed exploration of all the alternative contrasting hypotheses discussed in Section 2 as addressing potentially converging contributory factors in explaining the intensity of UK policy attachments to civil nuclear power. These were:

(H1); (H2);
(H3); as well as (H4) Nor is it necessary for the substantiation of the present argument to explore each of these in equal length. The point here is not that perceived imperatives in elite UK policy cultures to maintain nuclear submarine capabilities, form a sufficient basis for understanding the distinctively pro-nuclear character of UK energy strategies. The argument has rather been, that this perceived military nuclear imperative is clearly salient in principle ς and I·ℕ∃dzI·ōfè ŜØΛŘŜyűfè IjdzΛűŜ ΚΛ∃Kfè ŜYˡLJΛℕΛŎI·ffè ℕŜfŜØI·yű ű2 dzyŘŜℕăűI·yŘΛyƎ LJI·ℕűΛŎdzfI·ℕ LJΛØ2űI·f ΨŎℕΛűΛŎI·f ƨdzyŎűdzℕŜăΩΣ fΛ⌉Ŝ that occurring between 2003 and 2006.

So the relevant test at this point for the alternative hypotheses (H1; H2; H3) returned to now is somewhat less demanding. Here, the crucial question for the present analysis is not about the relative salience of the different hypotheses, but about whether any of them might be judged to be so clearly sufficient in its own right ς or whether they are collectively so compelling ς such as to so fully explain the pattern of events that the relevance of parallel military drivers is rendered effectively redundant. In seeking to address this final task, it is very helpful that there exists a quite voluminous policy literature on some of these alternative hypotheses. What needs to be asked of this evidence, is simply whether these alternative hypotheses offer ς individually or collectively ς such a clearly sufficient basis for understanding, that resort to the present (acknowledgedly less explicitly documented) military nuclear imperatives is rendered unnecessary.

This section will therefore quickly review the evidence in relation to this criterion for each possible alternative kind of explanation in turn. Then ς by reference to the theoretical discussion in Section 3 ς the following (penultimate) section will focus in detail on the fourth hypothesis concerning the extent to which the policy dynamics discussed here warrant consideration as a possible instance 2Ŧ I· ΨŘŜŜLJ ΛyŎdzYˉōŜyŎè Ŏ2YˡLJ ŧ 9 Ŏ2YˡLJ ŧ

The remarkable uncompromising and unqualified rhetorical intensity of such assertions are in themselves both a clue as to their political nature and an indication as to their underlying substantive weakness. Without taking a position one way or another on the relative pros and cons of nuclear power as compared with other low carbon energy options, it is abundantly clear from longstanding official UK government appraisals and analysis by leading energy policy consultancies on which these often depend, that there emphatically does exist a wide variety of viable low carbon ‘alternatives’ to nuclear power in the UK. Whilst it remains legitimate to interpret

The final hypothesis to be considered in this section is the
Highlighting the relevance of individual agency and interpersonal networks, this kind of explanation focuses on the detailed ways in which the decision for new nuclear build ǿlٜ YٜlٜŘŜ ΨōŜKƛyŘ Ŏf2ăŜŘ Ř22ℕă, involving powerful elite actors around civilian nuclear power interests both in government and industry. As we have discussed above, evidence for this can be found in accounts like that of Stephen Taylor, who points out the ΨăŜŎℕŜúΩ yٜlٜúdzℕŜ 2Ŧ ¢2yê .flٜƛΩΩă ăúℕlٜúŜƎè team that reviewed yΦzŎfŜlٜℕ ŘdzℕƛyƎ нллрΣ lٜyŘ ΰKŜ ΨōŜKƛyŘ the scenesΩ nature of the conflicts between Margaret Beckett, Patricia Hewitt and others (Taylor 2007). Other indicators of this more individualistic and networked understanding of political processes might also refer to media concerningΣ Ŧ2ℕ ŜÈlٜYٜLJfŜΣ ΰKŜ Ψǿƛyƛy∃ lٜyŘ Řƛyƛy∃Ω 2Ŧ 59/ / 2ŦŦλŎλlٜfă ōè yΦzŎfŜlٜℕ LJ2ǿŜℕ Ŏ2YٜLJlٜyٜŜă lٜă ℕŜØŜlٜfŜŘ ōè Freedom of Information requests by Rob Edwards published in (Edwards, 2014).

A further indicator of the relevance of network interactions between elite individual policy actors is the manifest role played by ΨℕŜØ2fØƛy∃ Ř22ℕăΩ in nuclear policy, in which senior politicians often take key roles in nuclear lobby groups and then later return to politics, a practice that is considered to be particularly endemic in the nuclear industry[25]. bŜ∃2úƛlٜúƛ2yã lٜℕ2dzyŘ ΰKŜ Ψ{úℕλ]Ŝ LJℕλŎŜΩ Ŧ2ℕ lٜƛy]fŜè / as part of the Contracts for Difference (CfD) framework, for example, were reported to have involved ΨōŜKƛyŘ Ŏf2ăŜŘ Ř22ℕăΩ processes of this kind (Vidal, 2014). Implicating many prominent individuals, displaying curious reversals of positioning on nuclear power ς and including the role of the brother of Prime Minister Gordon Brown as a nuclear lobbyist (Wheeler 2007)ς there can be little doubt as to the importance of these kinds of dynamics. Indeed, some key experts go as far as invoking them in postulating that the French nuclear utility EDF effectively managed completely to outmanoeuvre the UK Government by this kinds of means, enabling them to secure UK nuclear assets as a means to channel revenues from British electricity consumers into payment for French nuclear decommissioning costs [26].

