

TSO perspective on

short-term operations

Impact of renewables for German and European System IEA – Paris, 15 January 2015

> Siem Bruijns – TenneT/TSCNET Services GmbH

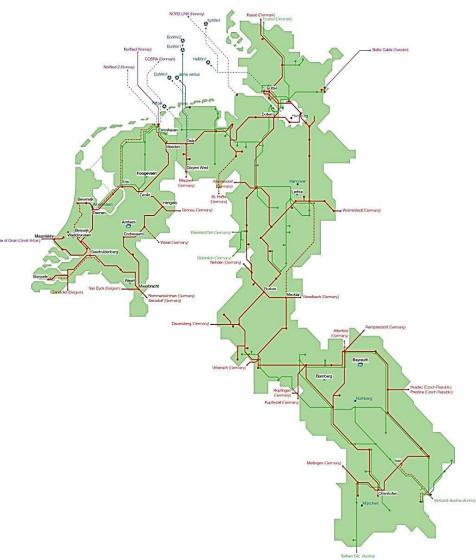
Content

- TenneT and TSC
- Renewables Growth and other developments in Germany
- Consequences for the system
- Measures to keep the system working
- Renewables and new challenges: an example



TenneT Overview

Key figures TenneT	
Grid length	21.000 km
Substations	440
XB-Inteconnections	14
Customers	36 miljoen
Custumer satisfaction	8,6
Employees	2.596
Installed Power	67.000 MW
Turnover (2013)	EUR 2,2 miljard
EBIT (2013)	620 miljoen
Grid availability	99,9999%
Investments t/m 2023	16 miljard



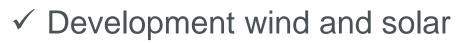
TSC: A powerful initiative





- TSO Security Cooperation launched in 12/2008
- Fostering regional European coordination for security of supply, system security, and operational planning
- 13 TSOs covering 10 European countries
- Following a decentralised approach, with TSOs in charge of grid security and remedial actions
- Harmonised capacity calculation mechanisms and remedial actions, new cooperation tools for control centres
- Panels and work groups share knowledge
 and expertise
- TSCNET Services GmbH in Munich, Germany
- Open to the participation of other TSOs

