

ROAD TUNNELS ENERGY GENERATION AND STORAGE OPPORTUNITIES

HIGHLY AVAILABLE, SUSTAINABLE AND EFFICIENT
OPERATION OF ROAD TUNNELS

The logo for AISFINAIG, featuring a stylized white circular icon with a curved arrow pointing clockwise, followed by the company name in a bold, white, sans-serif font.

AISFINAIG



AGENDA

1. Critical Infrastructure and Blackout
2. Sustainable and efficient road tunnel operation
3. Battery storage systems for road tunnel operation
4. ASFINAG Energy concept: “S01 Outer-Ring Expressway”



CRITICAL INFRASTRUCTURE AND BLACKOUT

- Critical infrastructure in Europe
- Blackout and possible triggers
- Energy supply for road tunnel operation

EUROPEAN CRITICAL INFRASTRUCTURE (ECI)

Directive 2008/114/EC - Identification and designation of European critical infrastructures and assessment of the need to improve their protection

“Critical infrastructure: assets or systems essential for the maintenance of vital social functions, health, safety, security, and economic or social wellbeing of people.”

Addressed sectors are Energy and Transport !




BLACKOUT DEFINITION

“Blackout is understood to be a sudden, supra-regional and prolonged (> 12 hours) power and infrastructure outage.”

Major disruption (“Blackout”)

	<p>Energy Transport and Production</p> 
	<p>Local Energy distribution Network</p> <p>BIG PROBLEM !!</p>

Local malfunction / Power failure

	<p>Energy Transport and Production</p> 
	<p>Local Energy distribution Network</p> <p>SOLVABLE ?</p>

ENERGY SUPPLY FOR ROAD TUNNEL OPERATION

GRID Connection



GRID Connection



Fixed Diesel Generator



Mobile Diesel Generator

UPS Backup power



WHAT ELSE ?



SUSTAINABLE AND EFFICIENT ROAD TUNNEL OPERATION

- Sustainable infrastructure operation
- ASFINAG strategic goals
- ASFINAG energy production projects
- Tunnel operation / Renewable use case

SUSTAINABLE INFRASTRUCTURE OPERATION

Roads and Tunnels as energy producers

- Organisations such as PIARC, CEDR or COB have already developed recommendations for sustainable operation.
- **PIARC initiated the project “Positive Energy Roads (PER)”:**
 - *Road infrastructure that generates more energy than is consumed during operation.*
 - *Energy is provided by renewable energy production.*
- **Five levels are defined - The first two levels are described as follows:**
 - *Level 1: Percentage of energy required to operate equipment (e.g. adoption lightning) that can be covered by renewable energy sources from own production.*
 - *Level 2: Percentage of the annual energy requirement for the operation of road infrastructure, which is covered by renewable own energy production.*

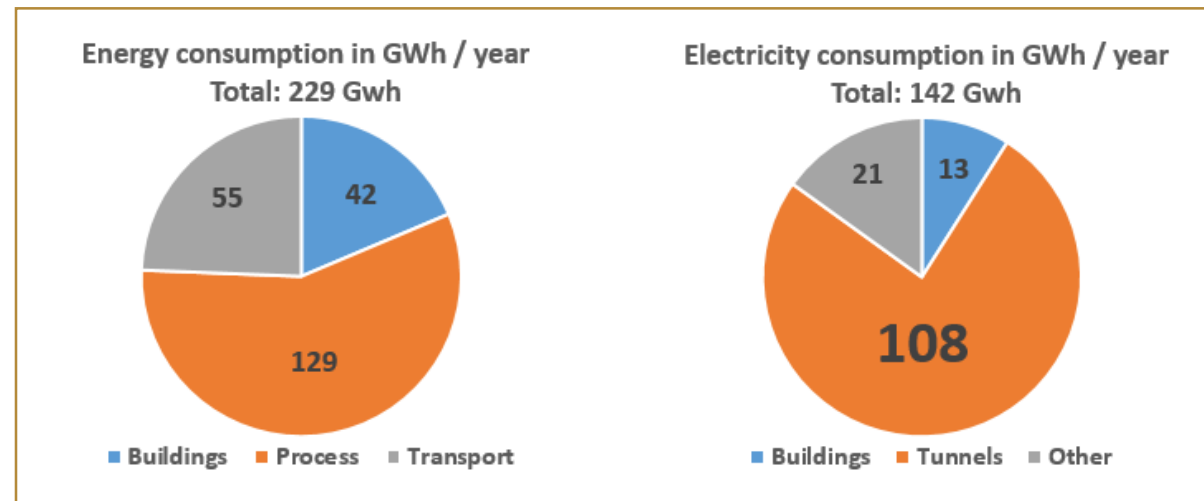


ASFINAG STRATEGIC GOALS

Energy Management

- Reduction of primary energy consumption:
 - -20% of the primary energy consumption per km Motorway by 2030

