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Vulnerability to terrorist attacks in European electricity decarbonisation scenarios: Comparing renewable electricity imports to gas imports

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HIGHLIGHTS

- A comparison of terrorism risks of importing solar power and gas for power generation.
- Both scenarios show low vulnerability to terrorist attacks.
- Within low vulnerabilities, gas imports are less vulnerable than electricity imports.
- Causing spectacular, large and long outages is very difficult for attacker.
- The attractiveness of gas and power import infrastructure as terrorist target is low.

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ABSTRACT

The decarbonised future European electricity system must remain secure: reliable electricity supply is a prerequisite for the functioning of modern society. Scenarios like Desertec, which partially rely on solar power imports from the Middle East and North Africa, may be attractive for decarbonisation, but raise concerns about terrorists interrupting supply by attacking the long, unprotected transmission lines in the Sahara. In this paper, I develop new methods and assess the European vulnerability to terrorist attacks in the Desertec scenario. I compare this to the vulnerability of today's system and a decarbonisation scenario in which Europe relies on gas imports for electricity generation. I show that the vulnerability of both gas and electricity imports is low, but electricity imports are more vulnerable than gas imports, due to their technical characteristics. Gas outages (and, potentially, resulting blackouts) are the very unlikely consequence even of very high-number attacks against the gas import system, whereas short blackouts are the potential consequence of a few attacks against the import electricity lines. As the impacts of all except extreme attacks are limited, terrorists cannot attack energy infrastructure and cause spectacular, fear-creating outages. Both gas and electricity import infrastructure are thus unattractive and unlikely terrorist targets.

1. Introduction

The European electricity system is changing, primarily driven by climate change concerns. Towards the middle of this century, the electricity system must – should Europe stand a fair chance to meet its long-term 80–95% decarbonisation target – be almost completely carbon-neutral (ECF, 2010). This target is however not the only one to fulfil. Modern economies come to an abrupt halt when the energy and, in particular, electricity supply is interrupted, so that the security of supplies is an equally important objective. Many point to terrorist attacks against critical energy infrastructure (CEI) as a particularly serious threat to energy security. For example, the European Commission perceives the terrorist threat against CEI as "*a priority*" for its critical infrastructure protection programme (EC, 2006, p.3). Also in science, a paramount view is that critical infrastructure is "*a dominant target for terrorist attacks*" (Tranchita et al., 2009, p. 246), especially the electricity system, which is "*the most critical of all*" (van der Vleuten and Lagendijk, 2010, p. 2053).

Thus, an electricity decarbonisation pathway that introduces unacceptable vulnerabilities to terrorist attacks should be discarded. In this, it must be acknowledged that there is no zero-risk pathway: if Europe discards one pathway, it must choose another, and this comes with its own set of vulnerabilities.

One much discussed option for the decarbonisation of the European power sector is to massively expand the domestic

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Table 1
Registered terrorist attacks in the WITS database between January 2004 and June 2011. Total entries, energy infrastructure (total, electricity, power station, gas pipeline, and gas well). Source: WITS, 2011.

	Registered attacks	Of which in EU27	Of which in North Africa	Of which in Russia
Total terrorist attacks 2004–June 2011	82,594	2415 (2.9%)	479 (434 in Algeria, 38 Egypt) (0.6%)	2296 (2.8%)
Attacks against energy infrastructure/employees	2572	18 (0.7%)	22 (17 Algeria, 5 Egypt) (0.9%)	70 (2.7%)
Of which against electricity assets	638	14 (10 Spain, 2 France, 2 Greece) (2.2%)	3 (2 Algeria,1 Egypt) (0.5%)	14 (2.2%)
Of which against power stations	63	1 (Spain) (1.6%)	2 (Algeria, Egypt) (3.2%)	1 (1.6%)
Of which against gas pipelines	354	0	6 (3 Algeria, 3 Egypt) (1.7%)	30 (8.5%)
Of which against gas wells	7	0	0	0

renewable generation, and complement this with imports of dispatchable concentrated solar power (CSP) from the Middle East and North Africa (MENA), such as proposed by *Desertec* and others (e.g. Desertec, 2008; Patt et al., 2011; Trieb, 2006). Given the already present concern about the vulnerability of the electricity system and its attractiveness as a terrorist target, proposals like Desertec further fuel these energy security worries. For example, the CEO of Bloomberg New Energy Finance stated: "*I'm not sure we want to be dependent on North Africa for our* [Europe's] *electricity supply when anyone with a shoulder-launched missile can take out the electricity supply for Europe*" (Morales, 2010).

