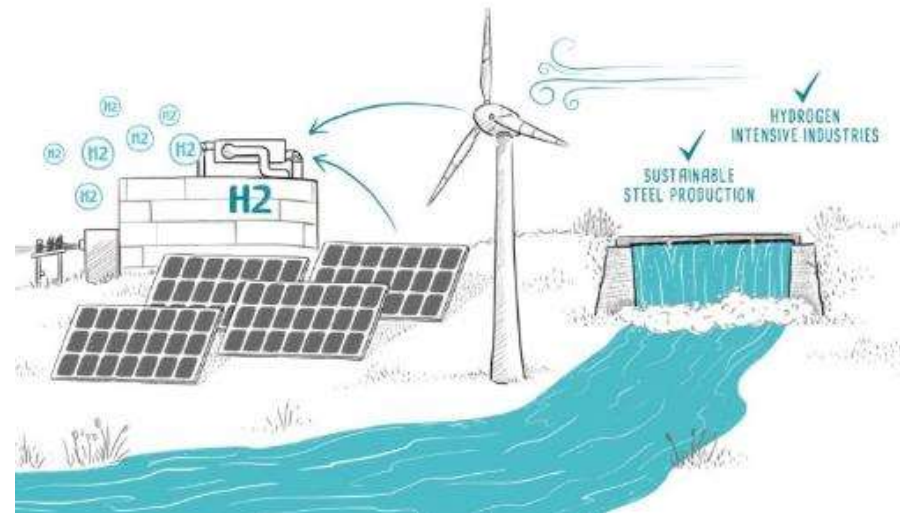


# VERBUND Hydrogen and e-Mobility

16<sup>th</sup> International A3PS Conference  
Vienna, November 2021



## VERBUND production capacity



**132 hydroelectric power plants**  
in Austria and Germany (Bavaria) –  
bottleneck performance about 8.222 MW



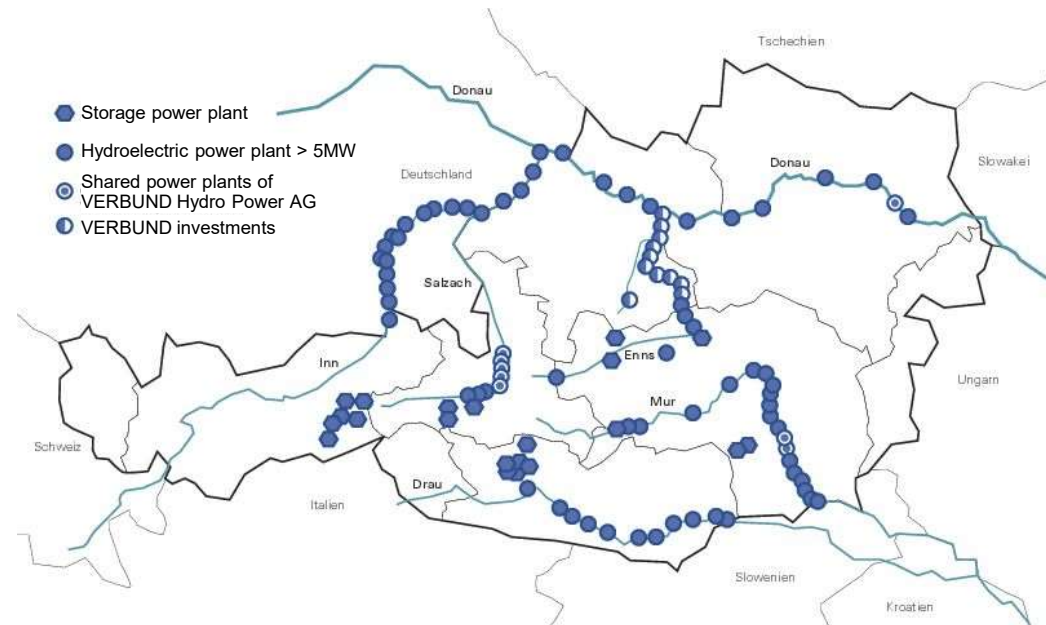
**153 wind power plants**  
in Austria, Germany and Rumania  
with 418 MW total capacity