- Expand renewable energy production:
 - Self-sufficient (balanced) by 2030
 - 100MWp renewable energy systems installed by 2030



ASFINAG ENERGY PRODUCTION PROJECTS



A02 Tunnel Herzogberg / 50kWp



S01 Tunnel Rustenfeld / 130kWp



A10 Tunnel Trebesing / 40kWp



A10 Tunnel Katschberg / 180kWp



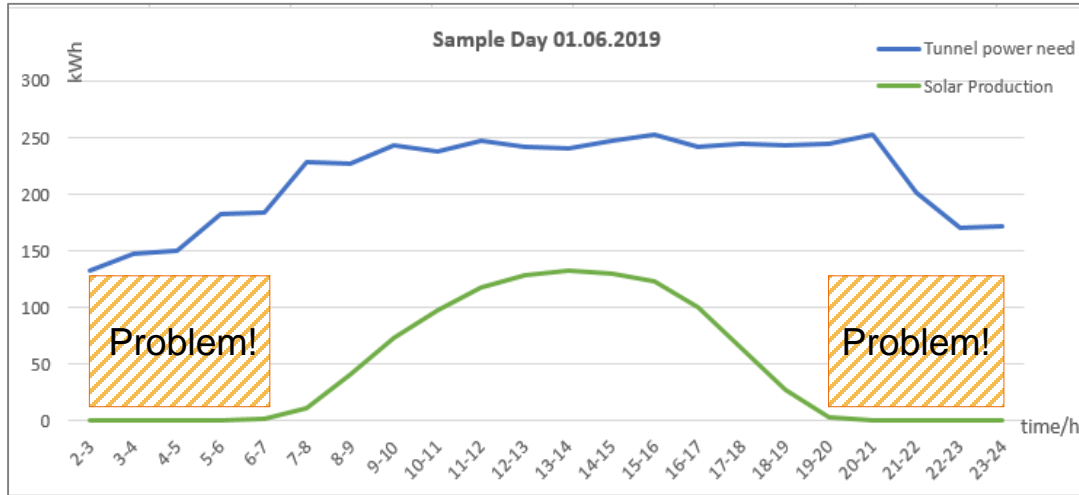
S10 Tunnel Manzenreit / 120kWp



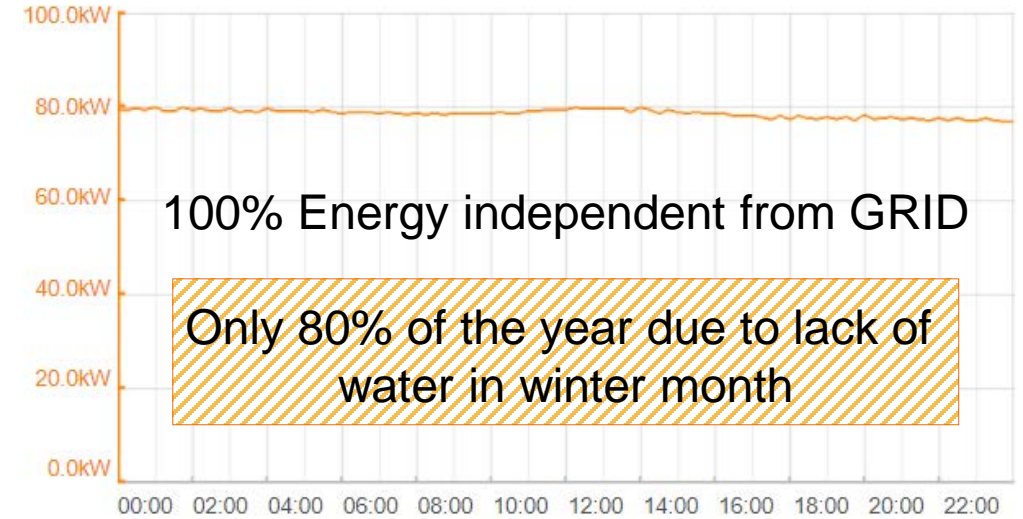
