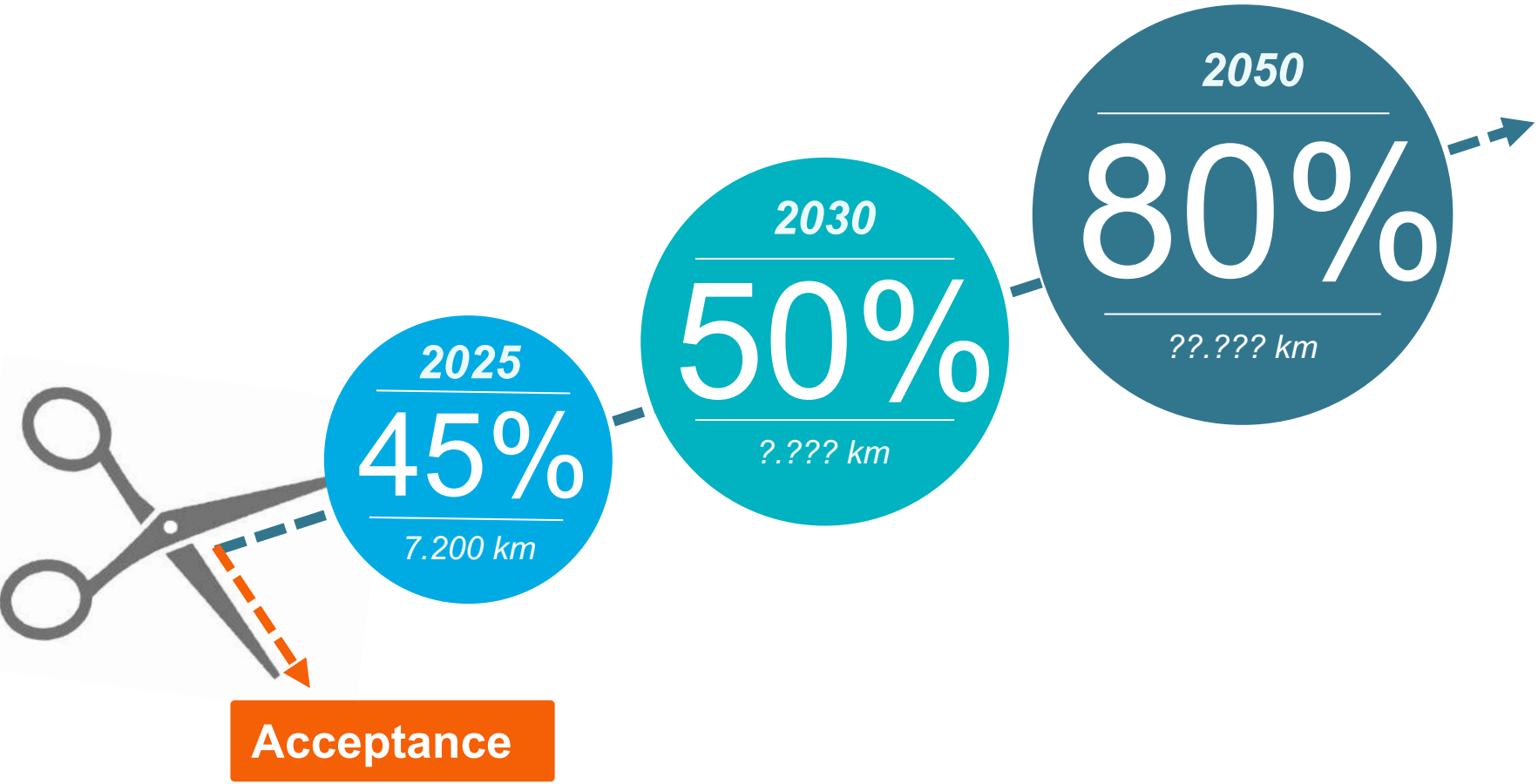
Grid Stress Test

What if?

Transport volume increases with growing Renewables



Need for grids and Acceptance: the scissors gap.

Increasing **RE-Integration** ▶ Increasing **Transport volume** ▶ More **Need for grids**

… uncertainty grows…

*„Von wegen Netze für die Erneuerbaren – da fließt dann doch **wieder Kohlestrom** durch“*

*„Die NEP-Szenarien springen **"zu kurz“***

*„Den Netzbetreibern geht es nur um **ihren Profit!***

*„Das ist doch klassische **Salami-Taktik**. Immer wieder neue Trassen. Mir reicht‘s.“*

*„Wir bauen immer mehr und mehr Leitungen, um den Strom zu transportieren – aber über technische **Alternativen redet keiner**“*

We reached a critical point. With less acceptance for grids the project of common interest „Energiewende“ is at risk.

Why the stress test?

Debates endanger planed projects

Model future developments better

Need for objectivication of the debate

TenneT — AUFTRAGGEBER

consentec — AUFTRAGNEHMER

Agora Energiewende — BERATENDES MITGLIED IM STEUERKREIS

Aim: Contribute to current political discussion concerning acceptance, economics, , technological innovations and the future of the enery turnaround.

