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Network Integration of DER

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Technological Control Capabilities of DER to Provide Future Ancillary Services

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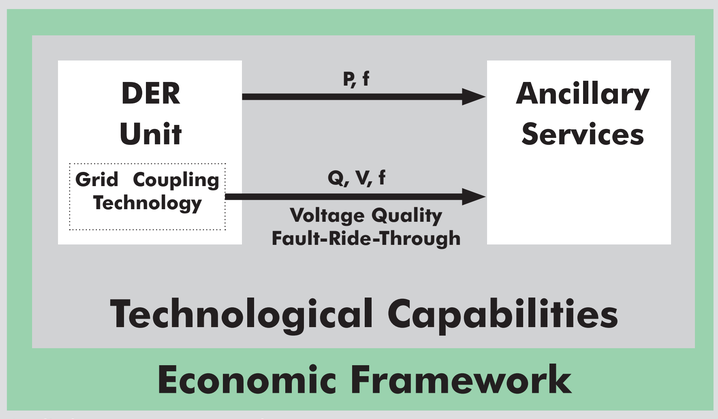
Sustainable Electricity Supply of the Future:

The increasing amount of Distributed Generators (DGs) has to participate in network operation to guarantee a sustainable and reliable electricity supply of the future. With the aggregation of distributed generators and loads, a Virtual Power Plant (VPP) can participate on electricity markets and provide ancillary services (see figures above). This enables the substitution of large centrally operated conventional power plants. The results presented here show the technological capabilities of individual Distributed Energy Ressources (DER) to provide ancillary services within the framework of VPPs.