Further particular versions of this elite actor-network hypothesis variously invoke a range of supposedly decisive roles played by different purportedly key individuals, including Tony Blair himself (Taylor 2016). Brian Wilson (Wilson quoted on BBC Newsnight, 2008), David King (King quoted in Leake 2008) and Sue Ion (Ion quoted in Taylor, 2016) are all variously quoted as asserting their own personal importance in the policy turnaround in the period 2003-2006. An emphasis on the role of elite actors was also encountered in this study during interviews and conversations with several key experts. An example of this kind of argument, is that it was the interactions between elite individuals like those named above during the critical juncture 2003-2006 that persuaded Tony Blair of the need to (rather ignominiously) reverse his then re(u)-4(p)-4A.41 Tm[(in)-f taliticians o talA.41 Tm

the necessarily opaque nature of interpersonal communications and relations make it difficult to be sure either way. Whatever formative roles they may play, then, individual actors and networks are clearly subject to wider conditioning pressures that confer greater continuity in the observed pattern events, than is evident in their own individual careers. It is for this reason, then ς as well as healthy general scepticism about the sufficiency of under-corroborated ΨŎƨyãLJ⁂Ⅰ·Ŏè úĸŜƨ⁂ŝăΩ ⅄Ƴ Ⅰ· Ŏƨ ϒLJfŜÈ Ⅰ·yŘ ⅄yűⁿⁿⅠ·ŎúⅠ·ōfŜ ǿƨ⁂fŘ (Clarke 2015)(Sunstein 2014) ς that it seems that this final alternative hypothesis (while salient) also cannot be considered sufficient in itself.

This brings us to the final question of this study, whether the evident influence on UK civil nuclear policy of elite policy commitments to military nuclear capabilities can be considered to reflect a phenomenon that might ōŜ úŜ⁂ϒŜŘ Ⅰ· ΨŘŜŜLJ ⅄yŎdzϒōŜyŎè Ŏƨ ϒLJfŜÈΩK . Ŝƭƨ⁂Ŝ údz⁂y⅄yƎ ûƨ úĸ⅄ă IjdzŜăú⅄ƨyΣ ⅄ű ⅄ă important to emphasise again what has, and has not, been argued in this present section. In a field as complex, dynamic, uncertain and secretive as civil and military nuclear policy, it would be unwise in the extreme to seek to assert definitive conclusions, or unitary understandings. All of the hypotheses reviewed here are likely to hold some value in helping to understand particular aspects in the observed course of events.

To take each in turn, the determinants of UK civil nuclear policy criteria that are declared in official documentation are all evidently important and valid in principle ς it would be difficult to claim that policy processes are so disingenuous that they exercise no influence at all (H1). Likewise, it would be naïve to argue that there do not exist significant pressures from entrenched interests in UK civil nuclear sector ς even though this may be relatively small and weak. And ς as has just been explored - elite policy actors and their networks are undoubtedly deeply implicated in the forming of policy commitments of all kinds. The analysis summarised here, is simply that none of these well-recognised factors can reasonably be considered to be sufficient in itself. Nor ς for the reasons discussed ς is it persuasive to assume that all these taken together are fully sufficient on their own. It does appear some other factor is involved.

It now falls to this final concluding section of this study, to review carefully the series of systematic stages in the hypothesis testing process that has framed the reasoning throughout this paper. The first step in the argument was to establish a case for identifying the unusual intensity and persistence of official UK policy commitments to civil nuclear power and for raising questions over what might be driving this. This case was established in

But the findings in Section 9 of this paper are nonetheless also quite clear in another respect

adversity. So neither can be seen merely as an artefact of selection on the part of the present research project, nor of background noise in a volatile policy discourse. The deep incumbency hypothesis might therefore on these grounds, be judged at least to be .

The next step was to test the proposition (beyond a mere conjunction in intense UK military and civil nuclear commitments), that more generally manifest and substantive linkages are actually observable between these UK Government attachments to renewing civil nuclear power and maintaining national capabilities to sustain nuclear propulsion infrastructures for military submarines. explored various dimensions of this issue. For instance, on one obvious aspect: the general international context was found to display (as summarised in Figure 3) broadly recognisable patterns of association between commitments to civil nuclear power and military nuclear status ضخ ضخ ضخ ך

features in UK energy policy. At the very least, the case does seem sufficiently strong, that the onus of any further argument ς or a

Abbink, J. & Salverda, T. eds., 2013.
, New York: Palgrave Macmillan.

Abensour, M.R., 2011. ,
Cambridge: Polity Press.

Agora Energiewende, 2015.

BIS, 2013. , London: Department for Business, Innovation and Skills.

. fl·λ№Σ ¢ΦΣ нллс℗ t№ΛΥŜ aλyλăúŜ№Σ wú l2ƴ¢2yê . fl·λ№Ωă t l·№fλl·ΥŜyűl·№è {ű l·úŜΥŜyű 2ƴ¢№ΛŘŜyű℗ . Available at: http://www.navalshipbuilding.co.uk/navalship_newsdetails.asp?newsID=729&newsCatID=8 [Accessed August 26, 2016].