Question: What are the drivers of transport capacity and.grid expansion?

Stresstest ≠ NEP?

Basic conditions NEP

Scenario framework BNetzA

Economy-principle

State of the art technology

Regulatory and legal status quo

Expectable development

Basic conditions Stresstest

Extrem Scenarios

Innovation-principle

Future technology

Alternative framework

Alternative developments

NEP calculates **expectable** scenarios **up to 2030**
Stresstest looks at **extreme** scenarios to **discuss potential developments** after 2030

„What if…“ - scenarios

Five potential developments until 2035

DE 100% zero coal

Complete phase-out of coal power by 2035

Replacement of lost generation with onshore wind

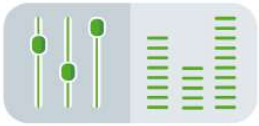
DEcentralized

Installed PV capacity: 150 GW in 2035

Less onshore wind

Combined with small scale storage systems and e-vehicles

Flexible Demand



Flexible management of industrial demand, particularly in regions with excess feed-in.

Power-to-Heat

NOVA*-Principle enhanced

Conversion of existing grid to 3600A with HTL lines

DC overlay grid with multi-terminal operation

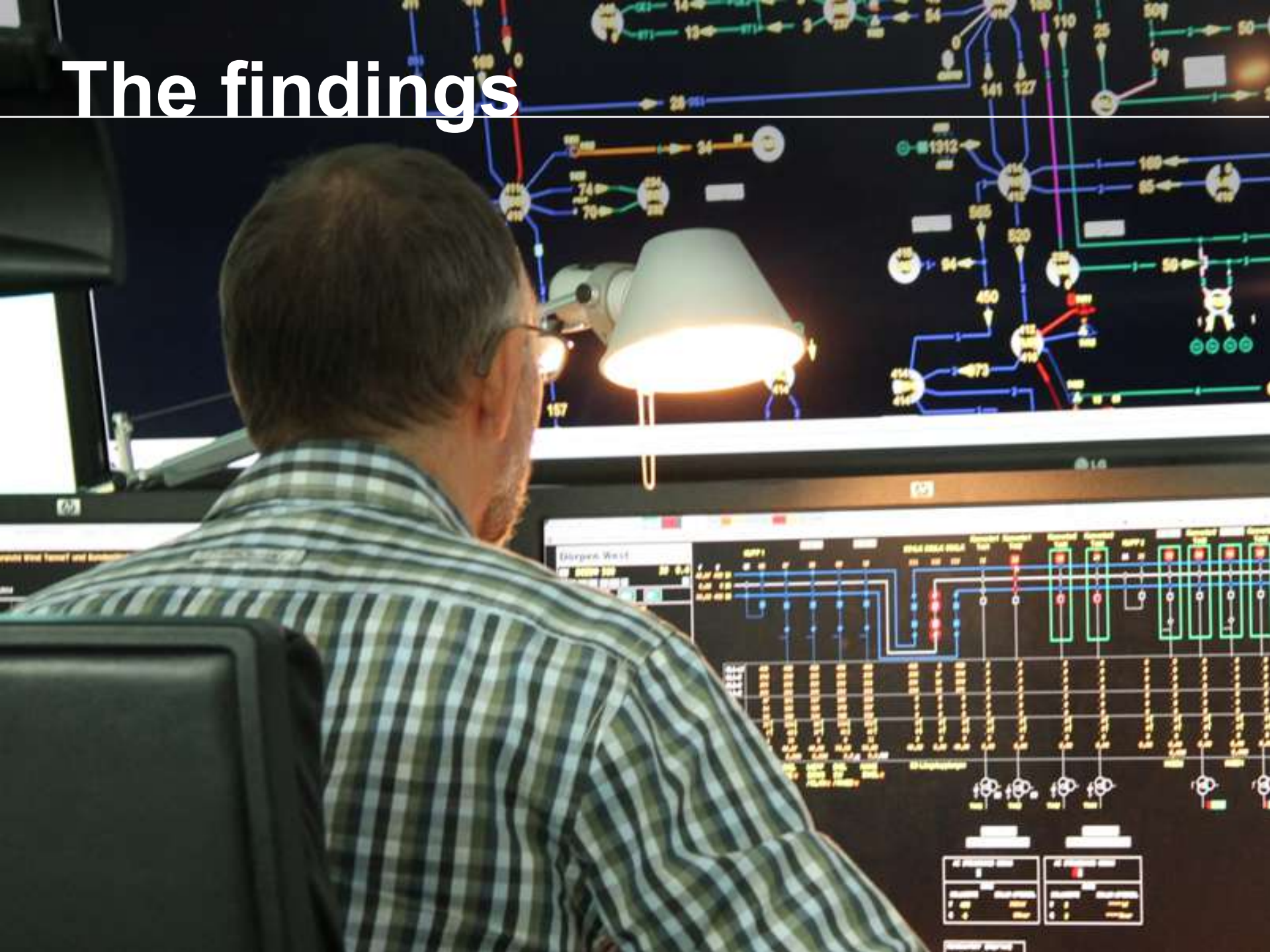
Automated System

Great possible exploitation of grid capacity

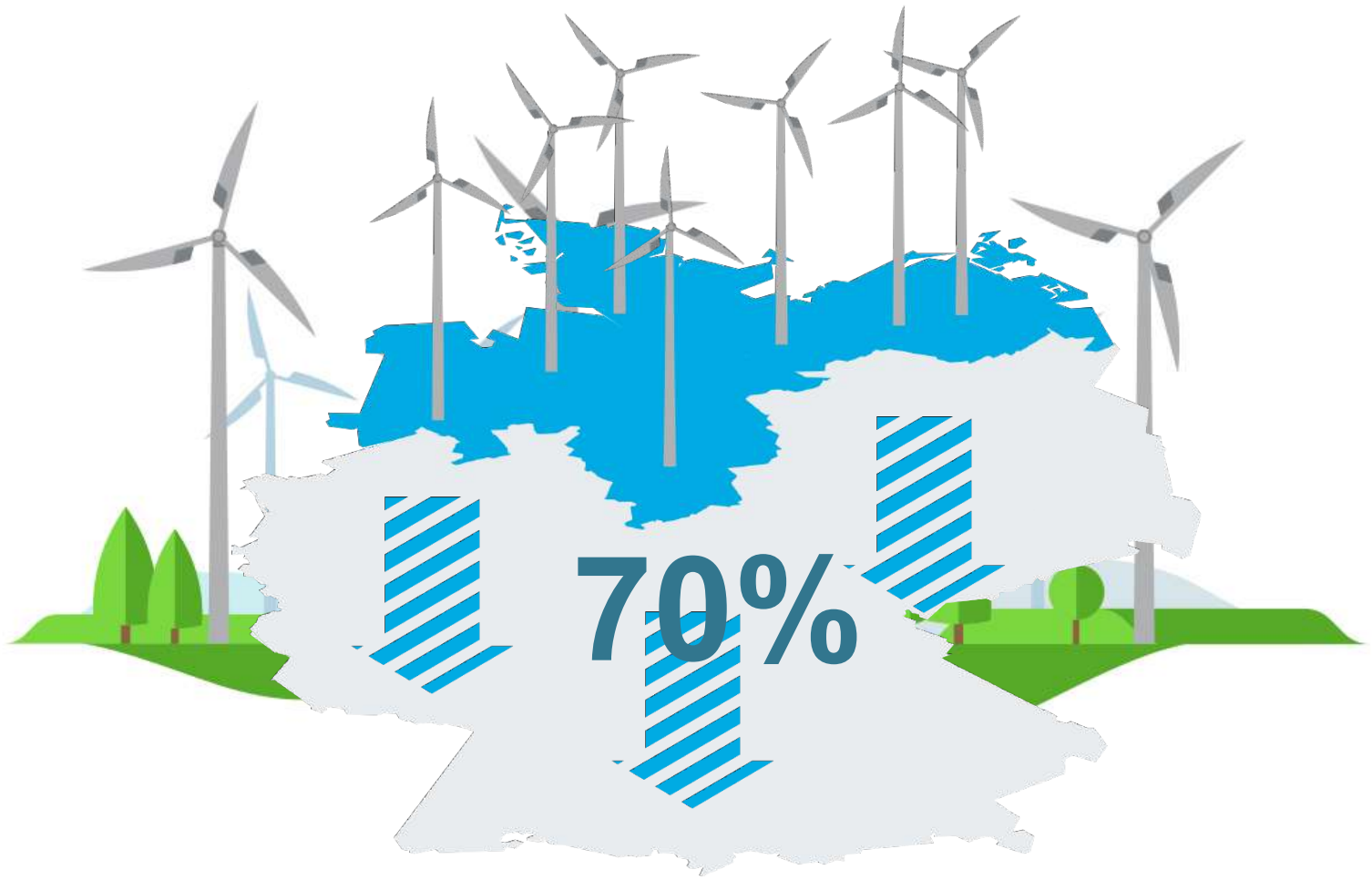
Assurance of system security with real-time interventions to actively manage load flow

- Energy-Economy Scenarios.
- Technology Scenarios.

The findings



Szenario DE 100% zero coal power



Complete phase out of coal replaced by wind onshore. Reinforces the „north-south-gap“.

