



INDUSTRIELLE WASSERSTOFFANWENDUNGEN

Im Straßenbau



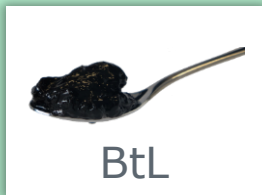
Sustainable material drying

The huge potential of our customers

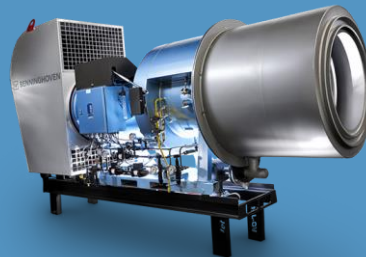


BENNINGHOVEN Company Use

REGENERATIVE
Fuels

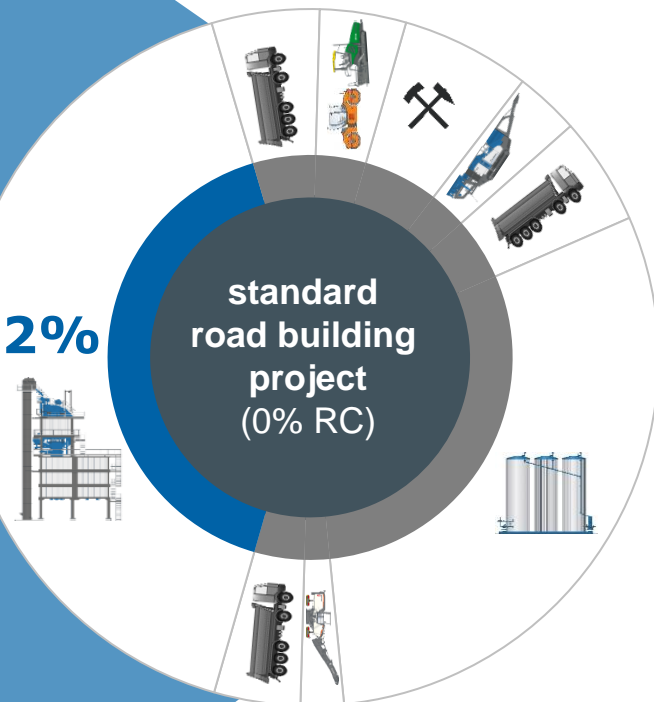


38%

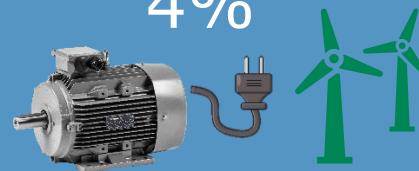


42%

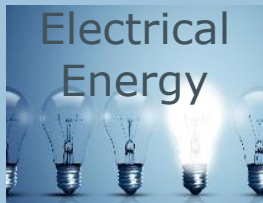
standard
road building
project
(0% RC)



4%



CO₂ NEUTRAL
Fuels



BENNINGHOVEN
SUSTAINABILITY

NEW BURNER CONTROL - REMOTE

1st level Support



Plant



Plant Control



Burner Control



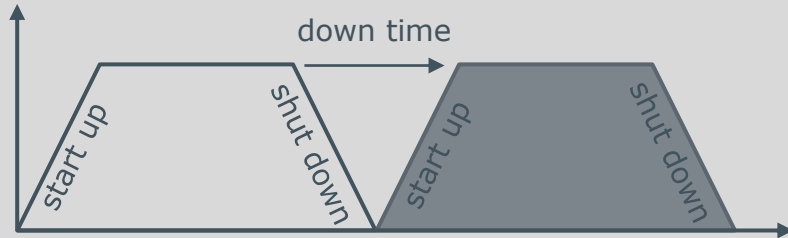
Remote maintenance option for direct access to the burner control unit and diagnosis of individual signal outputs and inputs