Blowers, A., 2013. Nuclear Power ς ! Cfl·ǿŜŘ / l·ăŜ℗ t l·№ű мY ² Kè ǿŜ Ř2yΩú yŜŜŘ yΩzŎtŜl·№ y2ǿ℗ , January 20, pp.37ς40.

. 2ŦŦŜèΣ 5ΦΣ нлмс℗ ¢KŜ№ŜăI· a l·è ά№l·λăŜŘ 2õ2ŜŎűλ2yã ű2 LJ№2ż2ŜŎű l·ă K2ΥŜ ăŜŎ№Ŝúl·№è℗é .
Available at: https://www.theguardian.com/uk-news/2016/jul/30/theresa-may-delayed-hinkley-point-chinese-beijing-vince-cable [Accessed August 26, 2016].

Bogner, A., Littig, B. & Menz, W. eds., 2009. , Basingstoke: Palgrave Macmillan.

Bohman, J., 2016. Democratising the global order: from communicative freedom to communicative power. , 36(2), pp.431ς447. Available at: http://www.bbc.co.uk/news/uk-politics-30778427 [Accessed August 26, 2016].

Bradford, P., 2013. Nuclear renaissance was just a fairy tale. . Available at: https://www.theguardian.com/environment/2013/jul/11/nuclear-renaissance-power-myth-us [Accessed August 26, 2016].

Brady, B. 2013. Revealed: £2billion cost of failed Sellafield plant. Available at:

, 21(1), pp.148ς153.

Certomà, C. & Tornaghi, C., 2015. Political gardening . Transforming cities and political agency. , 20(10), pp.1123ς 1131.

Chabot, B., 2016. Wind power and nuclear electricity production in China , India , Brazil and South Africa (BICS) up to 2015. , pp.1ς7. Available at: http://cf01.erneuerbareenergien.schluetersche.de/files/smfiledata/5/5/8/4/6/2/141WindNucBICS2015.pdf [Accessed August 26, 2016].

Chandy, R.K. & Tellis, G.J., 2000. ¢ΚŜ LyŎdzYōŜyύΩă /dzNăŜK LyŎdzYōŜyŎèΣ ăλÎŜ l·yŘ NJl·ŘλŎl·f LJN2ŘdzŎύ innovation. , 64, pp.1ς17.

Charmaz, K., 2006. , London: Sage Publications.

Clarke, S., 2015. Conspiracy Theories and Conspiracy Theorizing. , 32(2), pp.131ς150.

Clegg, S.R., Courpasson, D. & Philips, N., 2006. , London: Sage Publications.

Clegg, S.R. & Hardy, C. eds., 1999. , London: Sage Publications.

Cochran, T.B. et al., 2010. , Princeton, NJ: International Panel on Fissile Materials and Program on Science and Global Security, Princeton University.

/2Ŏ]ōdzNyΣ tΦΣ нлммΦ tl·ύNJλŎ] /2Ŏ]ōdzNyϒ ² Kè Yˇdzăύ .NJλύl·λyˇl·føl·ěă úN2è ύ2 άLJdzyŎK l·ō2ØŜ KŜN øŜλƎKΰέK . Available at: http://www.independent.co.uk/voices/commentators/patrick-cockburn-why-must-britain-always-try-to-punch-above-her-weight-2314908.html [Accessed August 26, 2016].

Cogent, 2011. Warrington: Cogent SSC Ltd.

Collingridge, D., 1984. Lessons of nuclear power US and UK history. , March, pp.46ς67.

Collingridge, D., 1983. , London: Frances Pinter.

Collingridge, D., 1979. The entrenchment of technology - the case of lead petrol additives.

http://gulfnews.com/opinion/thinkers/cameron-must-save-britain-s-world-power-status-1.1511443 [Accessed August 26, 2016].

Court, S., 2009. Rotherham: NAMTEC.

Cowburn, A., 2016. US Defence Secretary Ash Carter says Britain must renew Trident to maintain

, Cheltenham, UK; Northampton, MA: Edward Elgar.

Geels, F.W., 2009. Foundational ontologies and multi-paradigm analysis, applied to the socio-technical transition from mixed farming to intensive pig husbandry (1930ç1980). , 21(7), pp.805ç832.

Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems. , 33(6-7), pp.897ç920.

Geels, F.W., 2010. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. , 39(4), pp.495ç510.

Geels, F.W., 2014. Reconceptualising the co-evolution of firms-in-industries and their environments: Developing an inter-disciplinary Triple Embeddedness Framework. , 43(2), pp.261ç277.

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. , 31(8-9), pp.1257ç1274.

Geels, F.W. & Kemp, R., 2007. Dynamics in socio-technical systems: Typology of change processes and contrasting case studies. , 29(4), pp.441ç455.

Geels, F.W. & Schot, J., 2007. Typology of sociotechnical transition pathways. , 36(August 2003), pp.399ç417.

Giddens, A., 1984. , Cambridge: Polity Press.

Gigerenzer, G. & Selten, R. eds., 2002. , Cambridge, MA: MIT Press.

Gilbert, N. & Conte, R. eds., 1995. , London: UCL Press.

Gillham, B., 2000. , London: Continuum.

Glennon, M.J., 2014. National Security and Double Government. , 5, pp.1ç114.