DE 100% zero coal power = „ zero-sum game“

Strong wind/strong demand

NEP B1 2035

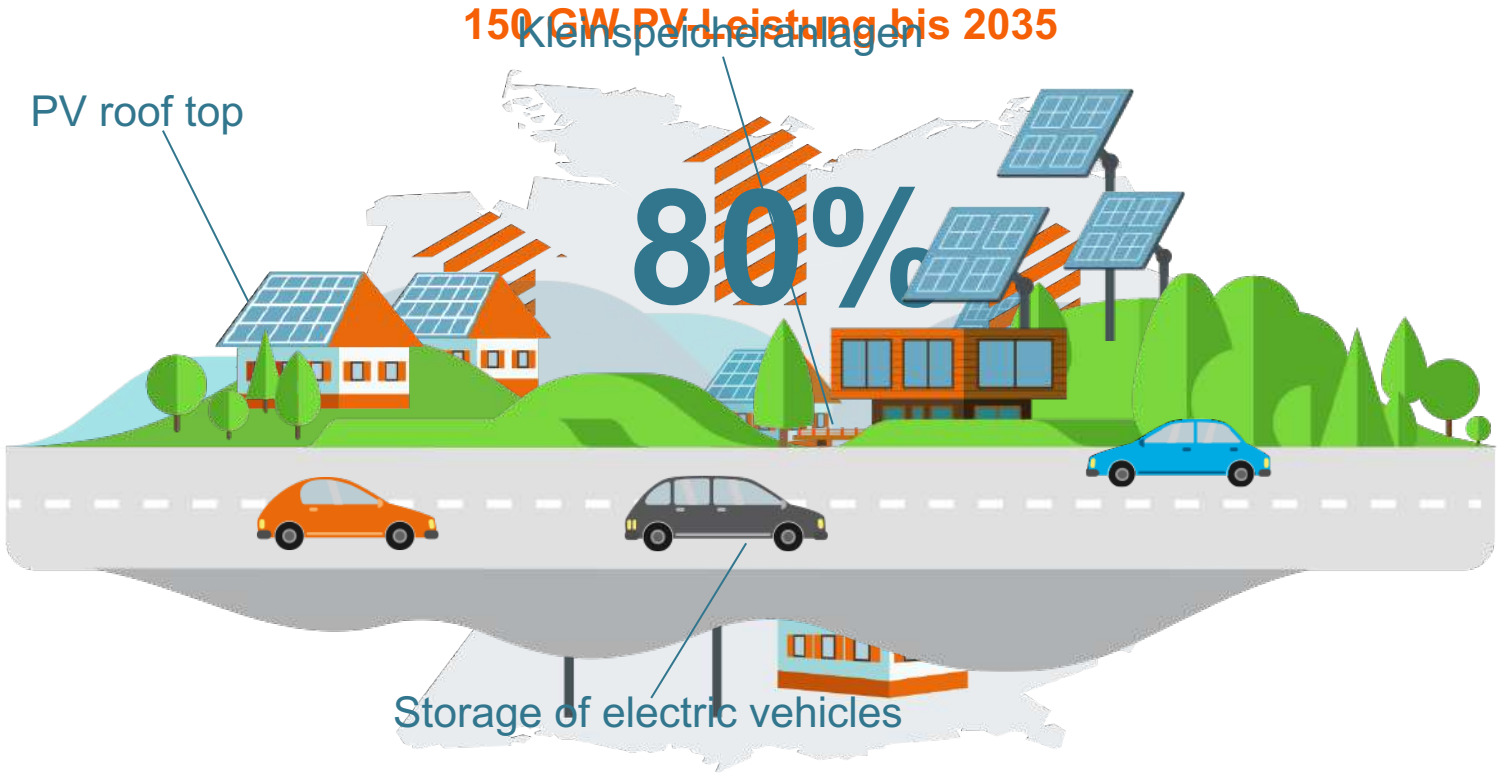
20,8 GW

100% zero coal power

36,5 GW

No significant change of transport needs.

Szenario „DEcentralized“



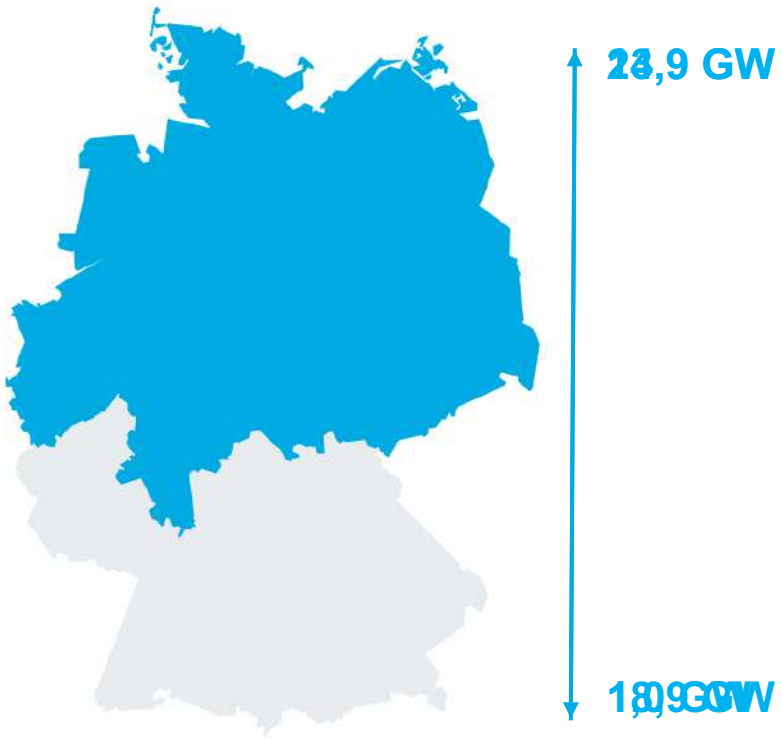
- PV concentrated in the south, reduced wind, more storage