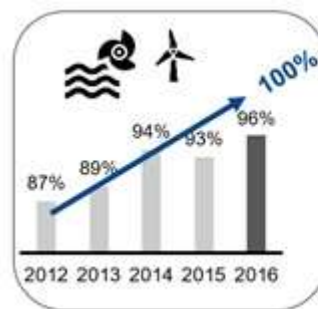
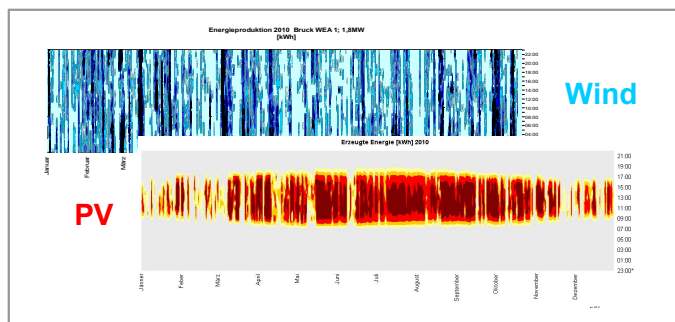
**5.500 photovoltaic installations**  
with about 350.000 m<sup>2</sup> module surface  
approximately 44.000 kWp installed power



**23 storage power plants**  
to cover load peaks, to stabilize electricity  
grids and to support supply security



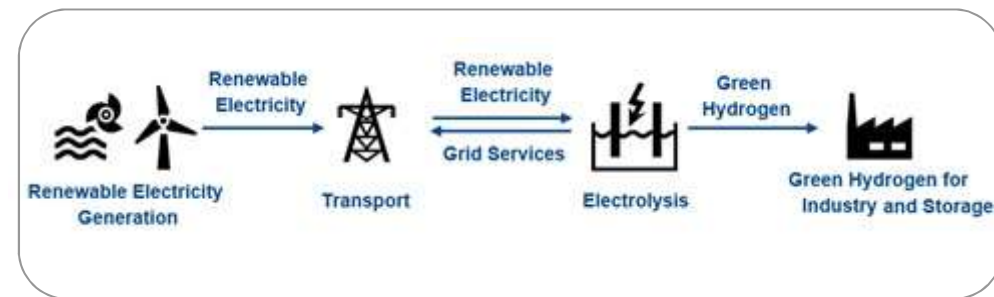
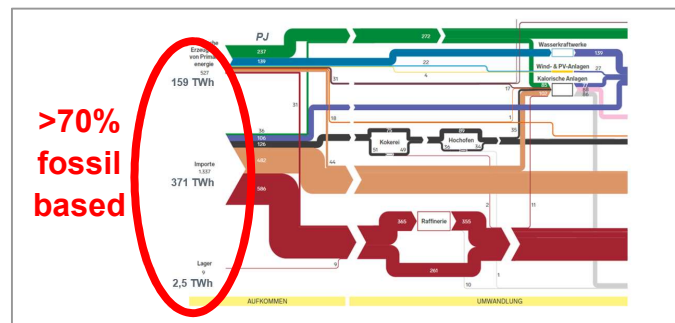
# Hydrogen as energy carrier for the electricity system



- 23 pumped storage plants (3,260 MW)
- 693 million m³ storage volume (1,800 GWh)

- Largest provider of grid and balancing services in Austria

# Hydrogen as feedstock for hard-to-abate sectors



## H2FUTURE: Green hydrogen for industry



### H2FUTURE: PEM electrolysis at a steel production site

- 6 MW PEM electrolyser (Siemens Silyzer 300)
- Hydrogen for **steel production** and **grid services**
- Located at **steel production site** in Linz, Austria
- **Start of pilot plant operation** started in 2019
- **Pilot tests** and **demonstration** until end of 2021