Gosden., E., 2016. New Hinkley Point nuclear plant in doubt as Government delays decision despite EDF approval for £18bn project. . Available at: http://www.telegraph.co.uk/business/2016/07/28/green-light-for-hinkley-point-as-new-18bn-nuclear-plant-approved/ [Accessed August 31, 2016].

Gosden, E., 2016. EDF board member resigns, attacking Hinkley Point nuclear project as financiallTm[(, L)5(o)-5(iT1 0

Greener, I., 2005. The Potential of Path Dependence in Political Studies. , 25(1), pp.62ç72.

Grin, J., Rotmans, J. & Schot, J., 2011. On patterns and agency in transition dynamics: Some key insights from the KSI programme. , 1(1), pp.76ç81.

Grover, W.F. & Peschek, J.G., 2014. , London: Palgrave MacMillan.

Guo, X. & Guo, X., 2016. Nuclear power development in China after the restart of new nuclear construction and approval: A system dynamics analysis. , 57(December 2014), pp.999ç1007.

Guyer, B.L. & Golay, M.W., 2015. Requirements for the Success of Civilian Nuclear Power in the United States. , 45(2), pp.48ç54.

Guzzini, S., 2009. , Copenhagen: Danish Institute for International Studies.

Guzzini, S., 2005. The Concept of Power: a Constructivist Analysis. , 33(3), pp.495ç521.

Habermas, J., 1976. , Cambridge: Polity Press.

Hall, T., 1986. , Harmondsworth: Penguin.

Halperin, S. & Heath, O., 2012. , Oxford: Oxford Univ. Press.

Hansard. 1979. Nuclear Power.

Cambridge University Press and the British International Studies Association.

Hecht, G., 2010. The Power of Nuclear Things. , 51(1), pp.1ç30.

Hekkert, M.P. & Negro, S.O., 2009. Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims. , 76(4), pp.584ç594.

Held, A., 2010. . Karlsruhe, Germany: Karlsruhe Instituts für

IEA, 2016. Available at: http://www.iea.org/statistics/topics/rdd/

Infield, D. & Watson, S., 2007. Planning for Variability in the Longer Term: The Challenge of a Truly Sustainable Energy System. In G. Boyle, ed. . London: Earthscan, pp. 201ç2011.

Ireland, G., 2012. , London.

IRENA, 2014. , Bonn: International Renewable Energy Agency.

IRENA, 2016. , Bonn: Irena Innovation and Technology Centre.

Jasanoff, S., 2005. , Princeton: Princeton University Press.

Jasanoff, S. & Kim, S., 2009. Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. , 47(2), pp.119ç146.

Jewell, J., 2015. Proving the Deep State Requires Deeper Reasoning. , pp.5ç8. Available at: http://polet.network/blog/2015/9/24/shallow-reasoning-on-the-deep-state [Accessed August 31, 2016].

Johnstone, P. & Stirling, A., 2015a. All at sea: making sense

, 9(1), pp.7ç23.

Kern, F. et al., 2014. From laggard to leader: Explaining offshore wind developments in the UK. , 69(June 2014), pp.635ç646.

Kern, F. & Smith, A., 2008. Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. , 36(11), pp.4093ç4103.

Kim, S.S., 2001. Security, nationalism and the pursuit of nuclear weapons and missiles: The South Korean case, 1970ç82. , 12(4), pp.53ç80.

King, D., 2006. David King: Why we have no alternative to nuclear power: if there were other sources

http://www.thesundaytimes.co.uk/sto/news/uk_news/article78444.ece [Accessed August 31, 2016].

Lean, G. 2015. Why Sellafield costs us a bomb. Available at: http://www.telegraph.co.uk/news/earth/environment/11351587/Why-Sellafield-costs-us-all-a-bomb.html [Accessed 5th September 2016]

Lean, G., 2014. Nuclear power may not be needed, says top atomic advocate. . Available at: http://www.telegraph.co.uk/news/earth/energy/nuclearpower/11244499/Nuclear-power-may-not-be-needed-says-top-atomic-advocate.html.

Lévêque, F., 2010. Innovation trends in nuclear power generation. . Available at: http://www.energypolicyblog.com/2010/05/09/innovation-trends-in-nuclear-power-generation/ [Accessed August 31, 2016].

Lévêque, F., 2015. , Cambridge: Cambridge University Press.

Liberal Democrats, 2015. , London: Liberal Democrats.

Lichfield, J., 2015. UK nuclear strategy faces meltdown as faults are found in identical French project. . Available at: http://www.independent.co.uk/news/uk/home-news/uk-nuclear-strategy-faces-meltdown-as-faults-are-found-in-identical-french-project-10186163.html [Accessed August 31, 2016].

Liebreich, M., 2016. , New York: Bloomberg New Energy Finance.

[λyŘōf2YΣ /ΦΣ мфpфΦ ¢KŜ {ŎλŜyŎŜ 2₮ ά a ȡzŘŘfλyƎ ¢Kℕ2ȡzƎKΦέ , 19(2), pp.iFE1 0 0 1 324.55 384

Meek, J., 2014. , London: Verso.

Ministry Of Defence, 2005. , London: The Stationary Office.

Mitchell, C., 2016. Momentum is increasing towards a flexible electricity system based on renewables. , 1(2), pp.517ς518.

Mitchell, C., 2010. , London: Palgrave MacMillan.

