How can improved energy efficiency affect energy security?

Energy efficiency (EE) is usually highlighted as a measure that provides multiple advantages including reducing greenhouse gas emissions, energy costs and energy security. Energy security is, however, a vague concept that could include a variety of aspects such as security of supply, security of demand and revenue, as well as political, technological and environmental risk factors. Below we present some aspects of the connection between energy efficiency and energy security.

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KEY ENERGY SECURITY DIMENSIONS	ENERGY SECURITY ASPECTS	EFFECTS FROM ENERGY EFFICIENCY (EE)	
Security of supply	Resource availability	+	In the short-term, due to less pressure on limited production capacity
		0	In the mid-term, since outtake will be adjusted to fit demand
		+	In the long-term, since limited resources will last longer
	Vulnerability to price shocks	+	Energy constitute a less significant share of total economy
	Vulnerability to supply cut-offs from abroad	0	Little effect unless EE has eliminated a certain external dependency
		-	If EE leads to lower prices forcing closure of domestic supply capacity
	Vulnerability to domestic infrastructure failures	0	Same vulnerability to total cut-offs
Security of demand and revenue	Energy revenues, when EE is implemented in importing countries	-	In the short-term, due to reduced demand and prices
		-/0	In the long-term: Resources and thus incomes will last longer which could compensate for near-time losses
	Energy revenues, when EE is implemented in exporting countries	+/0/-	Depending on the size of the EE improvements and its impact on energy prices
Political risk factors	Domestic aspects in non-democratic exporting countries; e.g. human security, resource curse, political situation, regime stability	-	In the short-term, since less revenue might destabilize prevailing power structures leading to violence
		+	In the long-term, if reduced demand helps weakening repressing regimes
	Use of the energy weapon: political pressure from an exporting country	+	Reduced vulnerability to price increases and supply reductions
		0	Same vulnerability to total cut-offs
	Increased securitization of energy leading to increased international tension and military involvement	+/0	Indirectly positive, but only if EE prevents the energy issue from passing the threshold of becoming a securitized policy theme
	Security through interdependency due to energy trade	-/0	Negative effect if interdependency is not withheld with other means than energy, e.g. other goods and services
	Energy poverty	+	Indirectly, if EE leads to reduced demand and lower energy prices
Technological and environmental risk factors	Infrastructural risk factors, e.g. electrical risks	0	Since risks are volume independent
	Explosive risks, oil tanker accidents, nuclear accidents	0/+	Remains as long as energy source remains, but decreased volumes lower accident probability
	Climate change, pollution, land-use effects of bioenergy, wind power etc. (volume dependent aspects)	+	EE leads generally to positive effects
	Land-use for infrastructure, radiation risks (volume independent aspects)	0/+	Positive effect only if EE leads to elimination of infrastructure and other facilities

+ increased security, 0 no significant effect on security, - decreased security

Security of supply

Security of supply includes both physical aspects (availability of energy to the consumer at the time of demand) and price aspects (affordable and stable prices). EE reduces the depletion of fossil energy resources and the stress on renewable resources. It also reduces the systems vulnerability to high and volatile prices.

In the short-term it will also increase the marginal in production and distribution capacity, but this advantage can be reduced in the longer term as capacities are adapted to new demand levels. If lower demands lead to fewer production and distribution facilities the system as a whole may be more vulnerable to disturbances or failures that would occur at a specific facility.

Security of demand and revenue

Reduced energy demand in energy importing countries can reduce security of revenue in exporting countries as a result of falling quantities and prices. Prices can be upheld by reducing production, saving resources and incomes for future needs. However, as a whole energy exporters will probably lose from energy efficiency measures in importing countries. Energy intensity is high in many exporting countries, often as a result of subsidized prices. Improved energy efficiency in exporting countries would increase the volumes available for export as well as potential revenues as exported energy is sold at market prices. The positive effects can be reduced or eliminated, if the extra supply to the market, resulting from EE, leads to significant price reductions.

Political risk factors

Political risk factors involve aspects that could be classified as national security issues, foreign policy, international relations and geopolitics (e.g. the ‘energy weapon’), but also energy poverty, human rights and corruption issues (e.g. associated with ‘resource curse’). EE reduces the stress on energy sources and might thus decrease international tensions and securitization of energy. However, the vulnerability to total cut-offs remains, which leaves some room for using energy as a weapon.

Reduced demand might destabilize exporting countries, which could lead to violence, but in the long-term also entail democratic reforms. Reduced energy trade might lead to decreased international security due to decreased interdependency among nations.

Technological and environmental risk factors

Technological risk factors involve hydro dam safety, risks with nuclear materials, explosive fuels etc. Lower volumes can reduce the probability for accidents and other events. When certain systems work near maximum capacity, risks are generally enhanced, and even small demand reductions can relax these risks. Significant demand decreases would also give the opportunity to remove more risk associated elements from the energy system.

Environmental risks related to energy such as climate change, health effects of air pollution and threats to biodiversity from biomass use constitute a large research field from which it is safe to conclude that energy efficiency generally entails positive effects.

Conclusion

Energy efficiency has positive effects on many aspects of energy security and is neutral with regard to many other. Aspects with potentially strong negative outcomes are connected to suppliers need for security of demand and the liberal argument of security through interdependence.

The impacts depend on energy source, market structure and infrastructural preconditions. It also depends on from whose perspective energy security is evaluated. Furthermore, energy efficiency has to be weighed against other strategies to improve security.