S16 Tunnel Flirsch / 130kWp

TUNNEL OPERATION / RENEWABLES USE CASE

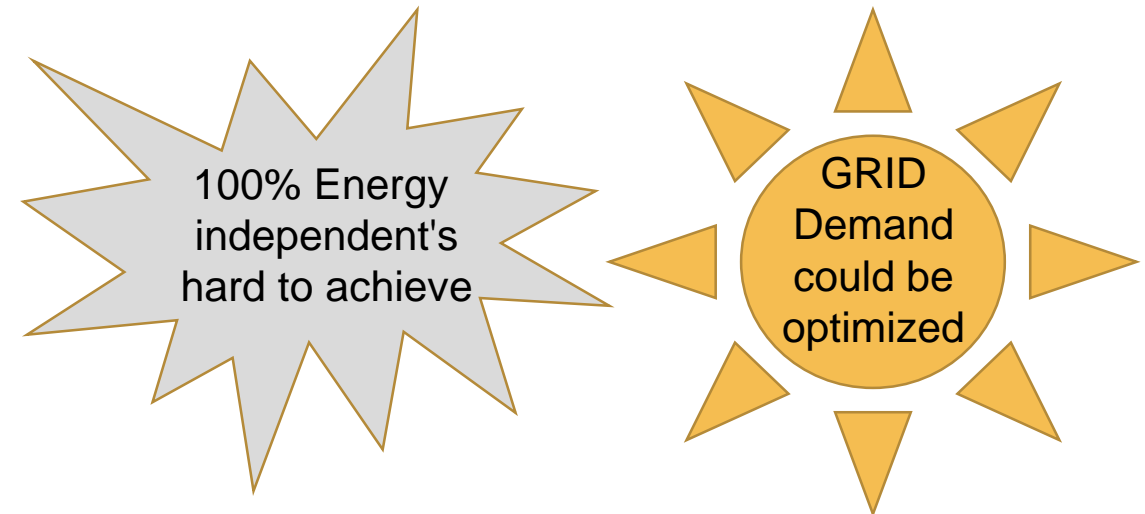
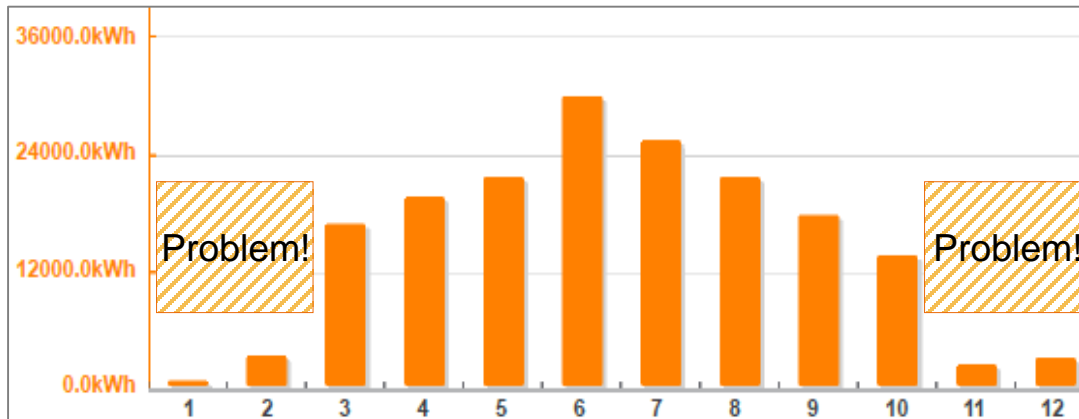
Solar Production vs. Power need



S16 Katschberg Tunnel / Hydro power plant



A10 Katschberg Tunnel / Energy production 2019 per month





BATTERY STORAGE SYSTEMS FOR THE ROAD TUNNEL OPERATION

- Electrochemical storage systems
- Potential areas of usage
- Batteries for road tunnel operation