DEcentralised = significant reduction of transport volume

Stacking with Statkraft demand

NEP B1 2035

PV-storage



Potential for significant reduction of future transport volumes.
But: **Strongly depends on regionalization of PV**

Scenario Flexible Demand

10 GW Industry

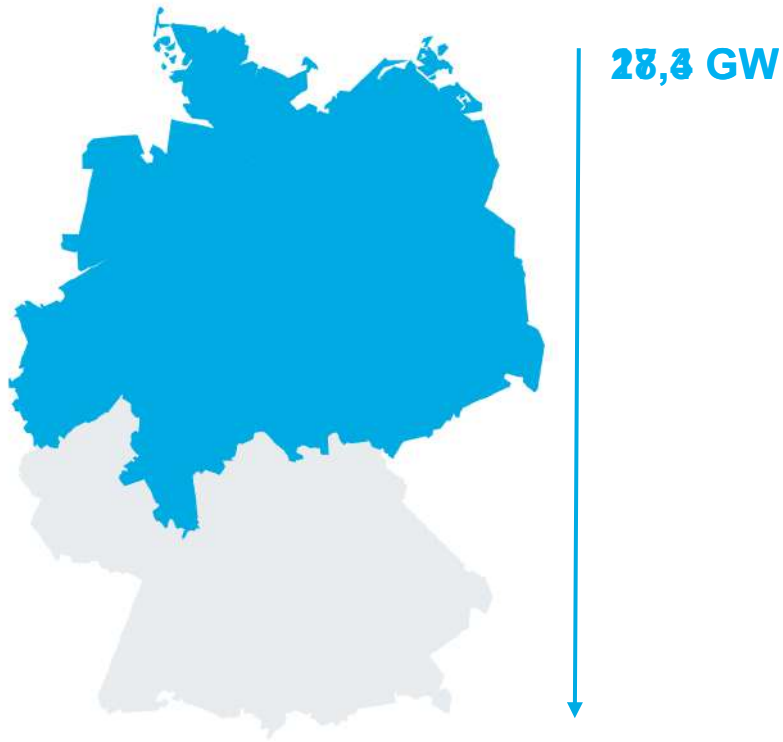
45 GW „Power-to-Heat“

Flexible demand reduces transport volume

Strong wind/Strong demand

NEP B1 2035

Flexible demand



More evenly grid utilization could reduce future transport needs.
No structural changes (north -> south) without change of renewables mix.