Developments Germany

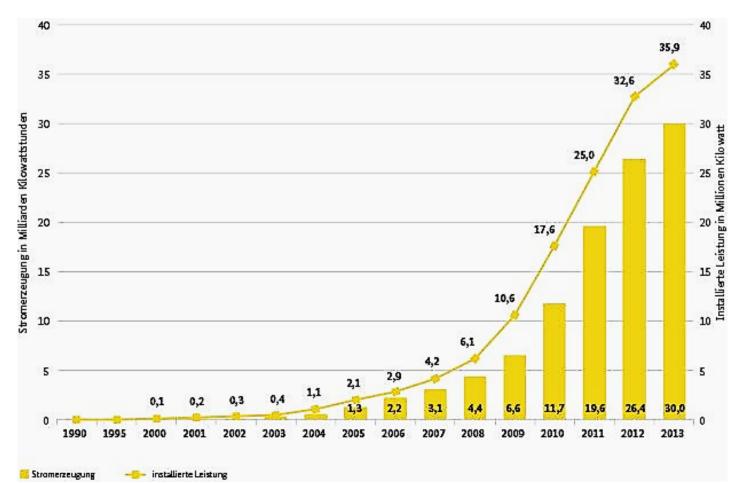


- ✓ Nuclear Phase-out
- ✓ Availability Conventional Power Plants



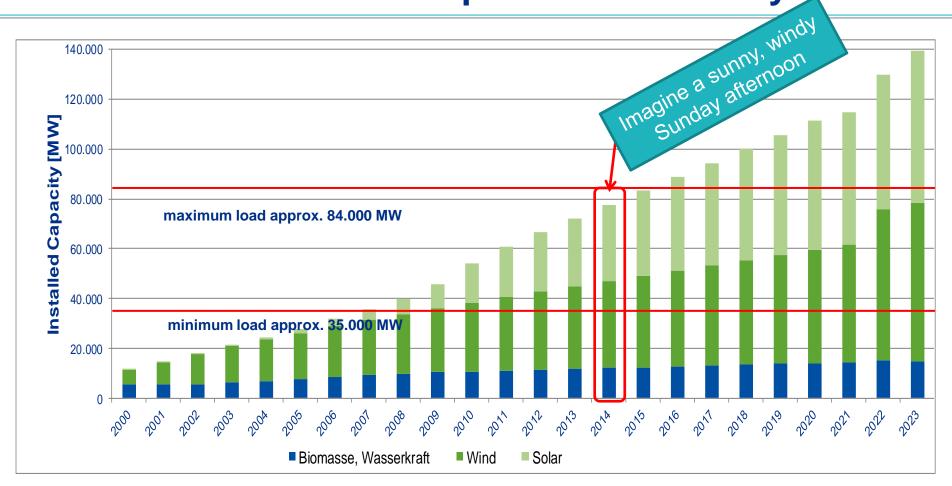
Growth of solar generation in Germany

2009-2014



Forecasted RES development in Germany





Major part currently not TSO-influencable with market mechanisms

Sources: BMU nach Arbeitsgruppe Neue Energien-Statistik (AGEE-Stat)



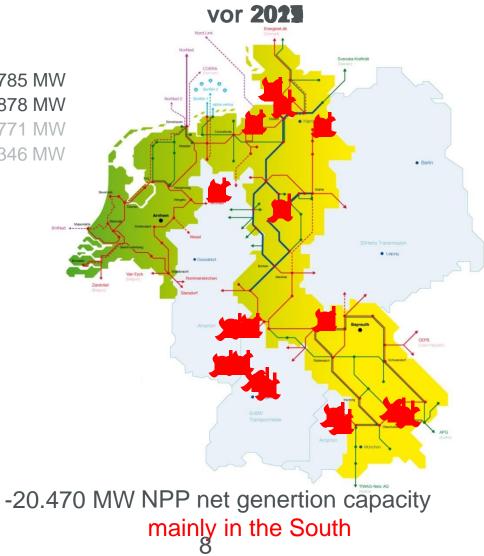
Nuclear Power Plant Phase-Out

Stages of the phase-out until 2022

2011:

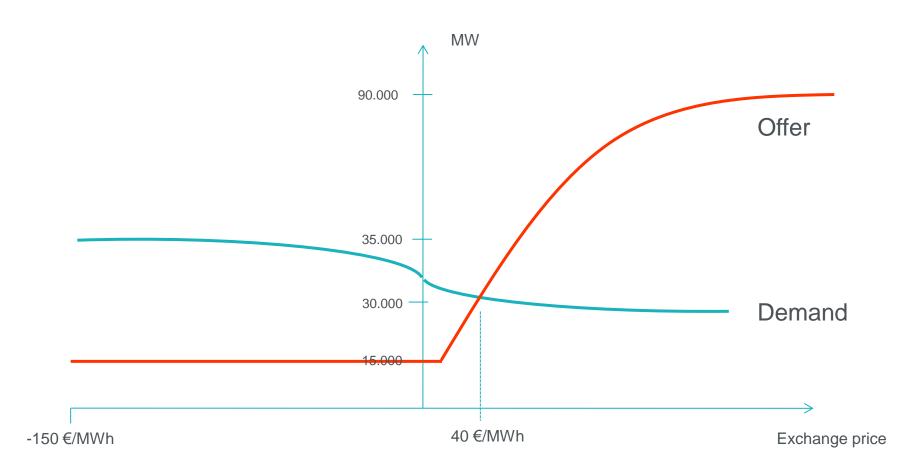
Biblis A	1.167 MW	Neckarwestheim 1	78
Unterweser	1.345 MW	Isar 1	87
Philippsburg	1 890 MW	Brunsbüttel	77
Biblis B	1.240 MW	Krümmel	1.34