ENERGY STORAGE SYSTEMS



Chemical Energy Storage (e.g. H2)



Thermal Energy Storage



Mechanical Energy Storage

Focus on Electrochemical Systems => Industrial Batteries



Electrochemical Energy storage

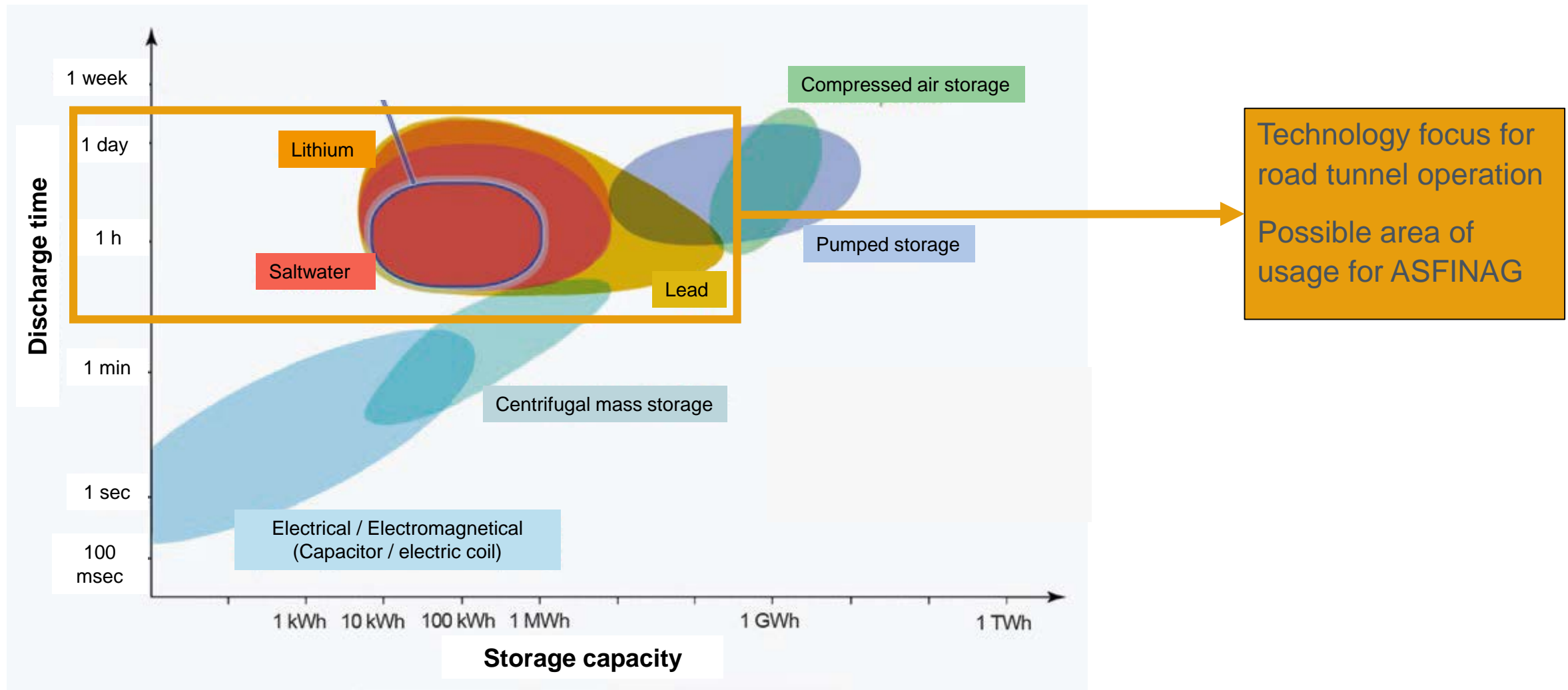


Electrical Energy storage



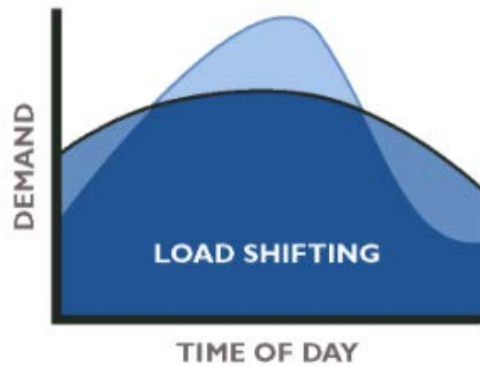
Power to Gas

ENERGY AND ELECTRICITY STORAGE



WHY ENERGY STORAGE (BATTERIES)?