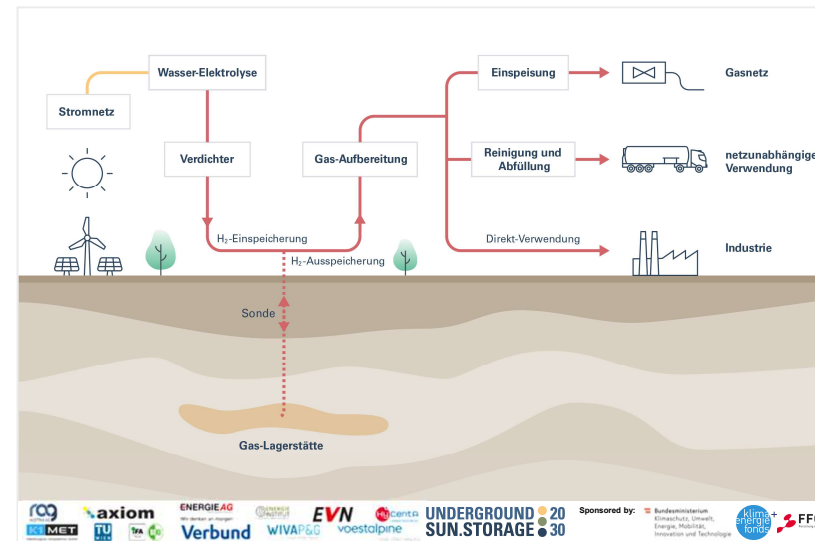
# HOTFLEX & UNDERGROUND SUN STORAGE: Green H2 as energy carrier



## HOTFLEX: High-temperature electrolysis at CCGT site

- 150 kW SOEC pilot plant and 20 kW SOFC
- Located at VERBUND CCGT site in Mellach
- Lower TRL than PEM, but higher efficiency expected
- Long term vision to **replace fossil based** flexibilities by the **reconversion of green hydrogen** into green electricity

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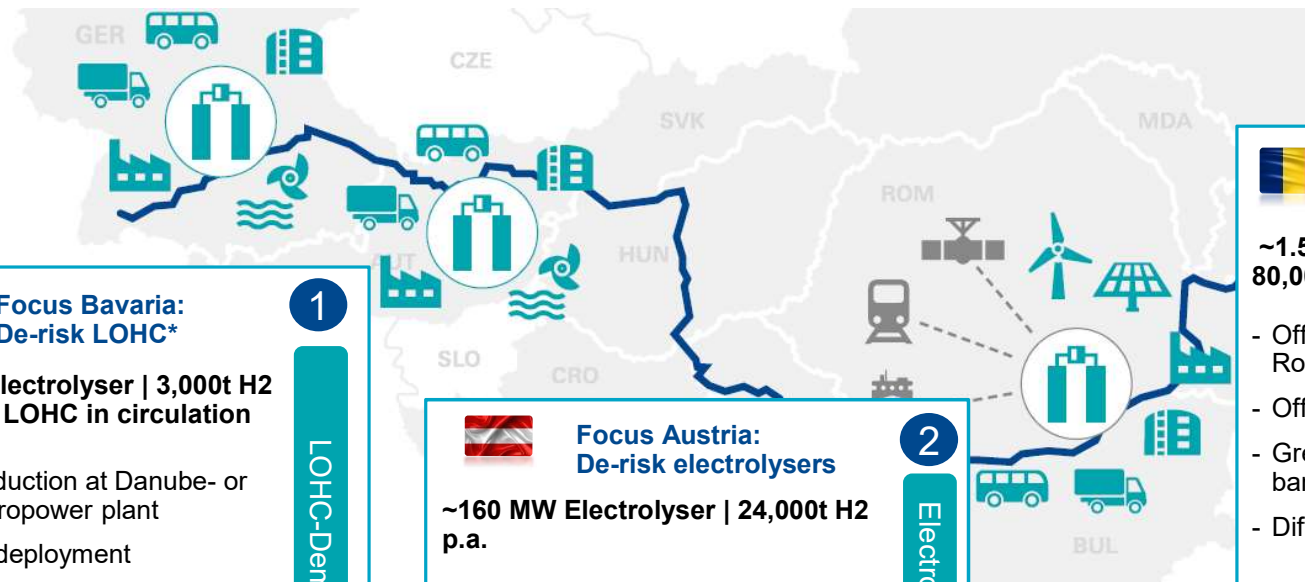


## Underground Sun Storage 2030: Hydrogen for Seasonal Storage

- Development and demonstration of **large volume seasonal H<sub>2</sub> storage** in exploited natural gas reservoirs
- Production of renewable based H<sub>2</sub> (2 MW PEM electrolyser)
- After **novel purification processes**, hydrogen from the storage will be feed into the natural gas grid or tested for other applications

18.11.2021

# GREEN HYDROGEN@BLUE DANUBE: An European import perspective for hydrogen



**1**

**Focus Bavaria: De-risk LOHC\***

~20 MW Electrolyser | 3,000t H2 p.a. | 400t LOHC in circulation

- H2-production at Danube- or Inn hydropower plant
- LOHC-deployment
- Off-takers in Bavaria
- Different options for plants in evaluation

LOHC-Demo

**2**

**Focus Austria: De-risk electrolysers**

~160 MW Electrolyser | 24,000t H2 p.a.