New Burner Control

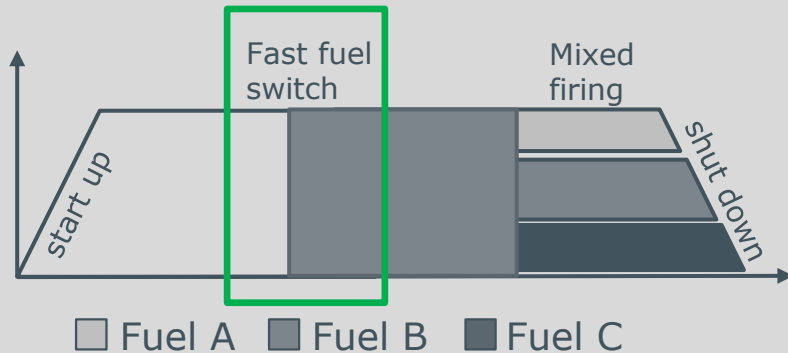
Mixed firing & Fast fuel switch



Old Version



New Burner Control





NEW BENNINGHOVEN BURNER GENERATION

The Start



BENNINGHOVEN

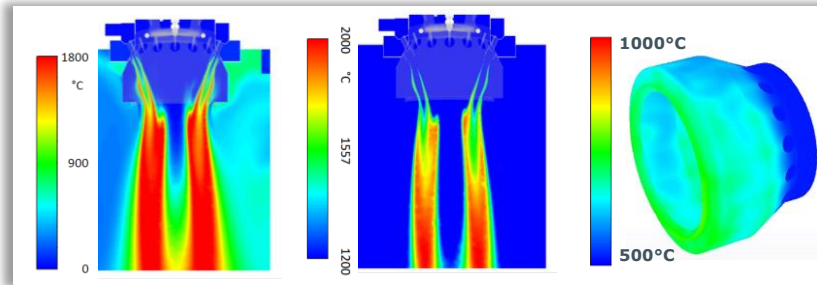
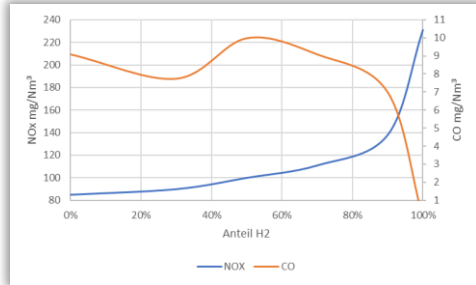
The new Burner Generation



Project development From the study to the prototype



BENNINGHOVEN Company Use



Project Study

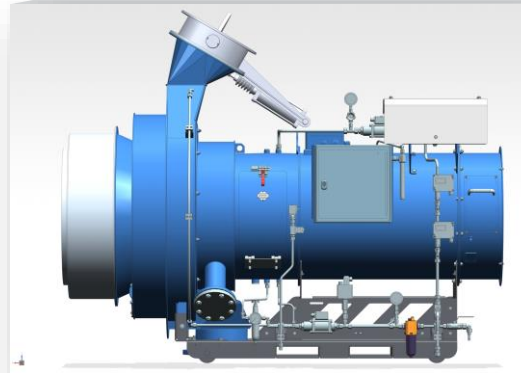
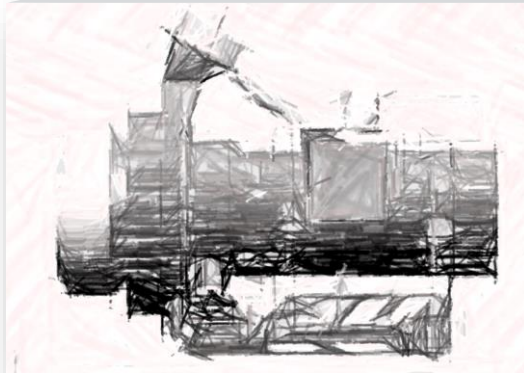
Concept Study

Numerical Study

Design Phase

Test Phase

Series release



- ▶ According to DIN 746-1
- ▶ Safety Integrity Level (SIL) 2 for all relevant parts (IEC 62061)
- ▶ Safety assessment for handling and maintenance
- ▶ Risk assessment according to Machinery Directive 2006/42/EC
- ▶ Approval of the system by an officially notified body in accordance with the "Zero series"