Load Shift



Use of during the day produced solar energy at night

Source: www.usaid.gov/energy/efficiency/basics

Peak shaving

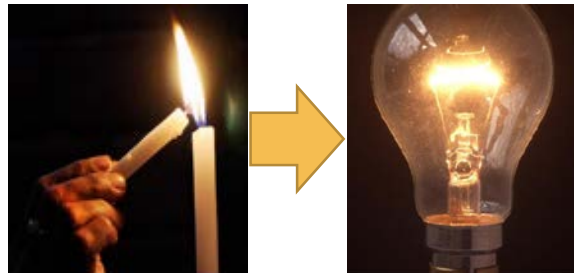


Supply needed energy peaks with alternative energy sources

Reduction of peak energy demand

Source: www.usaid.gov/energy/efficiency/basics

Blackout resilience



Safety net for longer power failures

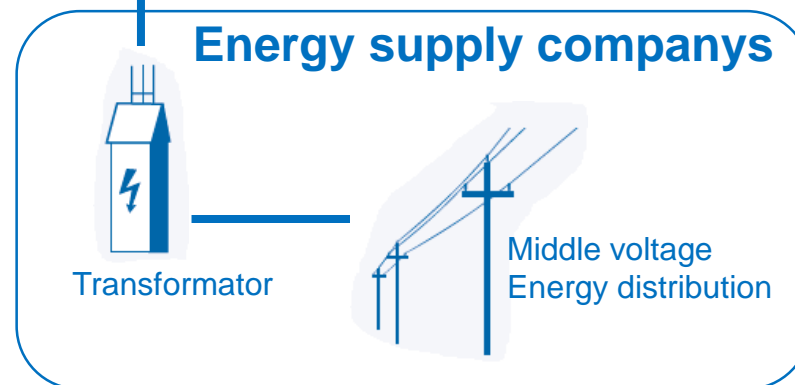
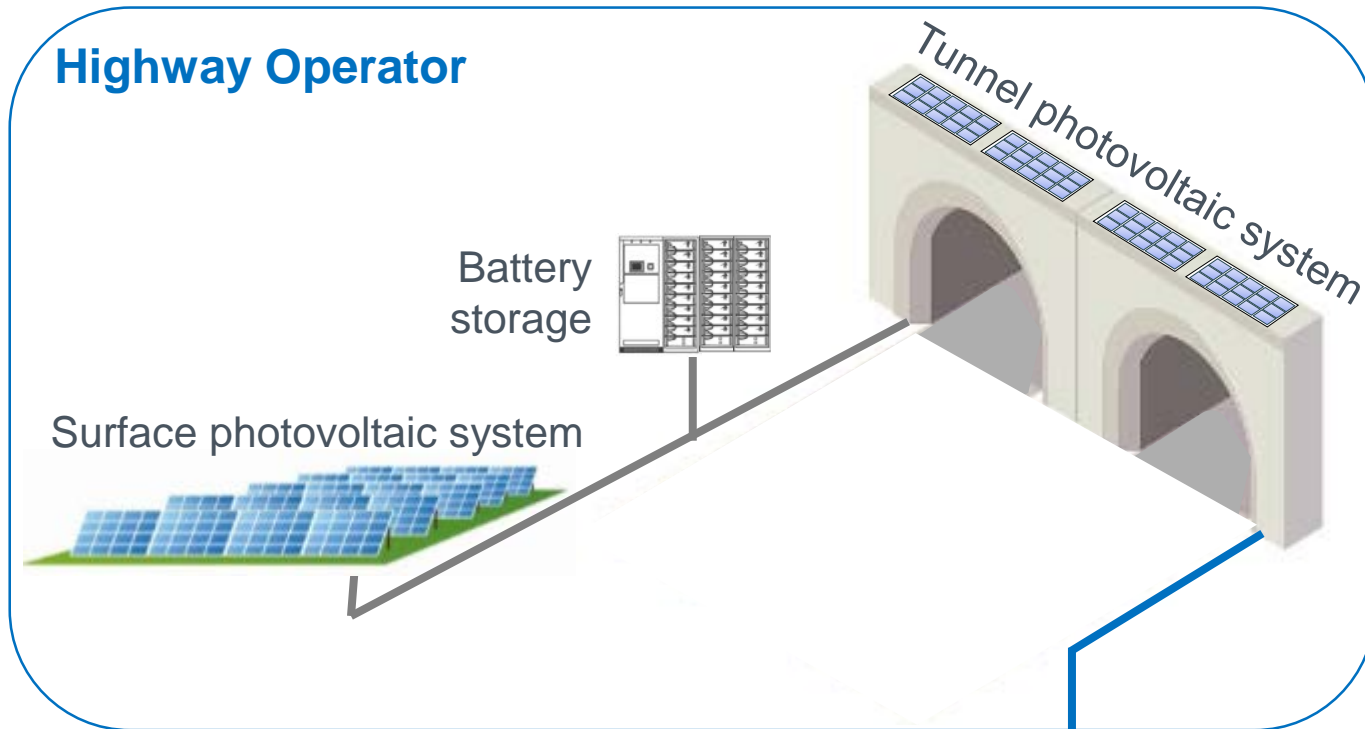
Balancing energy (positive / negative)