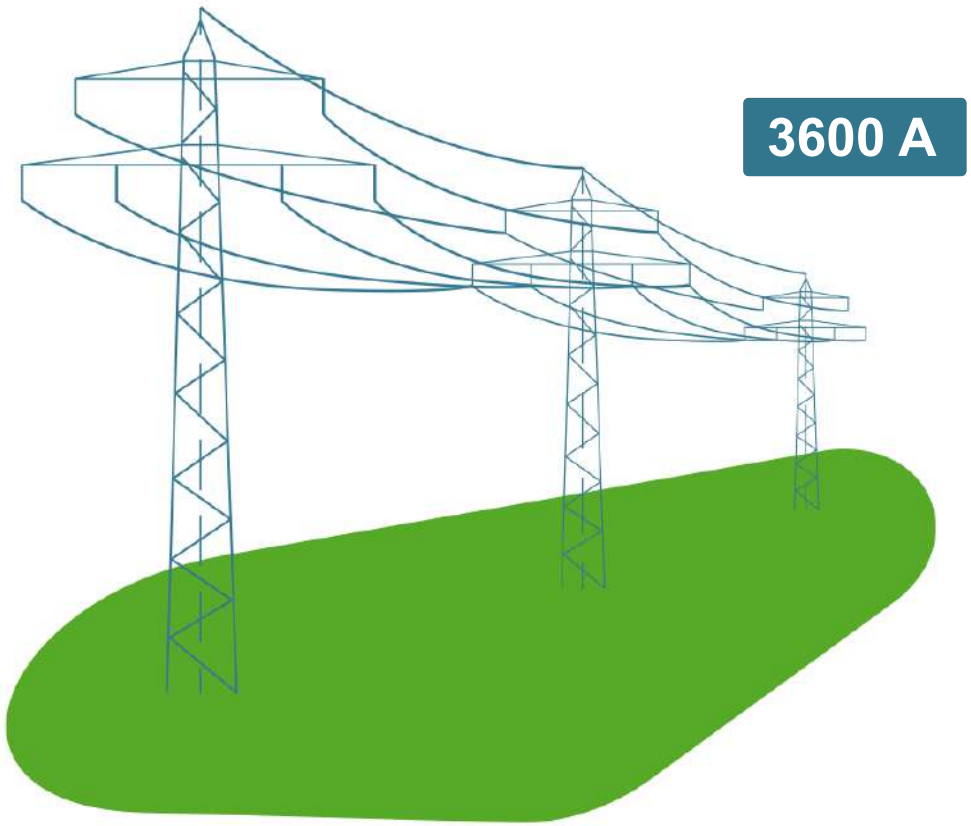
Combination scenario

DE 100% zero coal + **DEcentralized** + **Flexible demand**

Compared to BNetzA- development
more integration of renewables

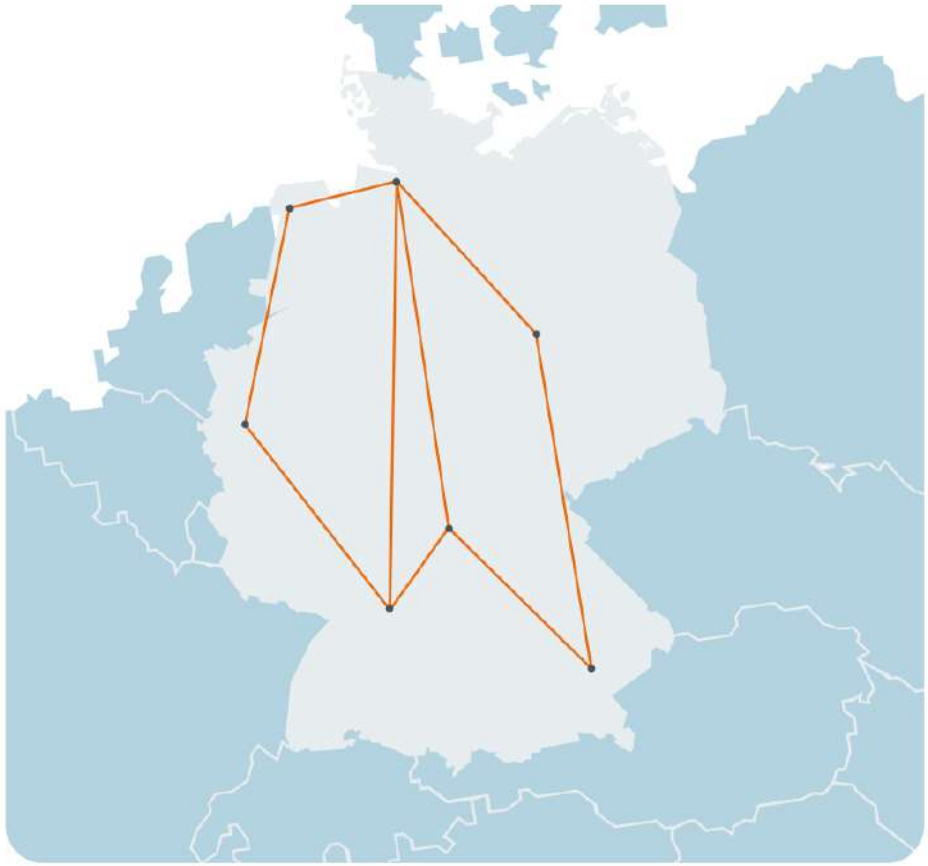
Strong effect when coal is replaced by **PV- storage (Focus on southern Germany)** combined with nationwide load balancing.

Szenario: NOVA enhanced



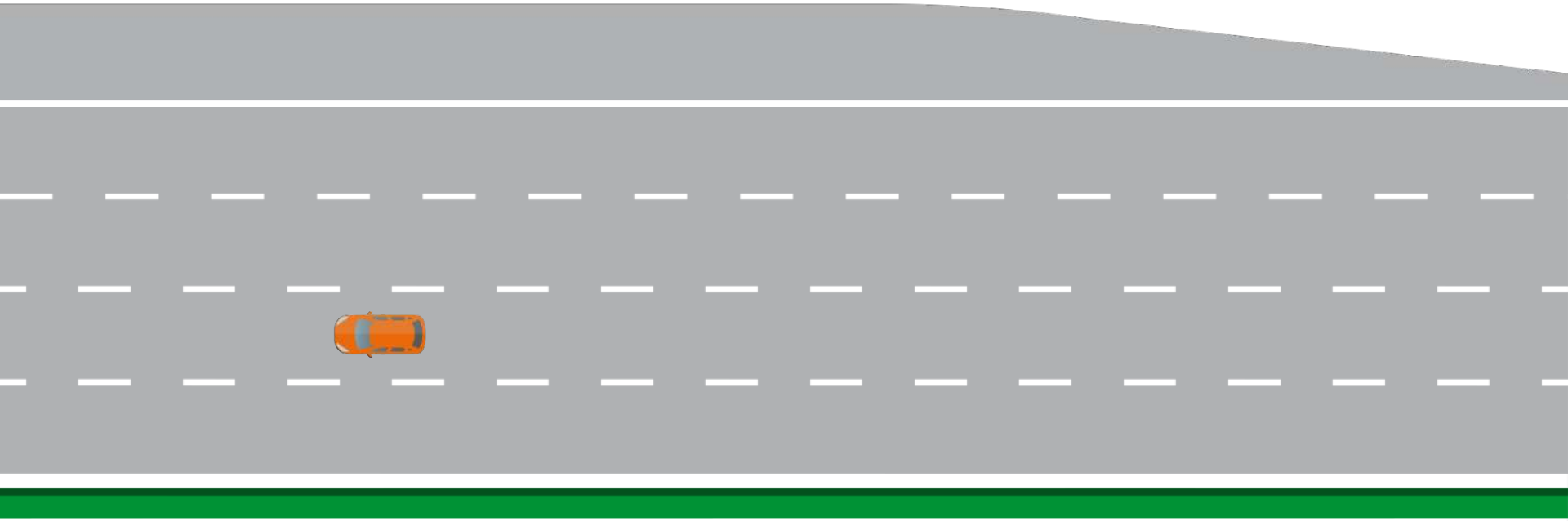
Higher load bearing capacity could significantly **reduce the future need for grids.**