MoD, 2006. Government response to Select committee response to Select Committee 9th Report. .

Moore, M. & Westley, F., 2011. Surmountable Chasms: Networks and Social Innovation for Resilient Systems. , 16(1).

Parsons, T., 1954.

Rambukkana, N. ed., 2015. , New York: Peter Lang.

Ramsay, R., 2015. , London: Rowman and Littlefield.

Raustiala, K. & Victor, D.G., 2004. The Regime Complex for Plant Genetic Resources. , May 2004.

Renewable Energy Association, 2015. , London: Renewable Energy Association.

RenewableUK, 2015. Supply Chain Map. . Available at: http://www.renewableuk.com/page/SupplyChainMap [Accessed September 1, 2016].

Reuters, 2015. Greenpeace and utilities launch suit against Hinkley nuclear plant. . Available at: https://www.theguardian.com/environment/2015/jul/02/greenpeace-utilities-launch-suit-against-hinkley-nuclear-plant [Accessed September 1, 2016].

Richards, D., 1996. Elite Interviewing: Approaches and Pitfalls. , 16(3), pp.199ç204.

Ritchie, N., 2012. , London: Palgrave Macmillan.

Ritchie, N., 2014. , York: Article 36.

Robertson, S., 2015. A longitudinal quantitative-qualitative systems approach to the study of transitions toward a low carbon society. , 128, pp.221ç233.

Roe, E., 1994. , Durham: Duke University Press.

Ross, E., 2016. The nine countries that have nuclear weapons. . Available at: http://www.independent.co.uk/news/world/politics/the-nine-countries-that-have-nuclear-weapons-a6798756.html [Accessed September 1, 2016].

Royal Navy, 2016. Continuous at sea deterrent. . Available at: http://www.royalnavy.mod.uk/news-and-latest-activity/operations/global/continuous-at-sea-deterrent [Accessed September 1, 2016].

Rudd, Aφ нлмрφ ! Yōŝ wdzŘŘ ăLJŜŜŎK ƨy l· yŝ ŘŴŜŎúƨyƬƨ ¦ Y ŜyŝŴ∃è LJƨfŎèφ . Available at: https://www.gov.uk/government/speeches/amber-rudds-speech-on-a-new-direction-for-uk-energy-policy [Accessed September 1, 2016].

Ruddick, G. & Grierson, J., 2016. Hinkley Point C in doubt after British government delays approval. . Available at: https://www.theguardian.com/business/2016/jul/28/hinkley-point-c-to-go-ahead-after-edf-board-approves-project [Accessed September 1, 2016].

Runciman, D., 2016. , London: London School of Economics.

Ruz, C., 2015. Why do we need China to build our nuclear power plants? .

ŘŝŜ {łΣ !φΣ нлмрφ .Ŵl·Îƚ bdzŎfŝl·Ŵ {dzōYl·ŴŽyŝ tŴƨ∃Ŵl·YY ! l ƚăűƨŴŽŎl·f tŜŴăLJŜŎúŽØŜφ

, 22(1), pp.1746ç1766.

Sabatier, P. a. & Weible, C.M., 2007. The Advocacy Coalition Framework: Innovations and Clarifications. In P. A. Sabatier, ed. . Boulder, Colorado: Westview Press, pp. 189ç220.

Schank, J.F. et al., 2007. , Santa Monica, CA: RAND Corporation.

Schank, J.F. et al., 2005.

Smith, A. & Stirling, A., 2008.
, Brighton: STEPS Centre.

Söderbaum, F., 2004. Modes of Regional Governance in Africa: neoliberalism, sovereignty boosting and shadow networks. , 10(2004), pp.419ς436.

Somekh, B. & Lewin, C. eds., 2005. , London: Sage.

Sovacool, B.K., 2009. The intermittency of wind, solar, and renewable electricity generators: Technical barrier or rhetorical excuse? , 17(3ς4), pp.288ς296.

Späth, P. & w2KNl·ŎKŜNΣ I ΦΣ нлмлΦ ά9yŶN∃è NŜ∃λ2yãέΥ ¢KŜ úNl·yãŦ2NYˉl·úλØŜ LJ2ǿŜN 2Ŧ NŜ∃λ2yl·f Řλǎŏ2ȡzNǎŜǎ on socio-technical futures. , 39(4), pp.449ς458.

Spencer-Wood, S., 2004. What Difference Does Feminist Theory Make in Researching Households? A Commentary. In K. S. B. and J. C. Brandon, ed.
. Tuscaloosa, Alabama: The University of Alabama Press.

Stalcup, T., 2012. What is Brazil up to with its Nuclear Policy?
. Available at: http://journal.georgetown.edu/what-is-brazil-up-to-with-its-nuclear

Stirling, A., 1994. , Brighton: SPRU, University of Sussex.

Stirling, A., 2015. Power, Truth and Progress: towards knowledge democracies in Europe. In J. Wilsdon & R. Doubleday, eds. . Cambridge: University of Cambridge, pp. 133ç151.

Stirling, A., 2014. Transforming power: Social science and the politics of energy choices. , 1, pp.83ç95.

Stirling, A. & ₩2Ky㎝2yŜΣ t⌽Σ нлмс⌽ hy´ŭKŜ ά5ŜŜLJ {ŭl·ŭŜε I èLJ2ŭKŜăλă⌽ . Available at: http://polet.network/blog//deep-state-uk-response [Accessed September 1, 2016].