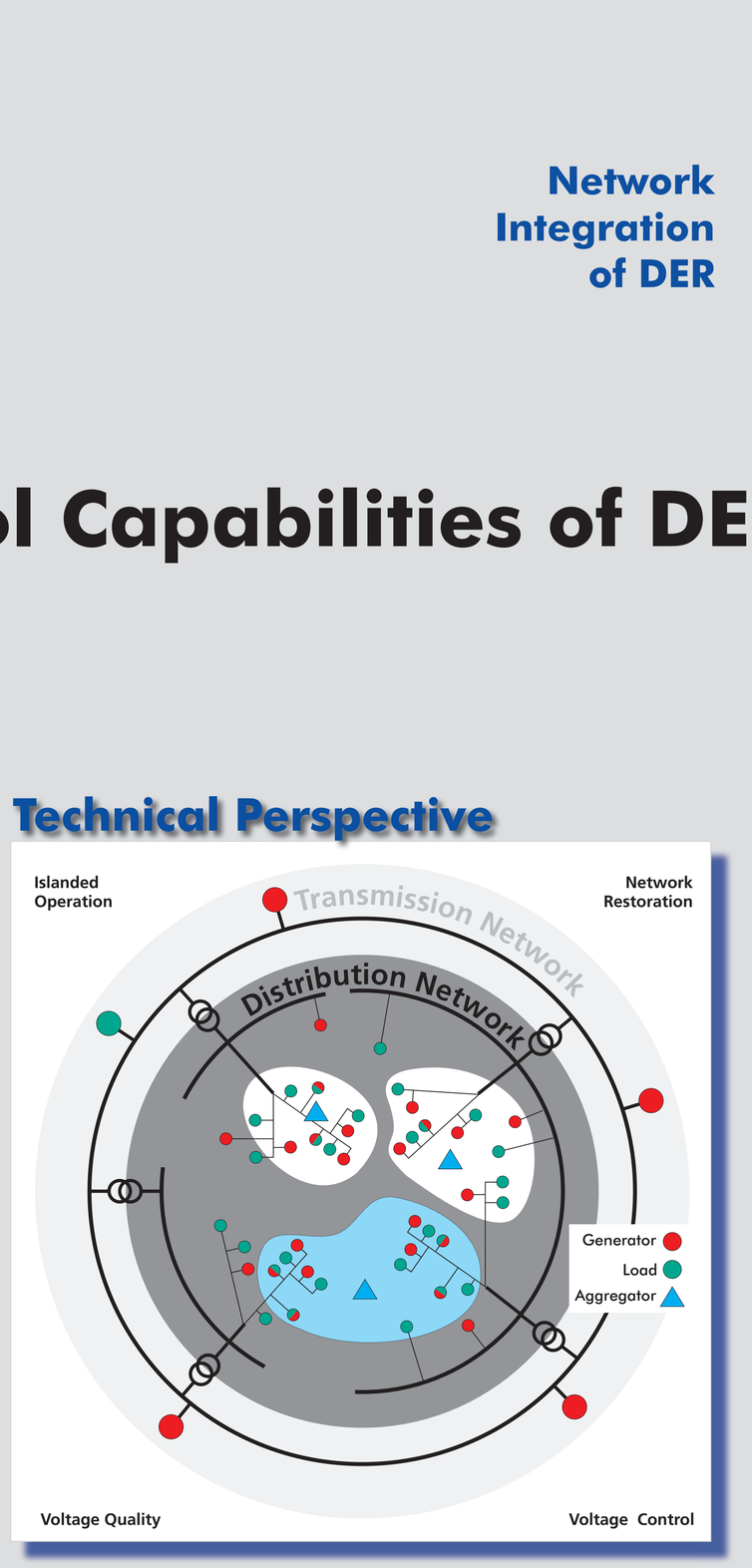


Applied assessment approach

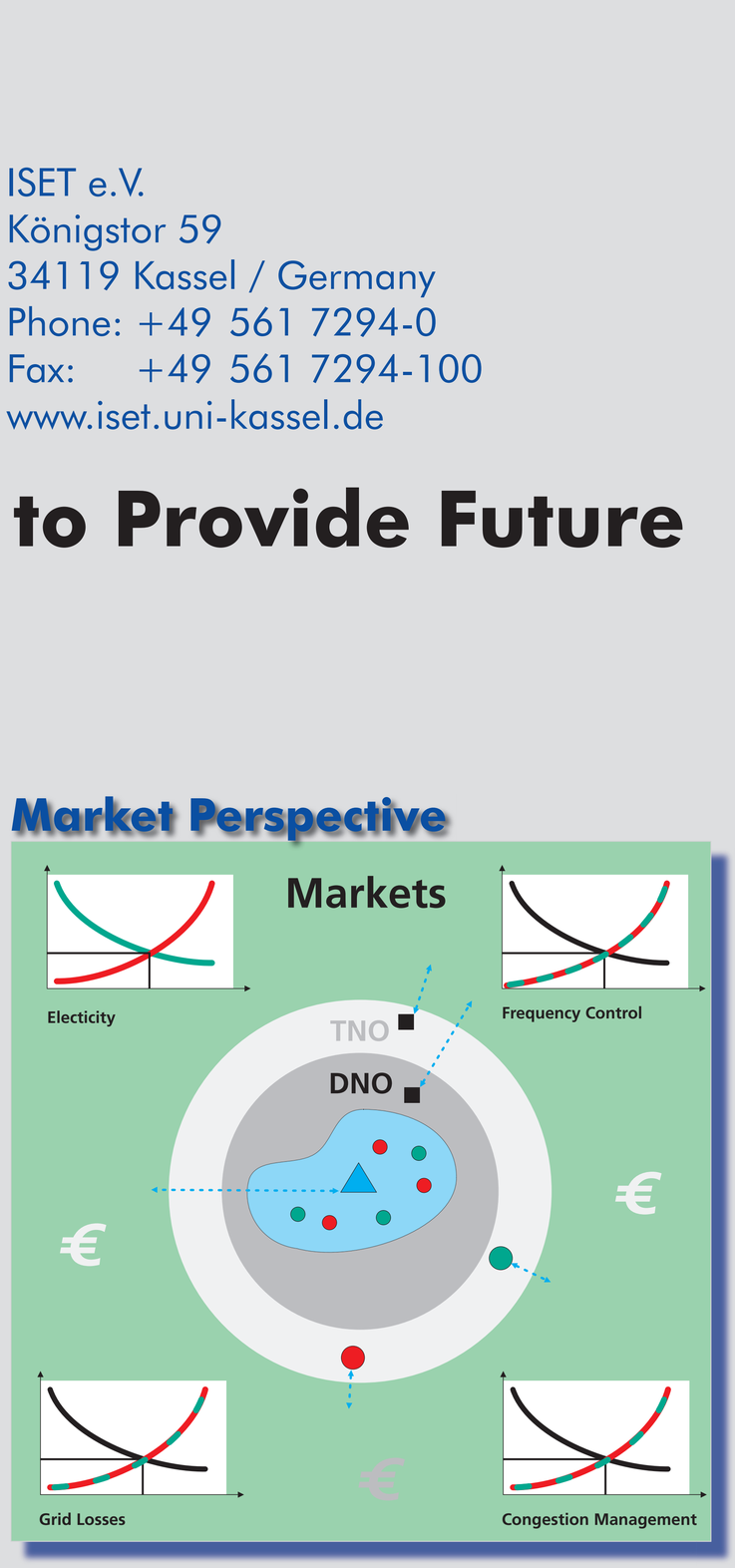
Assessment Approach:

Many DER units can be coupled to the grid by different grid coupling technologies. Consequently, the technological capabilities are analysed with an approach (see figure above) of looking firstly at the grid coupling technology and secondly at the whole DER unit. This distinction is necessary because the grid coupling technology determines many capabilities of the DER unit.

Technical Perspective



Market Perspective



Ancillary Services \ DER Unit	WTG		PV	Hydro		CCHP				Storage		Loads
						thermal-driven		electricity-driven				
Frequency Control		+	+		+		no		++		++	+
Voltage Control, Congestion Management, Optimisation of Grid Losses	Inv	++	++	Inv	++	Inv	+	Inv	++	Inv	++	+
	SG	++		SG	++	SG	+	SG	++	SG	++	
	DFIG	+										
	IG	-		IG	-	IG	no	IG	-	IG	-	
Improvement of Voltage Quality	Inv	++	++	Inv	++	Inv	++	Inv	++	Inv	++	-
	SG	no		SG	no	SG	no	SG	no	SG	no	
	DFIG	+										
	IG	no		IG	no	IG	no	IG	no	IG	no	
Black Start	Inv	+	+	Inv	+	Inv	no	Inv	++	Inv	++	no
	SG	+		SG	+	SG		SG	+	SG	+	
	DFIG	-										
	IG	no		IG	no	IG		IG	no	IG	no	
Islanded Operation	Inv	+	+	Inv	+	Inv	no	Inv	++	Inv	++	no
	SG	+		SG	+	SG		SG	++	SG	++	
	DFIG	-										
	IG	no		IG	no	IG		IG	no	IG	no	
Fault-Ride-Through	Inv	++	++	Inv	++	Inv	++	Inv	++	Inv	++	-
	SG	-		SG	-	SG	-	SG	-	SG	-	
	DFIG	+										
	IG	--		IG	--	IG	--	IG	--	IG	--	

Legend

Grid Coupling Technology
IG directly-coupled induction generators
SG directly-coupled synchronous generators
DFIG doubly-fed induction generators
Inv inverters (including inverter-coupled IG and SG)

++ indicates very good capabilities
+ indicates good capabilities
- indicates little capabilities
-- indicates very little capabilities
no indicates that this is not possible without additional external equipment

Results:

The table shows substantial technological potentials of DER within the framework of VPPs. Especially, inverter-coupled units can provide various ancillary services. Although many of these features would have economic benefits most of them are not used at present. With their application, DER integrated in VPPs are expected to build a supporting role of the future electricity supply and the future network operation.

contact: Martin Braun • phone: ++49 561 7294-118 • e-mail: mbraun@iset.uni-kassel.de • Second International Conference on Integration of Renewable and Distributed Energy Resources • NAPA CA, USA, 4-8 December 2006

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