2015:	Grafenrheinfeld	1.275 MW				
2017:	Gundremmingen B	1.284 MW				
2019:	Philipsburg 2	1.392 MW				
2021:	Brokdorf Gundremmingen C Grohnde	1.410 MW 1.288 MW 1.360 MW				
2022:	lsar 2 Neckarwestheim 2 Emsland	1.400 MW 1.310 MW 1.329 MW				





Merit-Order-effect due to renewables





Closed/mothballed Power Plants

April 2013 – June 2014

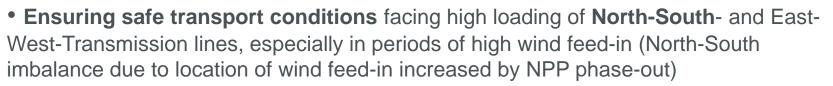
	Germany	The Netherlands			
Gas	3223	5567			
Coal	992	240			
Oil	424	-			
Multi fuels	152	-			
Lignite	60	-			
Total	4851	5807 *			

* 3284 MW in 'mottenballen'

Consequences for the system

- ✓ Adequacy
- ✓ Flows: volatility, transit flows, etc.
- ✓ Voltage stability
- ✓ Inertia

Challanges for the secure operation of the German transmission system



- Ensuring safe voltage levels facing the loss of NPPs as substantial generators of reactive powert:
 - → Problem of **low** voltages **during winter** (high load conditions)
 - → Problem of high voltages during summer (low load conditions)
- Ensuring system ballance

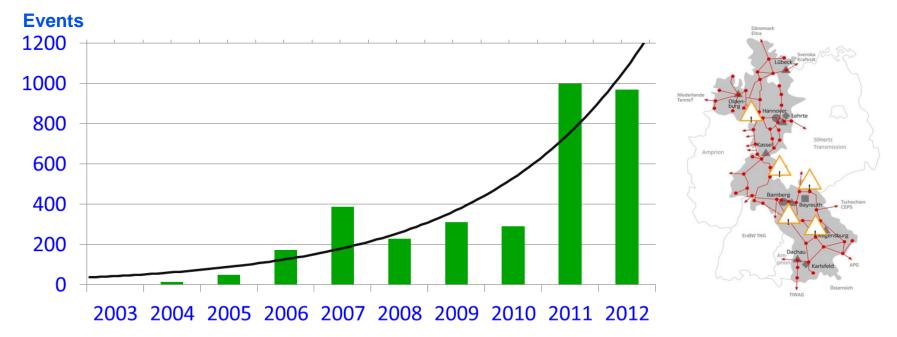
Forecast deviations due to:

- RES infeed
- Load development
- Grid losses
- power plant schedules



Development of (n-1) violations

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
situations*	2	15	51	172	387	228	312	290	998	970
days	2	14	51	105	185	144	156	161	308	344

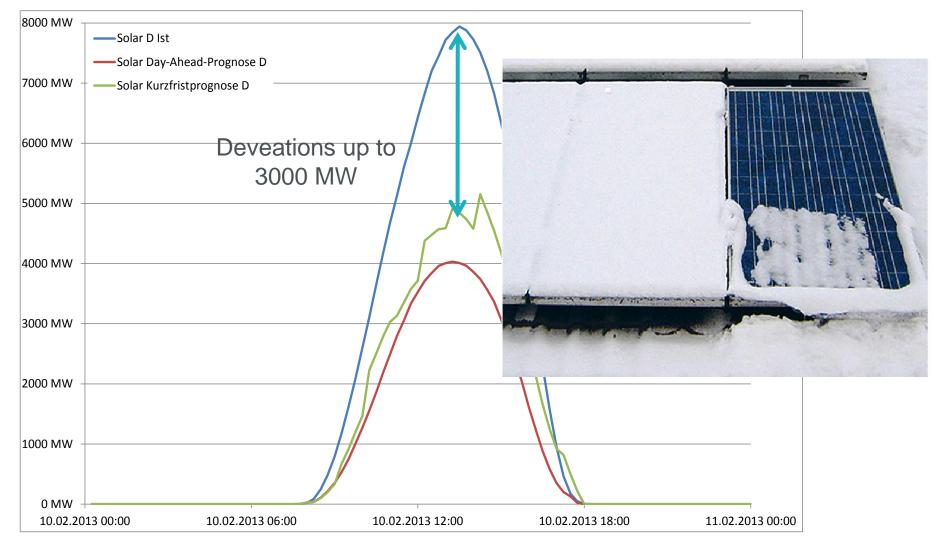


* Situations in which measures of § 13 EnWG and § 11 EEG were activated; voltage violations are not counted