Scenario: NOVA enhanced



With supplementary realization of an HVDC overlay grid, excess load in the three-phase grid can be additionally reduced.

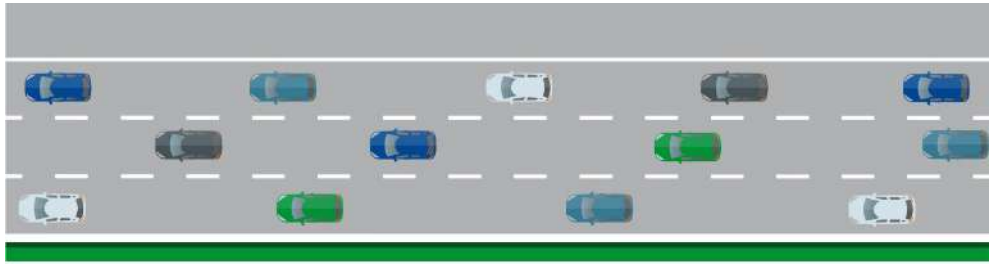
Szenario „(n-1)“-Sicherheit im (n-0)-Fall



New technology would enable almost **100% utilization of the lines.** There would be real time reaction to an incident.

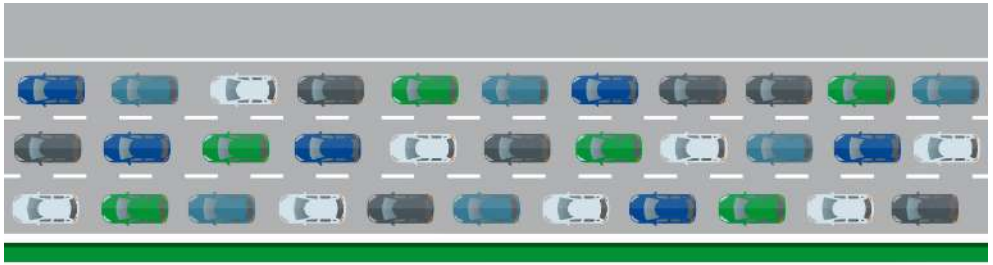
Szenario „(n-1)“-Sicherheit im (n-0)-Fall (1)

1



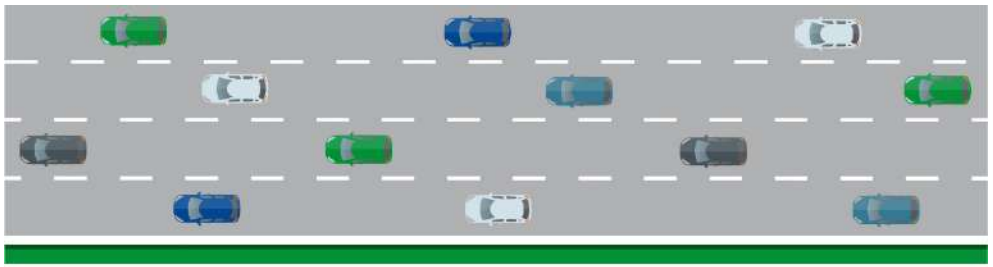
Das Prinzip der (n-1)-Sicherheit funktioniert vereinfacht gesagt wie die Standspur einer Autobahn. Dabei verhindern **Reserve-Kapazitäten** bei Fehlerfällen im Stromnetz einen Blackout.

2



Bei steigendem Übertragungsbedarf ermittelt der Netzplaner in bestimmten Situationen (Einspeisung vs. Verbrauch) einen drohenden **Netzengpass** (Stau).

3

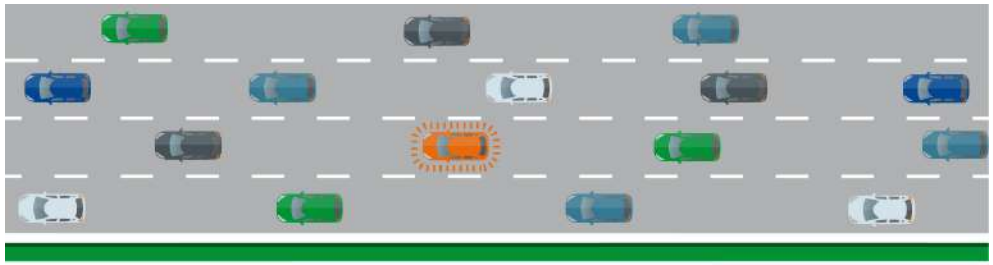


Dieser Engpass entstünde in vielen Fällen nicht, wenn die Sicherheitsreserve (Standspur) auch **als Leitungskapazität** (Fahrspur) verfügbar wäre (n-0-Fall).

