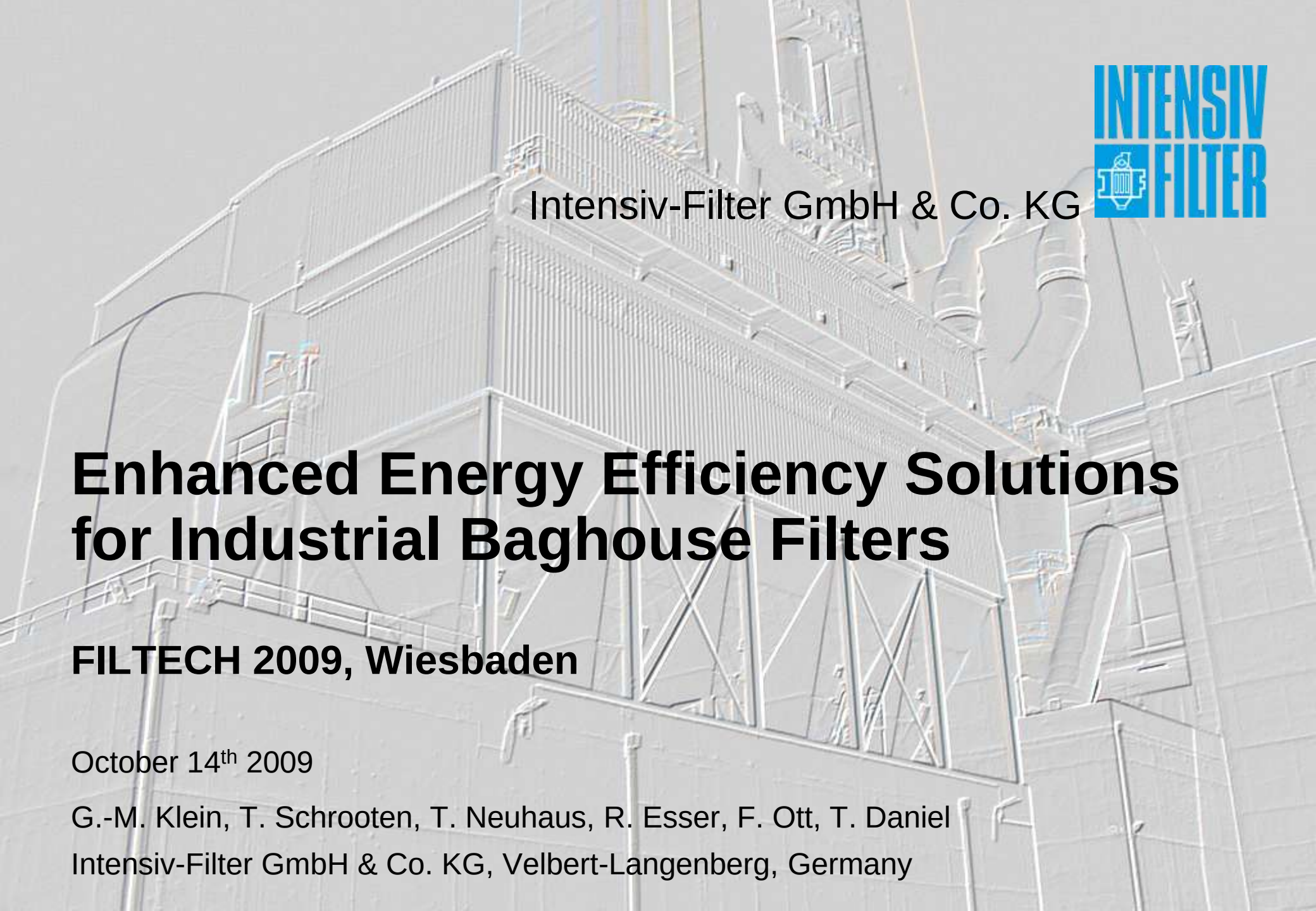


Intensiv-Filter GmbH & Co. KG

# Enhanced Energy Efficiency Solutions for Industrial Baghouse Filters

## FILTECH 2009, Wiesbaden

October 14th 2009

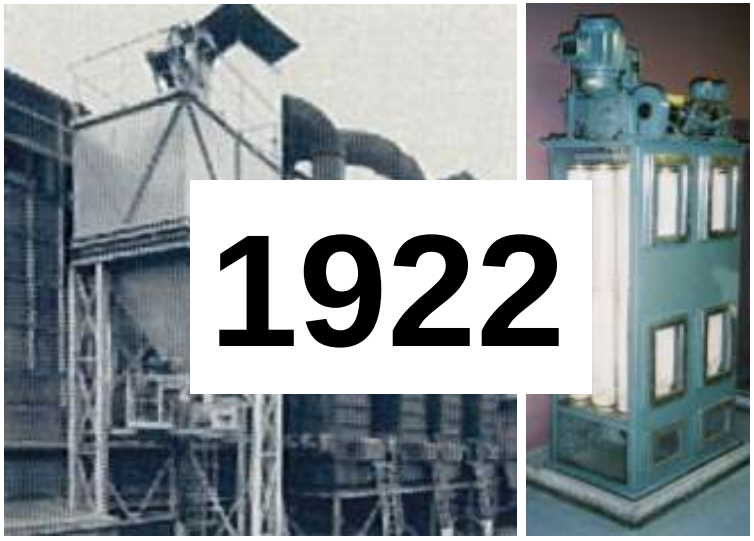
G.-M. Klein, T. Schrooten, T. Neuhaus, R. Esser, F. Ott, T. Daniel
Intensiv-Filter GmbH & Co. KG, Velbert-Langenberg, Germany

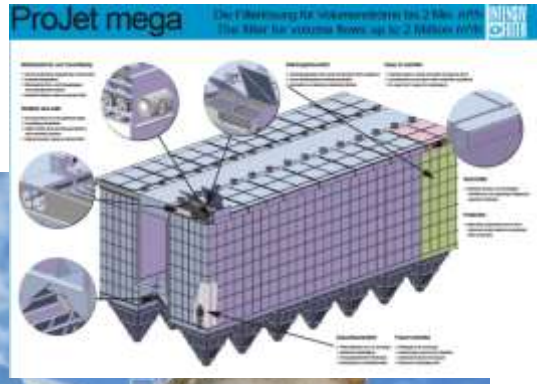
# Enhanced Energy Efficiency Solutions for Bag Filters