- H2-production at Danube-hydropower plant
- Off-takers in close proximity
- Direct lines to facilitate transport
- Different options for plants in eval.

Electrolyser -Demo

**3**

**Focus SEE: full roll-out of GH@BD**

~1.5 GW Electrolyser capacity | 80,000t H2 p.a.

- Off-grid production with RES in Romania (SEE)
- Off-takers along the Danube
- Green propulsion for ships & barges
- Different options for transport:
  - LOHC via ships and barges (base case)
  - Additional options (e.g. train with pressurized containers, pipelines)

Roll-out of infrastructure

\*Liquid Organic Hydrogen Carrier

# CARBON 2 PRODUCT AUSTRIA: Circular Value Chain based on green hydrogen

## Scope

Creation of a novel carbon circular value chain stretching across the industrial sectors of energy, cement and chemicals. Green H<sub>2</sub> + CO<sub>2</sub> from cement production → renewable based plastics

## Vision

Complete use of the CO<sub>2</sub> emitted from Austria's largest cement factory for the production of renewable based products in 2030

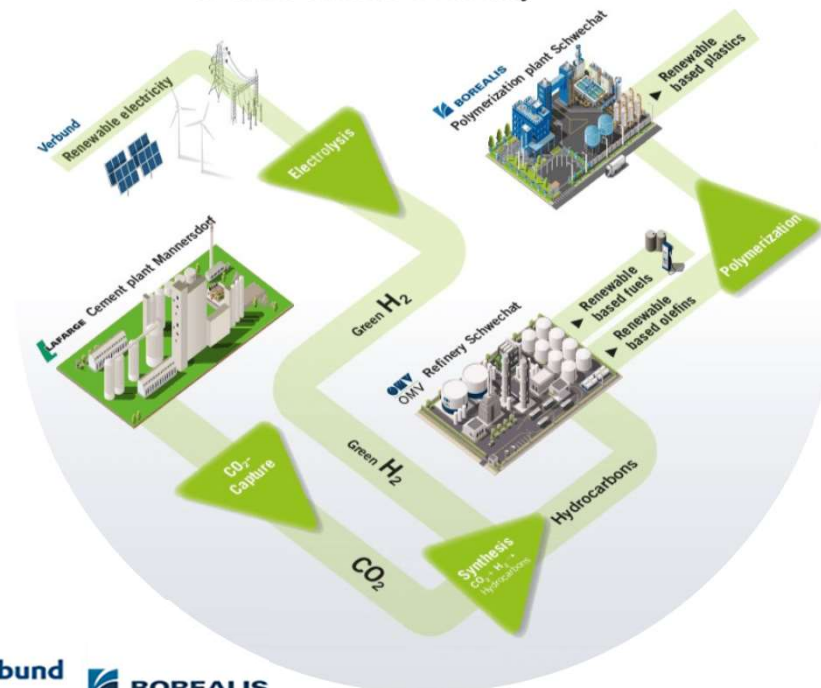
## Currently

- Refinement of technical concept
- Project development for a first demo plant which shall address the various technical, operational, regulatory and economic challenges.
- Acquisition of Co-Financing
- Partnering

## Main Challenges

- Business Case
- Technology
- Energy Demand

## Cross sectoral value chain to drive climate neutrality





## Green Hydrogen – scarce good

“Experts see gigantic CO2 savings potential through the use of green hydrogen in the chemical industry, (...) cement production and the steel industry (...)” as well as with “air, sea and heavy transport.”

Alone to cover the electricity needs for green hydrogen production for Austria’s largest steel producer, we’d need the electricity output of all VERBUND Danube hydro-power plants.