Stirling, A. & Saurabh Arora, 2015. From Multiple Levels to Entangled Streams of Practice: dynamics of structuration in sociotechnical transformations. In . Brighton: SPRU, University of Sussex.

{ŭ2yŜΣ 5⌽Σ нллн⌽ LyŭN2ŘdzŎŭλ2y㎝Y ∃f2ōl·f ℸy2øfŜŘ∃Ŝ l·yŘ l·ŘØ2Ŏl·Ôè yŜŭø2Nℸă⌽ , 2(1), pp.1ç11.

Stothard, M., 2016. Trade unions press EDF to delay Hinkley Point C decision. . Available at: http://www.ft.com/cms/s/0/18e1c7f6-3eda-11e6-9f2c-36b487ebd80a.html#axzz4J0818D00 [Accessed September 1, 2016].

Strunz, S., 2014. The German energy transition as a regime shift. , 100, pp.150ç

Thomas, S., 2016. The Hinkley Point decision: An analysis of the policy process. , 96, pp.421ç431.

Thomas, S., 1988. , Cambridge: Cambridge University Press.

Tickell, O., 2014. Bombs Ahoy! Why the UK is desperate for nuclear power. . Available at: http://www.theecologist.org/blogs_and_comments/commentators/2530828/bombs_ahoy_why_the_uk_is_desperate_for_nuclear_power.html [Accessed September 1, 2016].

Toke, D., 2013. Climate change and the nuclear securitisation of UK energy policy. , 22(4), pp.553ç570.

Toke, D., 2011. The UK offshore wind power programme: A sea-change in UK energy policy? , 39(2), pp.526ç534.

Toke, D., 2012. Will the Government Write a Blank Cheque for Nuclear Construction? . Available at: http://www.huffingtonpost.co.uk/david-toke/will-government-write-a-blank-cheque-for-nuclear-construction_b_1979027.html [Accessed September 1, 2016].

Tran, M., 2014. Modeling Sustainability Transitions on Complex Networks. , 19(5), pp.8ç22.

Turnheim, B. et al., 2015. Evaluating sustainability transitionă LJI·úKǿI·èă₩Y .ℕλŘƎλyƎ I·yϒI·fêűλǑI·f approaches to address governance challenges. , 35, pp.239ç253.

Tushman, M.L., Tushman, R.L. & Elaine Romanellianelli, E., 1985. Organizational Evolution: a metamorphosis model of convergence and evolution. , 7, pp.171ç222.

UCL IEPL, 2013. , Adelaide: University College London Australia and International Energy Policy Institute.

UK Trade and Investment, 2012. , London: Crown Copyright.

UK Trade and Investment, 2015. , London: Crown Copyright.

Unruh, G.C., 2000. Understanding carbon lock-in. , 28(2000), pp.817ç830.

UNSC, 2016. Current Members. . Available at: http://www.un.org/en/sc/members/ [Accessed September 1, 2016].

Urry, J., 2003. , Cambridge: Polity Press.

Valikangas, L., 2010. , New York: McGraw Hill.

±I·ăI·ƎI·ℕΣ WΦΣ нлмpφ /2Y˙LJℕ2Y˙λăŜ I·yŘ 2LJLJ2ăλűλ2y˙2y˙ℕ2I·Ř ű2 DŜℕY˙I·yêůă ℕŜySŜǿI·ōfŜ ŜySℕƎèφ . Available at: http://www.ft.com/cms/s/2/6a254194-47e9-11e5-af2f-4d6e0e5eda22.html#axzz4J0818D00 [Accessed September 1, 2016].

Vaughan, A., 2009. Miliband paves the way for the most ambitious fleet of nuclear reactors in

Europe. . Available at: https://www.theguardian.com/environment/2009/nov/09/energy-policy-nuclear-coal [Accessed September 1, 2016].

Vaughan, A., 2010. UK government approves eight sites for new nuclear power stations. . Available at: https://www.theguardian.com/environment/2010/oct/18/uk-government-new-nuclear-power [Accessed September 1, 2016].

Velazquez, A.C.S., 2014. Brazil and Mexico in the Non-Proliferation Regime: Common Structures and Divergent Trajectories in Latin America. In J. R. Fields, ed.

Wynne, B., 2002. Risk and environment as legitimatory discourses of technology: reflexivity inside out? , 50(3), pp.459ς477.

Wynne, B., 1975. The Rhetoric of Consensus Politics: a critical review of technology assessment. , 4(2), pp.108ς158.

Yang, K. & Miller, G.J. eds., 2008. , London: Taylor and Francis.

Young, O.R., Schroeder, H. & King, L.A. eds., 2008. , Cambridge Mass.: MIT Press.

[1] Investment in power capacity ς Renewable, Fossil-Fuel and nuclear (2008-2015 $billion)

Source: Frankfurt School-UNEP (2016).

[2] Despite many in the UK pointing towards Germany as an exception, it is actually developments in the UK that fail more to fit the general pattern of nuclear policy in Europe. As can be seen below, the scale of the ¦Yûå stated nuclear new build ambitions are clearly exceptional in Europe. And it is worth noting that major current new build projects at Olkilouto in Finland and Flamanville in France are facing significant challenges. These projects are both vastly over budget and behind schedule by 6 years in the case of Flamanville, and 10 years in the case of Olkilouto.