Transport task of grid increases due to Energiewende

Example: PV-forecast deviation due to snow

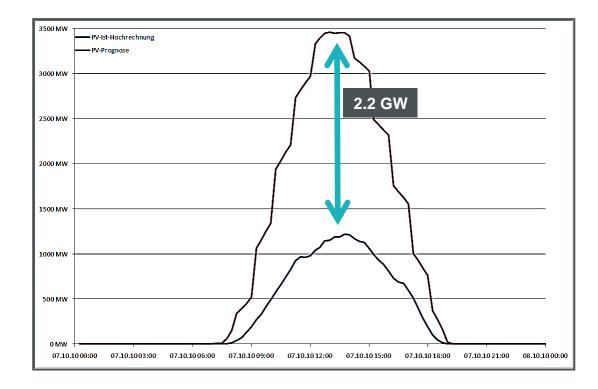
Installed PV capacity: 31.900 MW





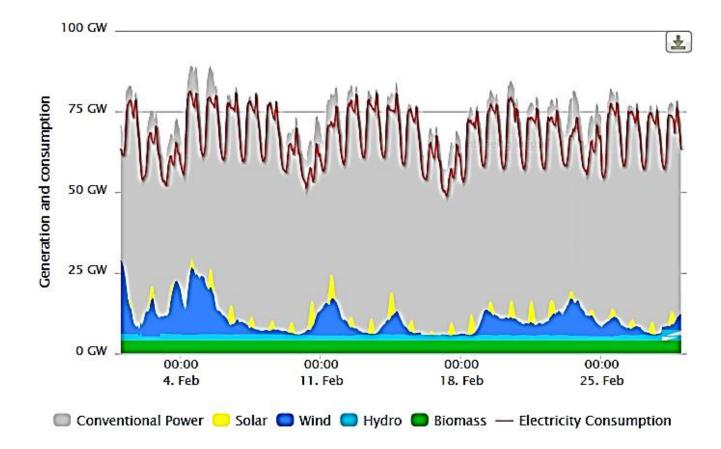
Another example of deviation

Morning fog doesn't disappear











Inertia – fly wheel



Measures to keep the system working

- ✓ (Network development incl. strategic fit)
- ✓ (Reserve Power Plants)
- ✓ (Compensation devices/ Ancillary Services with RES)
- ✓ (Smart Grids/DSM)
- ✓ (Market Design)
- Harmonization and Coordination

Future TSO coordination through a mandatory framework

TSOs have decided:

- to establish a mandatory framework through which, certain coordination functions will be organized by RSCIs (existing or new);
- All TSOs will be procuring the relevant services in the framework of these RSCIs.

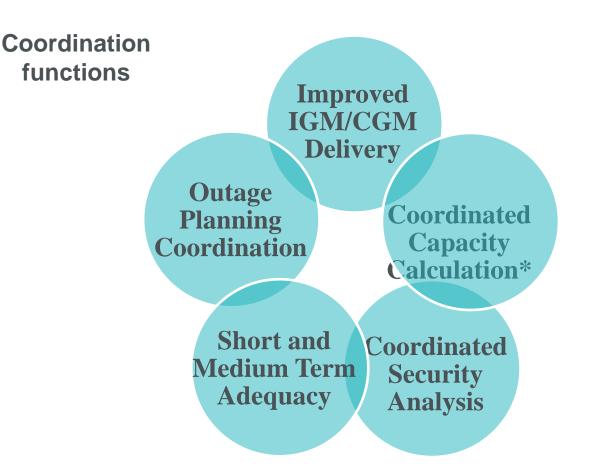
All-TSOs Multilateral Agreement

RSCI contract

• The contractual instrument for the establishment of the framework for TSO coordination.