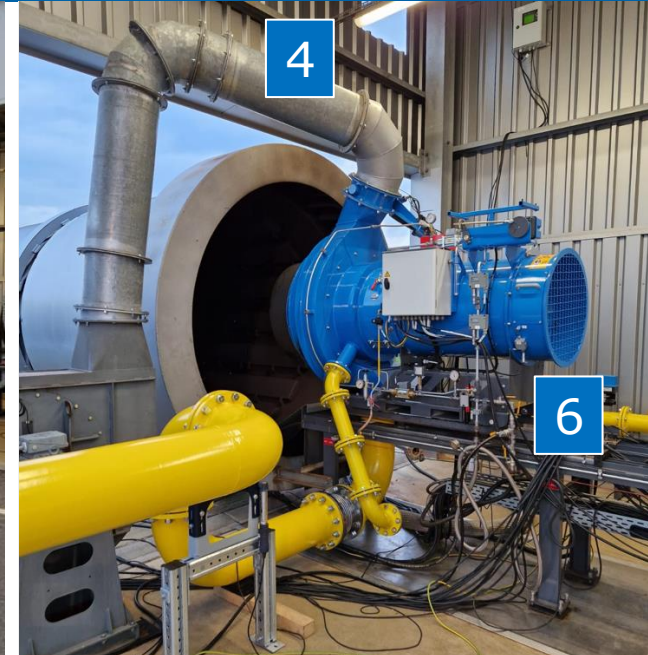
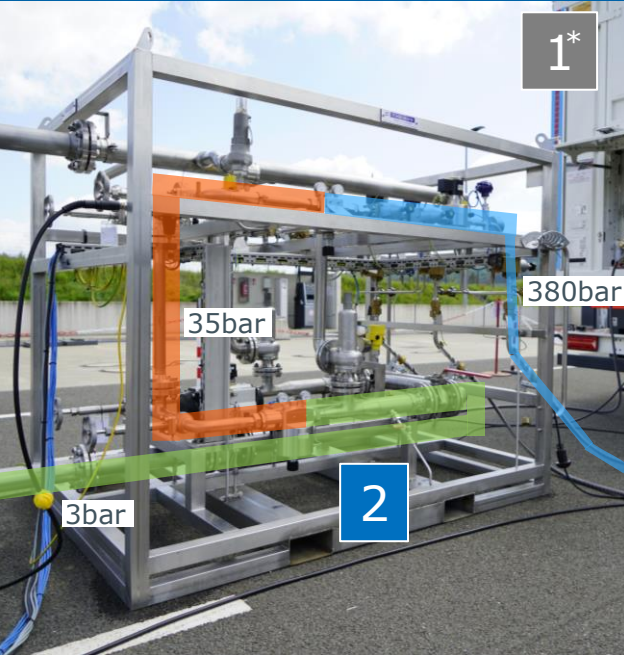


Production System Solution

Delivery scope Benninghoven



Company Use
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1 Mobile hydrogen storage unit*

2 Pressure control section

3 Hydrogen control section

4 Inert gas recirculation

6 Burner

*Not included in the scope of delivery

Production System Solution

Schematic illustration



Company Use
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- 1 Mobile hydrogen storage unit*
- 2 Pressure control section
- 3 Safety chimney
- 4 Hydrogen control section
- 5 Drying drum, H₂ prepared



*Not included in the scope of delivery

Prototype test

Installation site Norway



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Kristiansund, Norway October 2023

▶ **3000 tonnes** of asphalt already produced with **100% H2** (Dec. 2023)

Prototype test

Kristiansund, Norway



- Safety assessment and authorisation – Norway
- Function of the drying system in long-term test
- Heat transfer profile in the drying drum
- System behaviour under changing framework conditions
- 3000 tonnes of asphalt already produced with 100% H₂ (Dec. 2023)

Project development

Next Steps



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Further tests on the test bench and at asphalt mixing plants



