Terrorism risks in climate-friendly electricity scenarios for Europe

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Introduction

If Europe is to reach its long-term climate targets of 80-95% greenhouse gas emissions by 2050, the power sector must be made almost entirely carbon neutral. Decarbonising the European power system with mainly domestic renewables and supporting this with imports of dispatchable solar power from North Africa, as foreseen in the Desertec concept, is one frequently proposed way to achieve this.

However, Desertec also triggers concerns and numerous unanswered questions remain. One critical question is whether the long, largely unprotected import HVDC lines would be an attractive terrorist target and a threat to European security of electricity supply. Concerns that critical energy infrastructure, and especially electricity transmission lines, are "*a dominant target for terrorist attacks*" (Tranchita et al., 2009:246) are prominent in science, policy and industry alike. For example, the CEO of Bloomberg New Energy Finance stated: "*I'm not sure we want to be dependent on North Africa for our electricity supply when anyone with a shoulder-launched missile can take out the electricity supply for Europe*" (Morales, 2010).

However, if Europe decides against Desertec, it must choose another pathway for its decarbonised electricity supply. Among the most feasible pillars for this appears to be to rely on natural gas for power generation and add carbon capture and storage (CCS). 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, at first sight, both these decarbonisation pathways have similar vulnerabilities. Here, I assess and compare the inherent terrorist attack vulnerabilities of an electricity import (Desertec, Trieb, 2006; Trieb et al., 2012) and a gas import-based CCS scenario (from the Global energy assessment (GEA) Johansson et al., 2012).

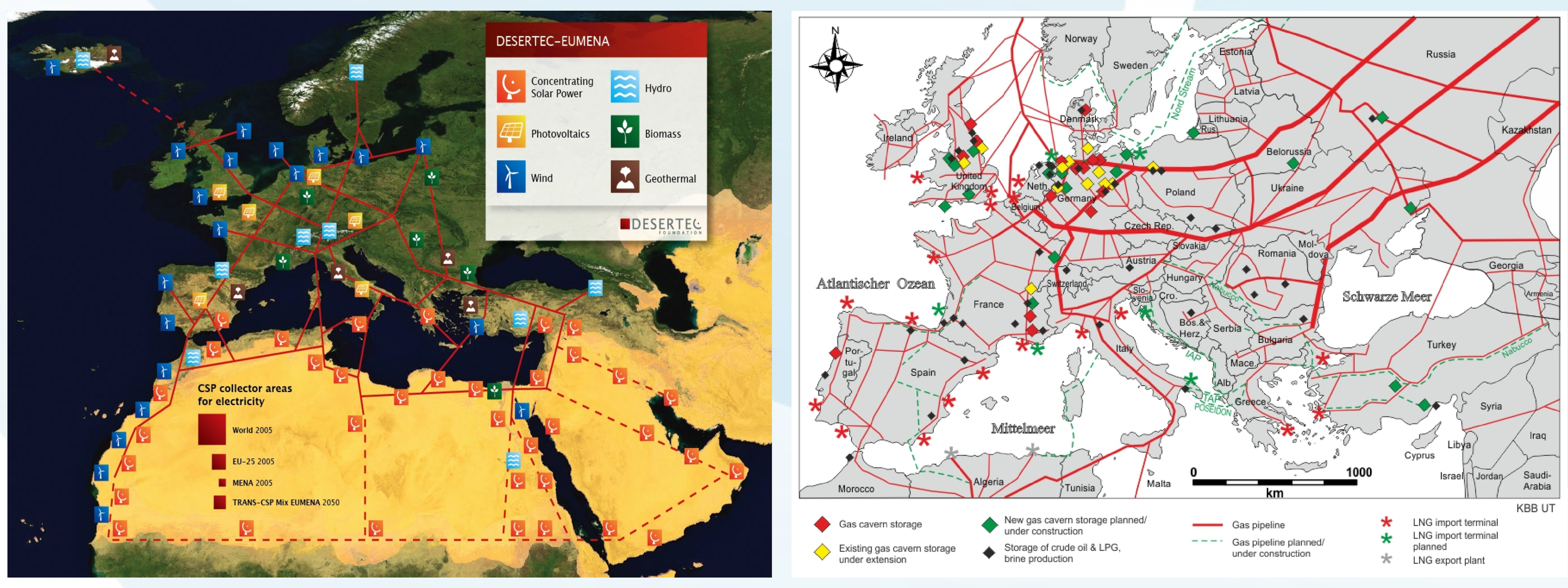

Figure 1: General structure of electricity (left) and gas (right) import channels. Sources: Desertec foundation, kbbnet.de,