\*Source: <https://www.zdf.de/nachrichten/wirtschaft/klima-klimaneutralitaet-gruener-wasserstoff-100.html>

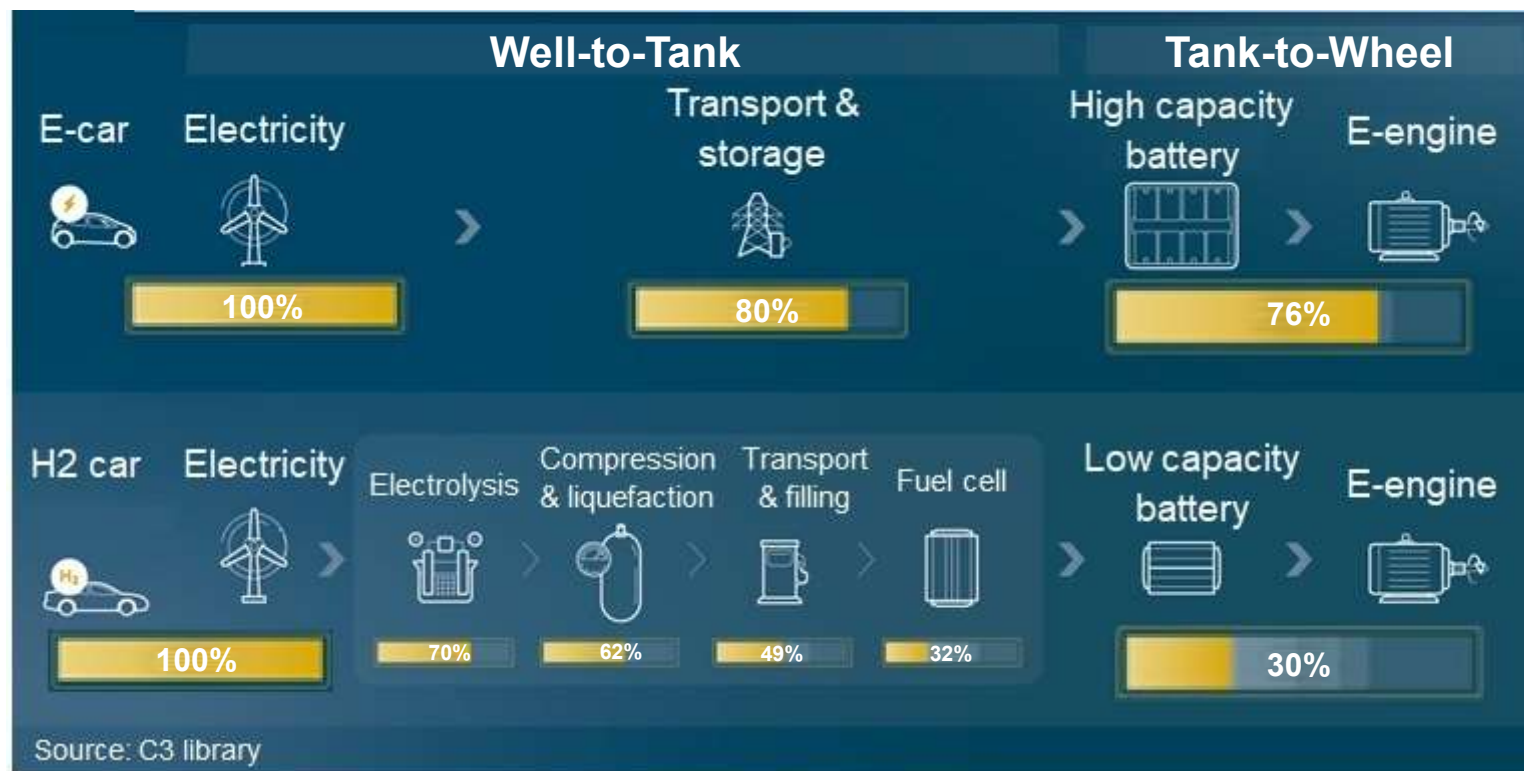
## Use hydrogen where it makes sense

The "very poor energy efficiency well-to-wheel" of fuel cell cars ensures that battery-powered e-cars are "several times more efficient.