Grid stabilisation support by consuming or delivering energy to the Grid

Source: <https://blog.ebl.ch/durch-regelenergie-zur-sicheren-stromversorgung/>

CONCEPT FOR ROADTUNNELS



Use case	Eignung	Why
Energy Load Shift	✓	The energy requirement during the night is covered by the battery and the energy comes from in-house production.
Peak Shaving Battery	✓ ✗	Due to the GRID connection capacities required in the event of an incident (fire), the GRID connection cannot be optimized. In the case of tunnel systems without ventilation, however, it is possible.
Peak Shaving PV-System	✓	Peak demand in regular operation due to the entrance lighting covered by photovoltaic in-house production.
Blackout Resilience	✓ ✗	Due to the energy requirement in the event of an incident (fire), only to a limited extent based on the current legal basis. In the case of tunnel systems without ventilation, however, it is.
Grid Support (Balancing energy)	✗	Giving energy supply systems to third parties as safety-critical equipment is not recommended.



ASFINAG ENERGY CONCEPT

“S01 OUTER-RING EXPRESSWAY”

- Basic information
- Starting point for more GRID Independence
- Concept and Idea behind
- Proposal



BASIC INFORMATION

- It is a very busy route with 100,000 vehicles per day in the Vienna area.
- It is 16.2 km long in total.
- There are six tunnels with a total length of about 4 km on the route.
- Technical facilities are in operation in addition to the tunnel systems. (lighting, traffic control systems, pump systems, Emergency call, etc.)
- Facilities are equipped for power failures with a maximum duration of 60 minutes (SSV systems) and can then only ensure the availability to a very limited extent.