Another decarbonisation option is to continue to burn fossil fuels for electricity generation, in particular gas, which is a lower-carbon fuel than coal, and add carbon capture and storage (CCS) technologies to capture and store the CO_2 away before it is vented into the atmosphere. Considering the dwindling European gas reserves, this would likely require Europe to rely on gas from neighbouring, gas-rich countries – predominately in MENA and the former Soviet Union (FSU) – imported through long, unprotected pipelines or exposed terrorist targets like liquefied natural gas (LNG) terminals. Thus, the vulnerabilities seem similar, and the choice between a Desertec-like Supergrid future and a gas-import dependent one seems to be a choice between two rather equally secure, or insecure, options: "*renewable energy infrastructure* […] *is not significantly more vulnerable to attack than its oil and gas counterparts*" (Lacher and Kumetat, 2011, p. 4476).

In this paper, I investigate the question whether solar power imports from MENA introduces new, significant terrorism vulnerabilities threatening European energy security, and how these vulnerabilities compare to an alternate scenario in which gas for electricity generation is imported.

2. Critical energy infrastructure and terrorism

Despite the worries voiced, terrorism against CEI was not a major issue in Europe in the past. Overall, blackouts are both rare and small in Europe: each customer experiences on average two per year, lasting around 100 min (CEER, 2008). Practically all blackouts are caused by natural events, especially lightning, and technical failures; terrorism and sabotage are so uncommon that they are not accounted for (Nordel, 2008). In the US, 80% of the infrastructure failures 1984–2006 were caused by natural events, whereas terrorist attacks caused zero blackouts (Simonoff et al., 2007). The gas supply from Algeria to Europe has been interrupted twice by terrorist attacks, in 1997 and 2006, both times for a few days, with no end-consumer supply impacts in Europe (Lacher and Kumetat, 2011). Serious attacks against gas pipelines have occurred elsewhere, prominently the 14 attacks in 2011–2012 against the Sinai gas pipeline in Egypt (NYT, 2012).

Furthermore, CEI are not dominant terrorist targets, see Table 1. Only 3% of all terrorist attacks registered in the US government terrorism database WITS affected CEI, including attacks against gasoline trucks and employees of CEI facilities (the employees appear to have been the main target of many attacks, see Lacher and Kumetat, 2011). Less than 1% of CEI attacks took place in Europe. Most CEI attacks – at least 60% – and all attacks causing heavy damage affected energy transport facilities. Of the 2572 registered CEI attacks, only 12 caused "heavy damage" [1] (damage > $20 million), whereas almost all caused "none" or "light damage" (< $500,000). CEI attacks with serious impacts on supply are very infrequent worldwide, and extremely seldom – if they have happened at all – in Europe.

From the terrorism research literature we know that terrorists seek to influence a wider audience than the one immediately affected by an attack, by causing damages, which in turn induce fear, or *terror* (Ruby, 2002). They do this to show the target audience the costs of not complying with the group's political demands, and thus coerce the targeted state into conceding to these demands. As a response, most countries adopt a strict no-concessions policy to decrease the political usefulness of terrorism. Consequentially, terrorists rarely achieve their political aims: Abrahms (2006) shows that only 3 of the 42 political aims expressed by the 28 groups listed by the US State Department as foreign terrorist organisations were met, and all of these successes came from attacking military facilities, not from attacking civilians. He explains this by the perception of terrorists' demands in the target audience. The military is "used to" being attacked, and the terrorists' demands may be understood by the audience the way they are put forth when such targets are attacked. When civilians are attacked, the target audience often infers from the disastrous impacts that the terrorists aim to "destroy our nation" or "our way of life", even though this is rarely the actual aim of attackers. No government can concede to such maximalist demands, and can thus not accommodate the actual, non-maximalist, terrorist demands (Abrahms, 2006). In addition, countries are not very prone to changing their policies due to external pressure, as can be seen by the low success rate of imposed economic sanctions (Drezner, 2003; Hovi et al., 2005).

These limited prospects of political success should act as a deterrent for attacks, against energy installations and in general. Terrorists however still carry out attacks, indicating that they may be motivated not only by political aims but also by punitive ones – simply punishing a state for past or ongoing transgressions. Social aims, in particular such of members' belonging to a group, and maintaining that group over time, have also been identified in empirical studies as important drivers of terrorist action: the key determinant for joining a terrorist group is not political sympathy, but having a friend or relative in the group. The terrorist action – sometimes against other, ideologically similar groups – and the

[1] These were 9 oil pipeline attacks in Nigeria, 2 oil pipeline attacks in Iraq, and 1 gas pipeline attack in Mexico.