 A contract between TSOs of an RSCI that cover the operational cooperation between these TSOs. A basic services set for coordination through RSCIs will ensure consistency and geographical coverage







Commercial versus physical flows



Physical flows impact on NL-BE border after different commercial exchanges of 100MW

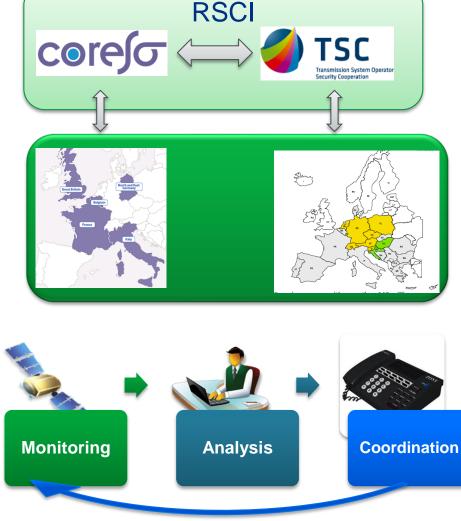
NL→DE
 DE→FR
 CH→FR

RSCI-Regional Security Coordination



International Coordination

- Data Collection
- Common Grid Model
- Exchange updated files
- Managing impact Remedial Actions influencing a number of countries
- Priority for non costly measures



TSCNET Services GmbH:Our services at a glance



- An international team of experienced experts at TSCNET Services delivers comprehensive services for TSOs and 24/7 support.
 - Made-to-measure coordination services for operational planning, forecast data merging, congestion assessment, and capacity calculation for control centres
 - High-end IT infrastructure for operational planning
 - Online information system (real-time awareness and alarming system)
 - High-secure video conferencing system between control centres
 - Weekly and daily operational planning teleconference (WOPT and DOPT)
 - Daily day-ahead congestion forecast (DACF)
 - Hourly intraday congestion forecast (IDCF)
 - Daily real-time snapshot (RTSN)
 - Moderation of multilateral remedial actions (MRA)
 - Weekly DACF, IDCF, and RTSN report
 - Additional services in preparation, especially capacity calculation services



New Challenges

An example



Solar Eclipse

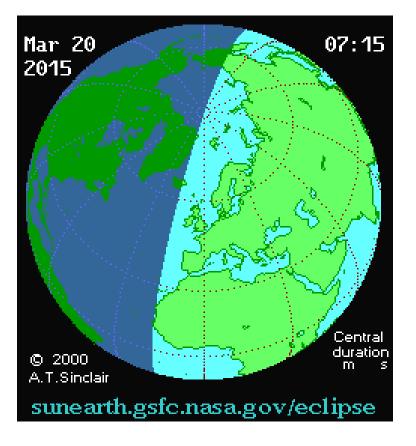


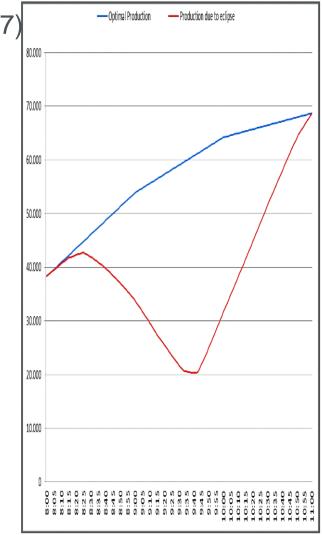


Solar eclipse

20 March 2015

- At maximum 81% coverage of the sun (10:37)
- CWE-region: a dip of 40 GW in 2.5 hour







Thank you for your attention!



www.tennet.eu

TenneT is de eerste grensoverschrijdende elektriciteitstransporteur van Europa. Met 21.000 kilometer aan hoogspanningsverbindingen en 36 miljoen eindgebruikers in Nederland en Duitsland behoren we tot de top 5 elektriciteitstransporteurs van Europa. Onze focus is gericht op de ontwikkeling van een Noordwest-Europese energiemarkt en op de integratie van duurzame energie. **Taking power further.**