Mit entsprechender Technik wäre eine **nahezu 100% Auslastung der Leitungen** möglich (n-0). Im Fehlerfall fände eine Reaktion in Echtzeit statt.

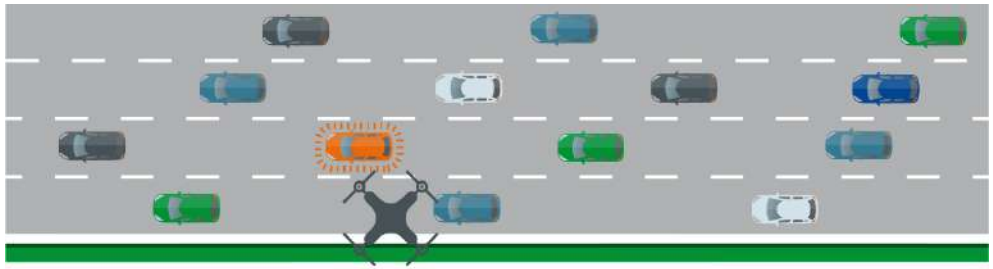
Szenario „(n-1)“-Sicherheit im (n-0)-Fall

4



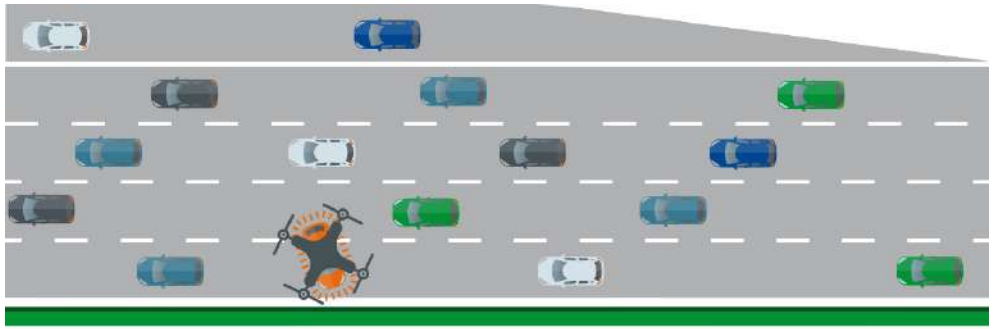
Damit auch ohne Reservekapazität (Standspur) bei Fehlerfällen die Sicherheit des Stromnetzes gewährleistet wäre, entwickeln die Netzbetreiber eine neue Technologie, die **automatisierte Systemführung**.

5



Automatisierte Systemführung bedeutet, dass Fehlerfälle (hier: defektes Auto) **in Echtzeit antizipiert** um im laufenden Betrieb (hier: Verkehr) gelöst werden. Engpass bzw. Blackout (Stau) wird damit verhindert.

6



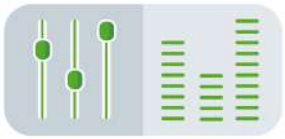
Bei der automatisierten Systemführung können **Lastflüsse aktiv gesteuert** werden. Bei Fehlerfällen werden diese in Echtzeit erkannt (hier: Drohne) und u. a. durch Umleitungen (hier: Abfahrt) behoben.

Mit entsprechender Technik wäre eine **nahezu 100% Auslastung der Leitungen** möglich (n-0). Im Fehlerfall fände eine Reaktion in Echtzeit statt.

At a glance: Stress test „What if…“

DE zero coal generation: Almost no effect on overall transport need.

DEcentraliced: Significant potential for reduction of transportation volume. But depends on PV regionalization.



Flexible demand: Evenly utilization coul resuce future transportation needs. But no structural changes (North ➔ South) without change in RE- mix.

NOVA enhanced: Higher load bearing capacity could significantly **reduce the future need for grids.** A supplementary realization of an HVDC overlay grid, excess load in the three-phase grid can be additionally reduced.

Automated system operaions can significally reduce transport needs.

Adjustment screws for new developments

the grid development measures that have been legally adopted in the **EnLAG and BBPIG** represent a solid and necessary basis for the integration of an 80% share of renewables by 2050.

For the next step towards **80% Renewables by 2050** we need to discuss and foster **alternatives in the political and regulatory framework an in technology**.

The **NEP- process is still needed and valid** because it identifies bottlenecks in a transparent way and shows solutions.

Next steps

Debate about the future of the Energiewende after 2030. The way we choose will influence the need for grids.

With a view to the optimization of existing regulations, **expert consultations** are needed between federal regulatory authorities, transmission network operators, offices for grid planning and approval, and relevant NGOs concerning the effects that would result at the local level from NOVA changes.

Discussion on new technologies: TSOs. authoroties and industry have to agree on timetables for the implementation of automated system operation.