## 1) Introduction

## Intensiv-Filter at Velbert-Langenberg, Germany

Deutsches Museum





**Leadership in industrial dedusting technology for more than 85 years**

# Enhanced Energy Efficiency Solutions for Bag Filters

1) Introduction

## Intensiv-Filter – key figures

**Turnover 2008:** 80 Million EUR (group)

**Staff:** 400 employees (group)

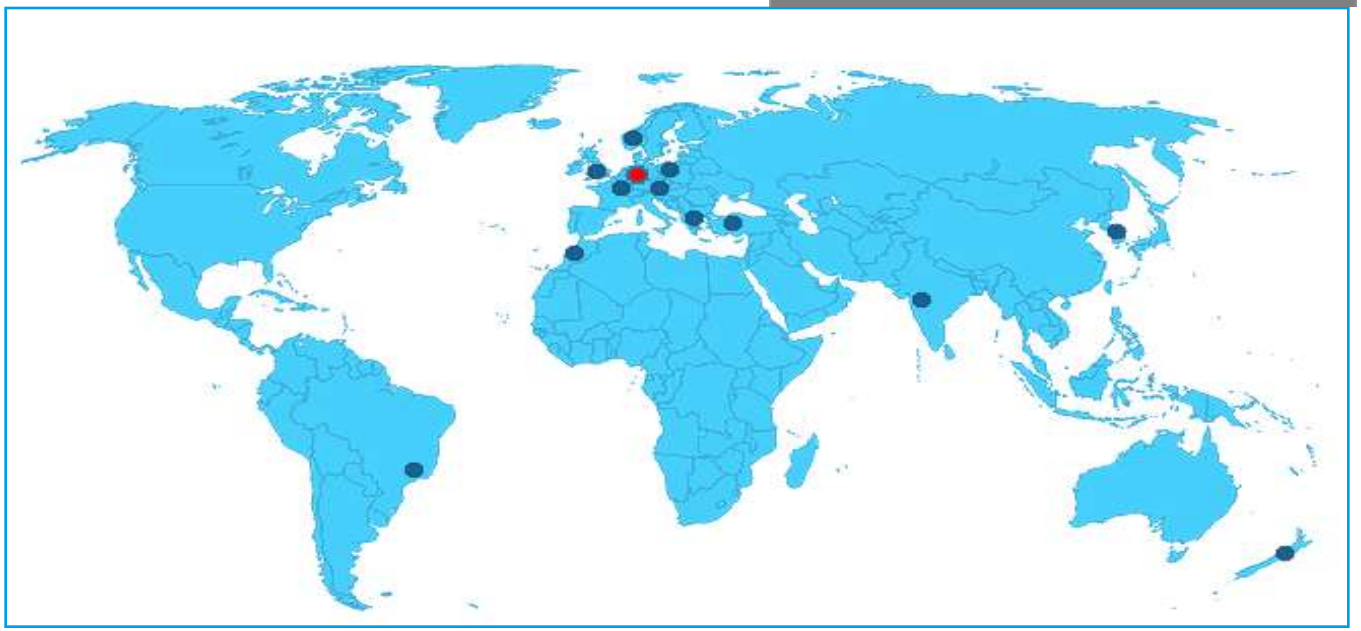
**Company network:**

2 affiliated companies,

7 subsidiaries,