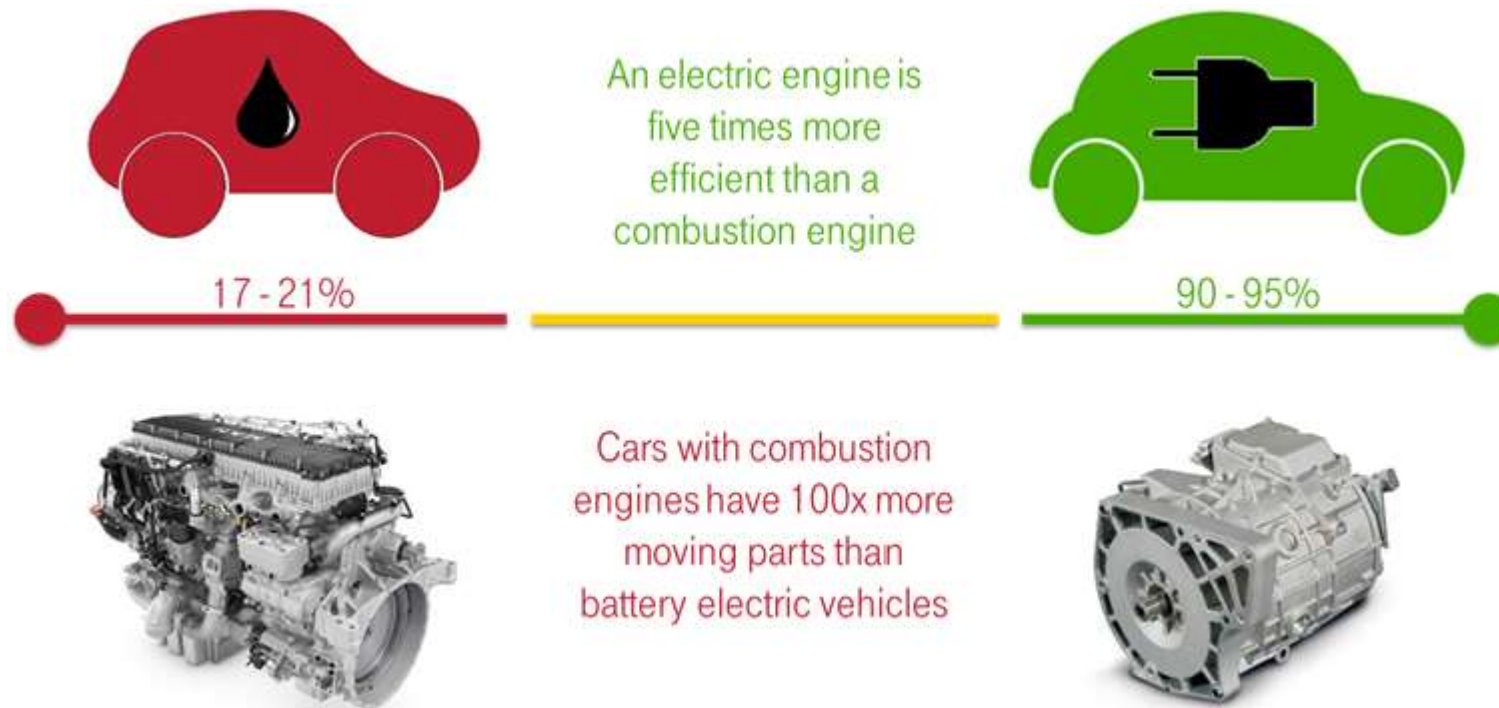
I am not at all against hydrogen as an energy storage medium. It's just that it has to be used where it makes sense - and that's not in passenger cars, but in the stationary sector."

Source: Prof. Maximilian Fichtner in Wirtschaftswoche, 05. November 2019

### Efficiency of battery electric vehicle vs. hydrogen fuel cell car



# Why we don't believe in internal combustion engine (ICE) cars and hence, not in e-fuels neither



Our SMATRICS HPC network: 5min for 100km range (with the right car)



## H2ZILLERTAL: Green hydrogen as feedstock for mobility



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### H2Zillertal: World's first narrow gauge hydrogen train

- **Switch from diesel to hydrogen** powered trains in cooperation with local public train operator
- Green hydrogen supply from **local hydro power plant**
- Extension to hydrogen-powered coach and bus service (skiing resort) under evaluation

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