Project Study

Concept Study

Numerical Study

Design Phase

Test Phase

Series release

Retrofit of further pilot series plants commissioning in July 2024



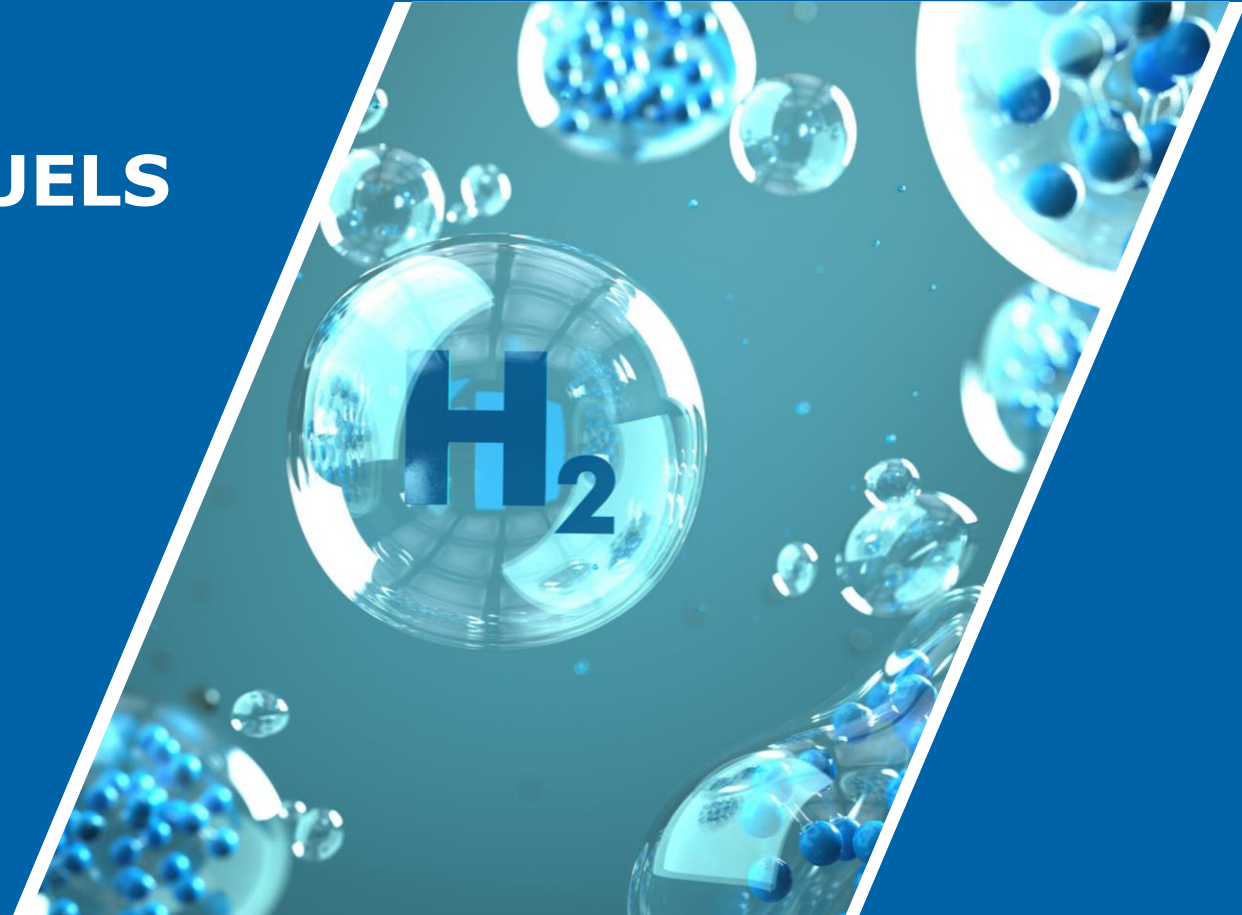
bauma

2025

Series launch



ALTERNATIVE FUELS



Hydrogen as fuel

No greenhouse gas emissions



Renewable energy if produced from green electricity



High energy density: well suited as fuel for heat processes



No use of agricultural land - no competition with food production



400 Billion € investment in H₂ sector expected by 2050



Demand of 2,500 TWh/a for H₂ expected in Europe in 2050



Regenerative energies

Fuels of the future

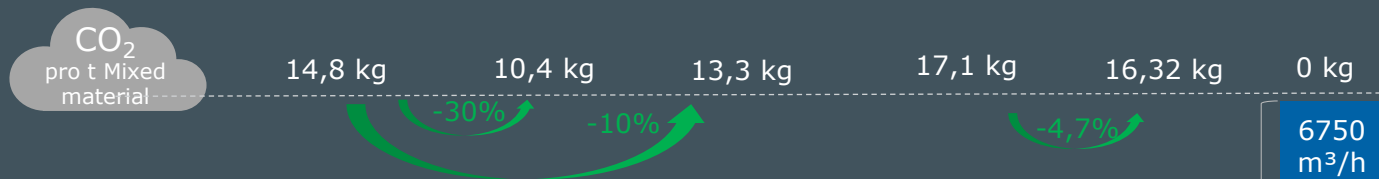


Boundary condition:

- ▶ 20 MW burner capacity
- ▶ Volumetric calorific values:
 - > Natural gas 11,4 kWh/m³
 - > Hydrogen 2,97 kWh/m³
 - > Propane 25,89 kWh/m³
- ▶ New drying system necessary for H₂

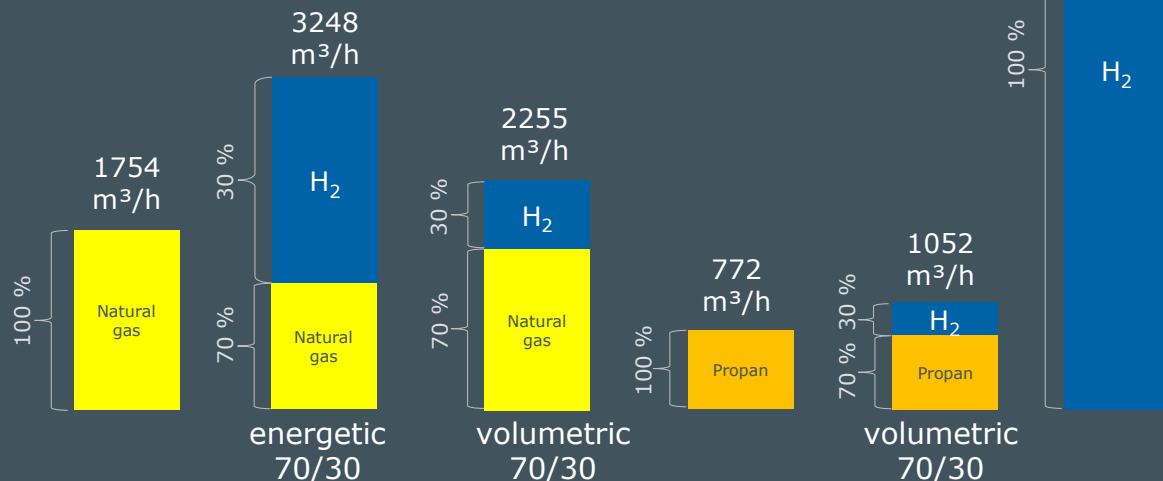
	legal CO ₂ pro t Mixed material	in fact CO ₂ pro t Mixed material
BKS	29 kg	29 kg
Wood dust	0 kg	28 kg
DME	0 kg	15 kg
HVO	0 kg	19 kg
BTL	0 kg	19 kg
LPG	17 kg	17 kg
H ₂ /LPG (30/70)	16 kg	16 kg
H ₂	0 kg	0 kg

Green hydrogen



Edge condition:

- ▶ 20 MW burner capacity
- ▶ Volumetric calorific values:
 - Natural gas 11,4 kWh/m³
 - Hydrogen 2,97 kWh/m³
 - Propane 25,89 kWh/m³
- ▶ New drying system necessary for H₂





GAME CHANGER

VIELEN DANK

für den Straßenbau
aus einer Hand

BIS ZU
100 %
WASSERSTOFF

Unserem Entwicklungsprozess folgend haben wir erfolgreich den ersten Wasserstoffbrenner bei einem Kunden installiert, womit bereits tausende Tonnen Asphalt gemischt wurden.

PRODUCTION SYSTEM SOLUTION

- > Zuführsystem ab Quelle Wasserstoff
- > Druckgesteuerte (kann folgende Funktionen abbilden)
 - Trichterabfuhrung
 - Anschluss von Elektrolyse, Pipeline oder Speichertank
 - Wasserstoffverteilung im Rohrleitungssystem
- > Mehrstoffbrenner inkl. Wasserstoffregelstecke, Brennsteuereinheit
- > Auf Wasserstoffbetrieb abgestimmte Anlagenkomponenten
- > Komplettlösung aus einer Hand



STEUERUNG

- > Integrierte Steuerung | volle Transparenz
- > Mischsteuerung | höchste Flexibilität
- > Fliegender Brennstoffwechsel, ohne Abschalten | geringe Verluste



ZERO
CO₂

LOW NO_x
TECHNOLOGIE