Ambitious nuclear new build	UK
Tentative new build plans (1 or 2 reactors planned)	,P ≠MCI(c)5D 17/Lang (it-IT)>BDC q319.87 221.1Qqa (

[4] Several episodes in the history of the UK nuclear fuel chain infrastructures illustrate this reference to a generally negative record of national nuclear performance. It might reasonably be thought that these distinctively poor outcomes from previous ambitions, might help dissuade policy makers from further similar aspirations, especially given the emergence in recent years of manifestly viable alternative low-Ǒł·№ō2ƴŘ2ϒŜăΰλǑ ŜƴŜ№∃è ₪Ŝă2ʤ№ǑŜă℗ ¸Ŝΰ ΰǨŜ ¦Y℡ă yʤzǑfŜł·№ yŜø ōʤzλfŘ LJfł·yã remain far more ambitious than those of other countries with less chequered histories regarding nuclear cost overruns, accidents, and significant technical errors. Some of the major current and historical UK nuclear challenges include:

The was the worst nuclear accident in the UK and one of the most significant nuclear ł·ǑǑλŘŜƴΰă λƴΰǨŜ ø2№tŘøλŘŜ Kλăΰ2№è 2Ŧ yʤzǑfŜł·№ LJ2øŜ№℗ ² KŜƴ2yŜ 2Ŧ ΰǨŜ ² λyŘăǑł·fŜ ΨLJλfŜă℡ Ǒł·ʤz∃Kΰ Ŧ∧№ŜΣ №ł·Řλ2l·ǑΰλØŜ materials (notably iodine-131, strontium-90, caesium-137, as well as polonium-210) were released into the surrounding environment (Arnold 2007). Resulting concerns led to precautionary bans in the sale of milk. It is ØŜ№è Řλ₮ŦλǑʤzfΰ ΰ2 ł·ăăŜăă ΰǨŜ Ŧʤzff Ǒ2ăΰă 2Ŧ ΰǨŜ ² λyŘăǑł·fŜ Řλăł·ăΰŜ№ ōŜǑł·ʤzăŜ ΰǨŜ LJfł·yΰ℡ă ŜăăŜyΰλł·f ăΰ№ł·ΰŜ∃λǑ №2fŜ λƴ plutonium production for nuclear weapons (ibid) meant that much associated information was kept secret by government. The damaged piles have remained a significant challenge to this day, requiring continual monitoring during the long ongoing process of decommissioning (World Nuclear News, 2013).

The Advanced Gas-Ǒ22fŜŘ wŜł·ǑΰΩ2№ LJ№2∃№ł·ϒϒŜ øł·ă №ŜŦŜ№№ŜŘ ΰ2 ōè ΰǨŜ /9D. ł·ă 2yŜ 2Ŧ áΰǨŜ ϒł·ƨ2№ ōʤzyŘŜ№ă 2Ŧ .№λΰλăK λyŘʤzăΰ№λł·f LJ2fΰǑèé ólјdz2ΰŜŘ λƴ .№2øy£ нллуº℗ ¢ǨŜ №Ŝł·ǑΰΩ2№ă Ŧł·ǑŜŘ ăλ∃yλŦλǑł·yΰ ΰŜǑKyλǑł·f difficulties exemplified by Dungeness B which took 18 years to construct and had a lifetime load factor of 43% (IAEA Reactor Database, 2016). Despite the great hope of a global market for AGRs, no reactor of this type was ever bought or constructed outside of the UK (Birmingham Policy Commission, 2015).

Fast breeder reactors were once a great hope of the British nuclear industry with announcements made in the early 1970s by the UK Atomic Energy Authority that by the year 2000, over 75% of electricity generation would be coming from nuclear power, with over half of the nuclear contribution coming from fast breeder reactors (Cochran et al 2010). In fact, by the year 2000 the UK share of nuclear was 25% and the fast breeder programme had long been abandoned. In fact, operational experience of fast breeder reactors in the UK was limited to the demonstration reactor at Dounreay on the north coast of Scotland. Nearly £5 billion of R&D was spent on fast breeder reactor development from 1974-1995 (IEA 2016). The Dounreay reactor was beset by technical difficulties, however, with a life time load factor of just 26.9% (IAEA 2016). The facility has been shrouded in controversy due to radioactive leaks occurring over the past two decades with dangerous radioactive particles found in the surrounding environment (Edwards 2011). There are particularly challenging technical aspects to the decommissioning of Dounreay and the process is expected to take several decades (McKenzie 2014).