Terrorist target selection

Typical terrorist targets are soft, or easy-to-attack, and high-profile targets, attacked with the aim to create fear – or *terror* – and affect an enemy audience wider than the population immediately affected by the attack. Successfully destroying energy infrastructure can potentially cause large economic damage and even disrupt the functioning of society and the state, making a terrorist-induced outages potentially very high-profile and fear-creating.

Long, unprotected pipelines and HVDC lines are soft targets: if a terrorist group decides to destroy a single line, they have good prospects of succeeding, but this does not necessarily cause outages. For this, multiple attacks are necessary, but this is difficult and only few terrorist groups have the capacity for a large number of coordinated attacks. Thus, the number of successful attacks needed to overcome the buffers is estimated as a proxy for the softness of the infrastructure system.

To fulfil the fear-creation criterion, however, the resulting outage must be large and, above all, sustained. Terrorist-induced outages have never happened in Europe, and are very rare in the world (especially outside Iraq, Pakistan and Afghanistan), but one cannot be sure that it remains this way. Future terrorists could see energy infrastructure as a symbol of their enemy, a large-scale attack is certainly possible (with no statement about probability) and the effects of a large and long outage would probably be fear-creating at a high level. If it is possible to cause severe outages, energy infrastructure could be attractive to terrorists. Thus, the potential outage size and length of various attack scenarios is a useful proxy both for the European vulnerability and the attractiveness for terrorists to attack energy infrastructure supplying Europe.

For this, the scenarios are decomposed down to the infrastructure level, with each import chokepoint (HVDC import line, gas pipeline or LNG terminal) depicted separately. Whereas Desertec allows for this level of resolution, the GEA scenario is assumed to be served by the gas import and storage infrastructure existing today and in construction/planning for 2020. In a sensitivity analysis approach, I test whether the data is robust and the conclusions generic to the supply modes, or if they are only valid to the precise import configurations of Desertec and GEA. For this, the full span of possible import channels is tested: the Desertec HVDC lines are doubled ("min-case") and halved ("max-case") compared to what is proposed, and the GEA gas imports come either only by pipelines the size of the Brotherhood trunk line ("min-case") or only by medium-sized LNG terminals ("max-case").

Results

The results show that the inherent terrorist attack vulnerabilities of the import systems for electricity and gas are low, as the systems are both diversified and have considerable buffers.

It is difficult to overcome the buffers and cause an outage at all: the buffers require terrorists to simultaneously disable at least 2 or 3 power lines if the aim is to cause a blackout, whereas between 5 (extremely conservative case) and over 100 gas import points must be disabled to overcome the immediate gas buffers, see Table 1. Therefore, although each single chokepoint is a soft target, the energy infrastructure system as a whole is not.

Table 1: Number of simultaneously disabled chokepoints required to overcome primary buffers. Source: Lilliestam (in review)

	Desertec			GEA		
	Max.	Base	Min.	Max.	Base	Min.
Peak demand	3	2	2	80	28	7
Average demand	3	2	2	102	54	11
Half response	3	2	2	40	13	5
Double response	3	2	2	n.a.	n.a.	n.a.

If the aim is to cause spectacular impacts which cannot be quickly remedied, a much larger number of simultaneous, successful attacks is required: achieving this would require the attackers to successfully carry out between 30 and 120 simultaneous attacks across a huge area, see Figures 1 and 2. Doing this is extremely difficult, so that the by far most likely impact of a reasonable-scale terrorist attack is negligible, or – for the large-number attack scenarios – short-lived and thus manageable. These unspectacular impacts of even spectacular, multiple attacks reduce the attractiveness of energy infrastructure as a terrorist target: a group capable of carrying out many simultaneous attacks may instead choose another target than the energy system.