8 agencies abroad and

2 regional offices



# Enhanced Energy Efficiency Solutions for Bag Filters

1) Introduction

## More than 100.000 references all over the world

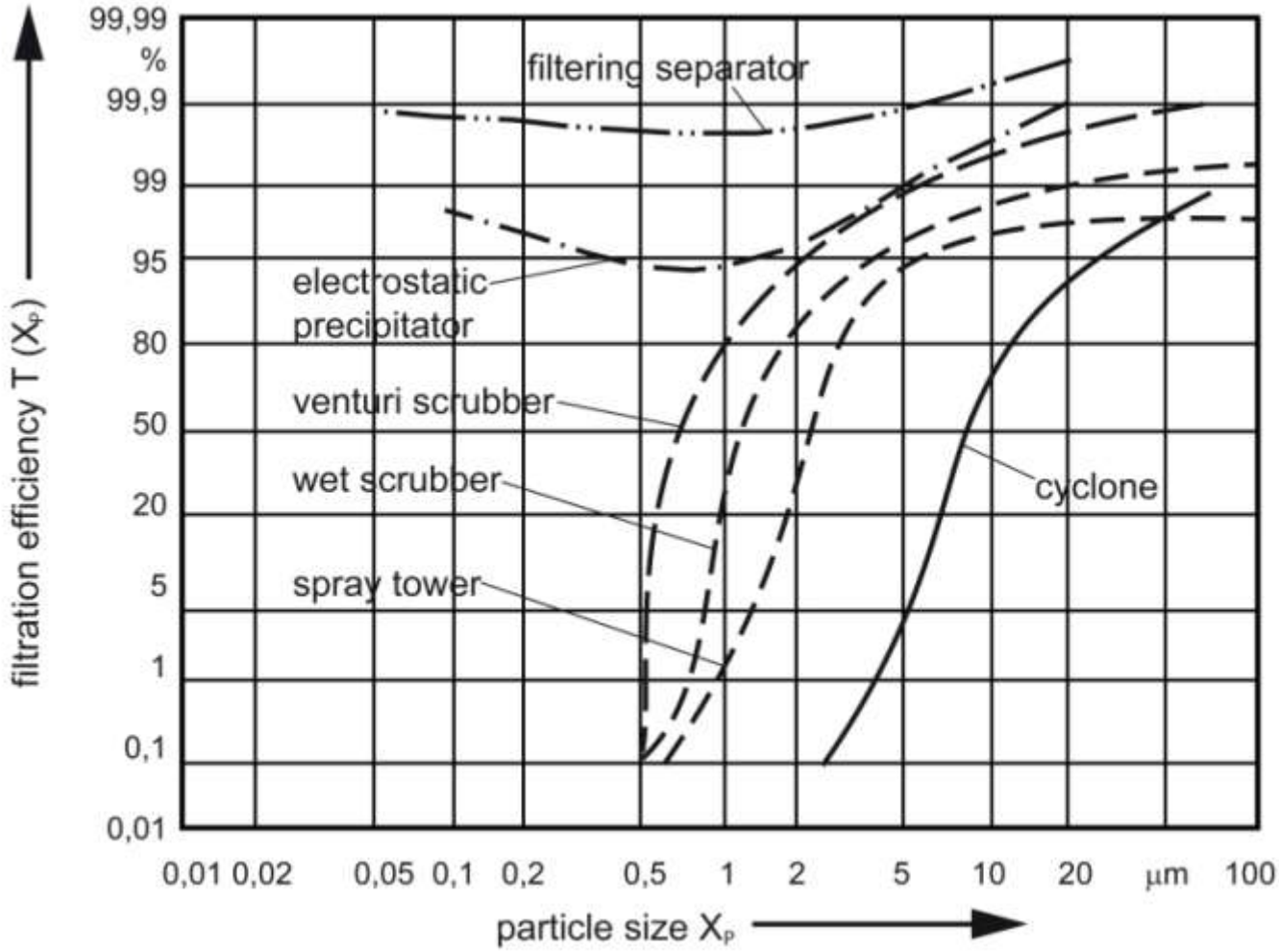
### Process filter kiln and rawmeal mill dedusting - France

| | | |
|---|---|---|
| Volume flow | 1.000.000 | m³/h n.c.. |
| Raw gas conc. | 100 | g/m³ |
| Clean gas conc. | < 10 | mg/m³ n.c. dry |
| Filter area | 13.700 | m² |