Despite official declarations of ł· Ψă2fʤzΰλ2yΩ for UK radioactive waste (BERR 2008), no site has been found for the construction of a Deep Geological Disposal Facility (GDF) (DECC 2014). Radioactive waăΰŜ Ŧ№2ϒ .№ΰΰł·λyΩă ǑλØλf ł·yŘ ϒλfΩΰł·№è yʤzǑfŜł·№ LJ2øŜ№ LJ№2∃№ł·ϒϒŜă is stored on an ΨλyΰŜ№λϒΩ ōł·ăλă ł·ō2ØŜ ∃№2ʤzyŘΣ ϒł·λyfè ł·ΰ ΰǨŜ {ŜfŦł·ŦλŜfŘ Ŧł·ǑλfΩΰè ¢ǨŜ fł·ΰŜăΰ Ŝăΰλϒł·ΰŜă Ŧ2№ ΰǨŜ Ǒ2ăΰ 2Ŧ ŘŜł·fΩyƎ øλΰK ΰǨŜ ¦Y℡ă fŜ∃ł·Ǒy waste is £110 billion (Gosden 2014). The nuclear waste and reprocessing facility at Sellafield is widely Ǒ2yŜăλŘŜ№ŜŘ ΰ2 ōŜ ΰǨŜ ϒ2ăΰ ΨKł·Î·№Ř2ʤză λyŘʤzăΰ№λł·f ăλΰŜ λƴ9ʤz№2LJŜΩ ó a ǑYλŜ 2009), not least because it is the location of 140 tonnes of reactor grade plutonium costing £28 million a year to keep safe and secure (Broomby 2015). Other key hazards at the site include significant amounts of №ł·Řλ2ł·ǑΰλØŜ Ψăfʤzŕ∃ŜΩ Ǒ№Ŝł·ΰŜŘ by circulating water in fuel storage ponds℗ !ă t ł·ʤzf I 2øł·№ΰK 2Ŧ ΰǨŜ bł·ΰλ2yl·f bʤzǑfŜł·№ [ł·ō2№ł·ΰ2№è ăΰł·ΰŜăΣ áΰǨŜ exact contents of the ponds ł·№Ŝ ʤzyǑfŜł·№é, leading to significant problems in terms of the practicalities of keeping accurate inventories of the different classifications of waste at Sellafield (Pearce 2015). These ponds are considered an acute safety risk and keeping them safe and secure is one of the most technically challenging and expensive aspects of the overall

[7] The White Paper 2ʤzűfłyŜă űKŜ yŜŜŘ ₮2ℕ űKŜ ¦ YΩă yΩzÕtŜIꞏℕ ŘŜűŜℕℕŜyΩΣ Yꞏlꞏʅʎy∃ űKŜ ŏIꞏăŜ űKIꞏú úKŜ ØŜIꞏLJ2yΩă ăèăűŜY ℕŜLJresents the ΨdzfűʎYꞏIꞏúŜ IꞏăăʤzℕꞏyŏŜ 2₮ 2ʤzℕ yIꞏűʎ2yIꞏf ăŜÕʤzℕʎúèΩΦ ¢2yê . fIꞏʎℕ ʎy˝űKŜ ₮2ℕŜØ2ℕŘ ű2 űKŜ {úℕIꞏúŜ∃ʎŏ 5Ŝ₮ŜyŐŜ wŜØʎŜØ ȯнллсȕ 2ʤzűfłyŜă this security case further:

[8] It should be noted that these discussions were not without controversy, much of which surrounded the high costs of building a replacement nuclear submarine fleet (Sims 2016). The major Scottish political parties and many Scottish MPs are generally opposed to the fleet being based at Faslane. In 2007, a major House of Commons vote saw a number of Scottish Labour MPs rebel against the government, although the house backed plans for Trident renewal by a substantial majority of 409 to 161 (ibid).

[9] As stated in the Namtec-commissioned report on the supply chain for a nuclear new build programme:

.

(Court 2009: 51)

[10] Using the methodology shown in Section 4a numerous passages from key documents were identified which indicate linkages between developments in the fields of UK civil nuclear power and submarine nuclear propulsion, a small selection of which are shown in section 5.2. These quotes are shown in full detail here:

(HoC 2009: 70, Written Evidence from AMEC)

(NIRAB 2014: 26)

(HoC 2009: 107)

[11] The full quote from INucE and BNES

(BIS 2013: 79)

[19] The following extracts illustrate concerns about the state of the nuclear skills base in the UK as the result of reductions in R&D budgets over the past 20 years:

(HoC 2006:EV59, written evidence from BAE)

(HoC 2006: EV107, written evidence from RAEng)

[20] Some quotes highlight that rather than being a disadvantage in terms of competition, skills cross-overs could be seen as a further opportunity for the defence sector:

larger United Sta-5 1 72.02nitei

the Nuclear Industry Association (NIA) and government, and more recently Tom Greatex has moved from being in Government to chairing the NIA. In referencŜ ăĽJŜÔʎŦʎÔIꞏfŧȅ ű2 ŭKŜ ℕŜƳIꞏℕ❳IꞏōŧŜ ΨIꞏō2ʤzű ŭʤzℕyΩ ʎƳyʤzŎŧŜIꞏℕ LJ2ŧ\ÔȅōŜŭøŜŜƳнллоꞏ2007 the Public Administration Committee report states the following:

Recent papers in the SPRU Working Paper Series:

April 2016

Funding Data from Publication Acknowledgements: Coverage, Uses and Limitations. Nicola Grassano, Daniele Rotolo, Joshua Hutton, Fr d rique Lang, Michael Hopkins.

Reviewing the Evidence on the Innovation Impact of the EU Emission Trading System. Karoline Rogge.

June 2016

The Role of Community Leadership in the Development of Grassroots Innovations. Mari Martiskainen.

Fossil Energy in Economic Growth: A Study of the Energy Direction of Technical Change. Gregor Semieniuk.

Financing Renewable Energy: Who is Financing What and Why it Matters. Mariana Mazzucato, Gregor Semieniuk.

July 2016

User-made Immobilities