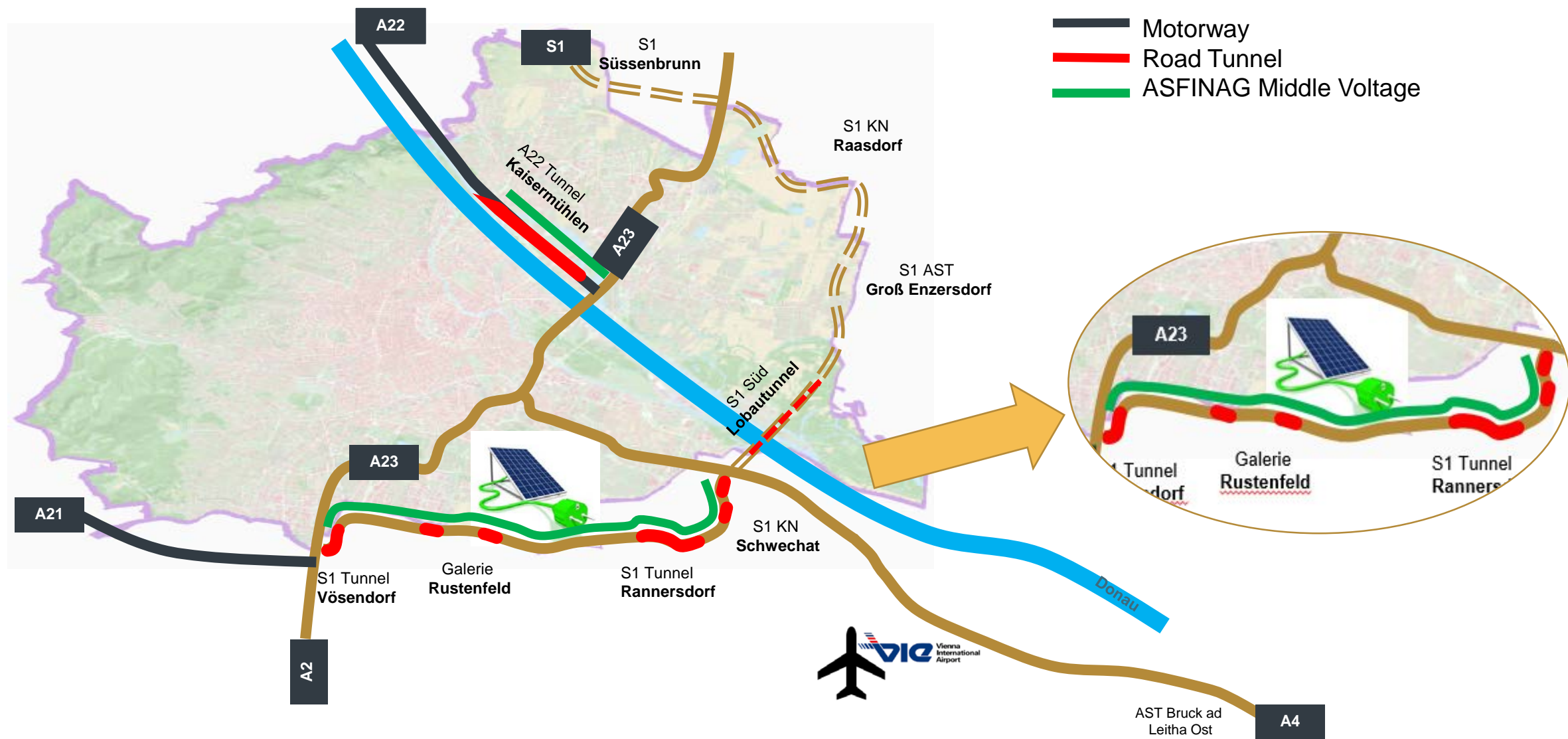
STARTING POINT FOR MORE GRID INDEPENDENCE

- The S1 is connected to the public power grid and has an energy distribution network (20kV) owned by ASFINAG.
- Upcoming renovation projects offers the opportunity to evaluate the implementation of self-generated energy by ASFINAG
- Actual Energy demand in different operating situation:

	Normal operation DAY	Normal operation NIGHT	Fire Vösendorf tunnel	Fire and heavy rain
Operating status	---	Night setback tunnel and open field lighting	Ventilation systems	Ventilation systems and pumps in open space
Energy demand	580 kW	500 kW	1,330 kW	2,270 kW



CONCEPT / IDEA



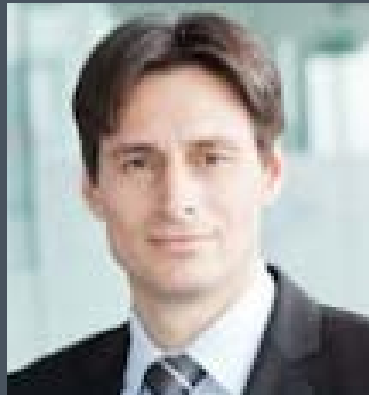


PROPOSAL TO BE CONSIDERED

- Evaluation: 4,500 kWp photovoltaic energy production along the Motorway could be implemented.
- Result: More energy is than produced than could be consumed in “Normal operation” during the day.
- Distribution: via ASFINAG medium voltage system possible.
- Load shift: Battery storage units 6 - 8 MWh for Load shift purposes.

- This solution result in optimised energy usage during night time.
- Excellent bridging in case of a blackout, at least for normal operation, over a period of 10 hours would be possible.

THANK YOU !



Electro technical and mechanical infrastructure
Head of the Department / Authorised officer

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