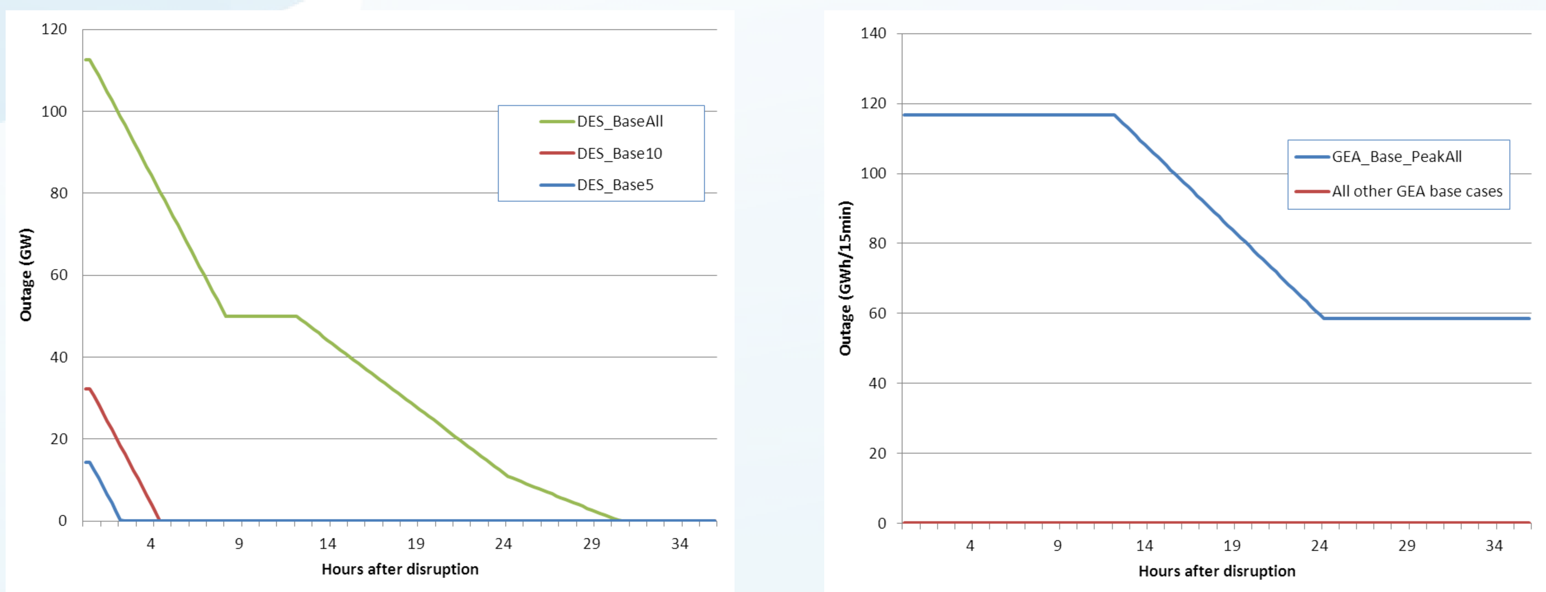

Figure 2: Potential outage size and duration for the simultaneaous disabling of 5, 10 and all (33 and 83, respectively) chokepoints for Desertec (left) and GEA (right). Source: Lilliestam (in review)

Conclusion

Traditional, forceful attacks are highly unlikely to cause spectacular (i.e. very large and long-lasting) outages and cause severe damage, as system functionality can be restored quickly in all but the most extreme attack scenarios. These however require a very large number, at least 10 but in some variations over 100, of simultaneous, successful attacks. This is especially true for gas imports, due to the presence of storages, whereas electricity imports are slightly more vulnerable. Achieving this would be very challenging for a national army, and almost impossible for a terrorist group. As a consequence, the potential impacts for Europe, and hence its vulnerability, are low, and the attractiveness to attackers is also low. Thus, the terrorism risk of both electricity and gas imports is not a major concern for the decarbonisation policies of Europe.

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