# Enhanced Energy Efficiency Solutions for Bag Filters

1) Introduction

## Particle separation effciency of different industrial gas cleaners

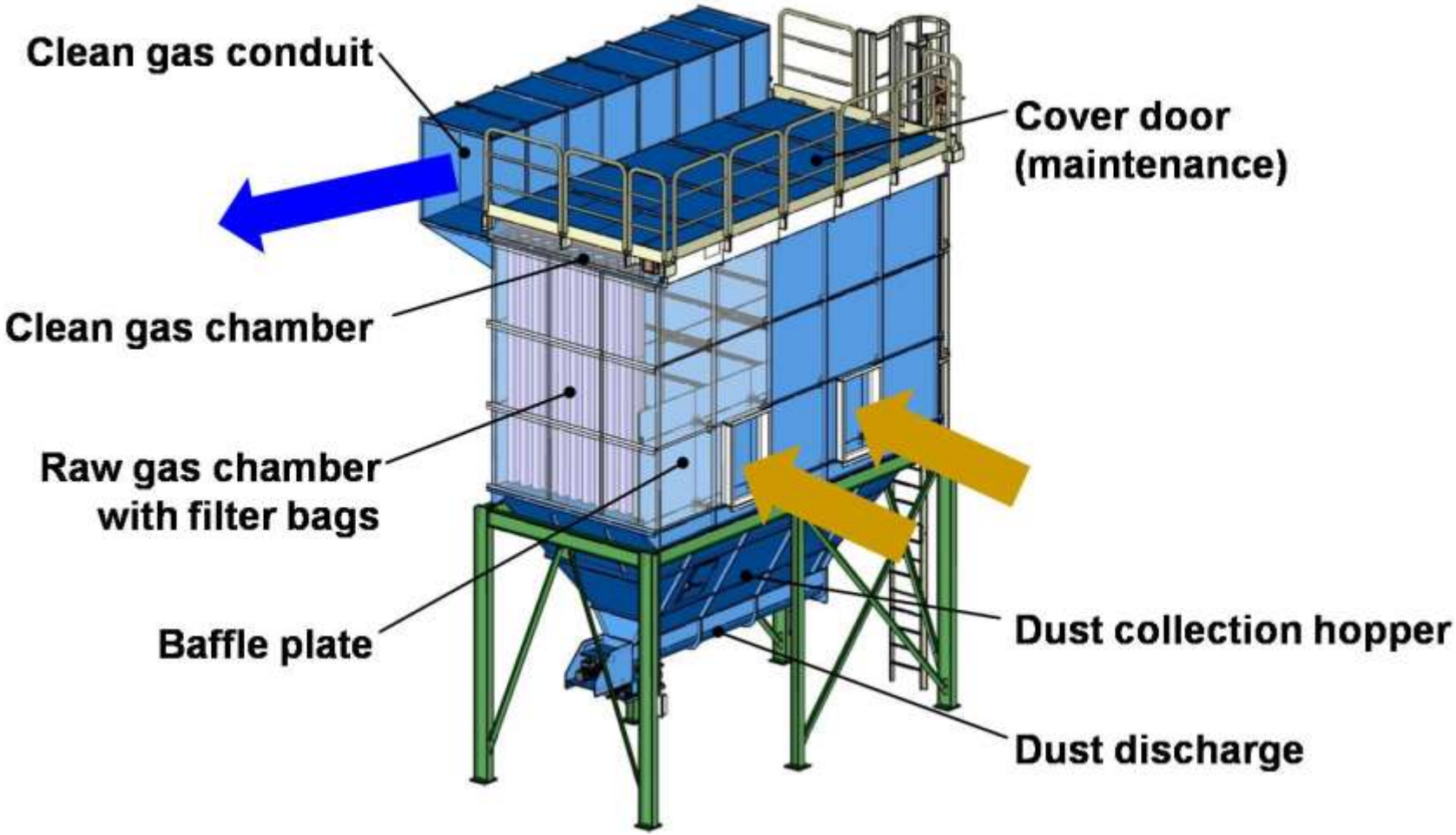



Bank, M.: Basiswissen Umwelttechnik, Vogel-Verlag Würzburg, 1995

# Enhanced Energy Efficiency Solutions for Bag Filters

1) Introduction

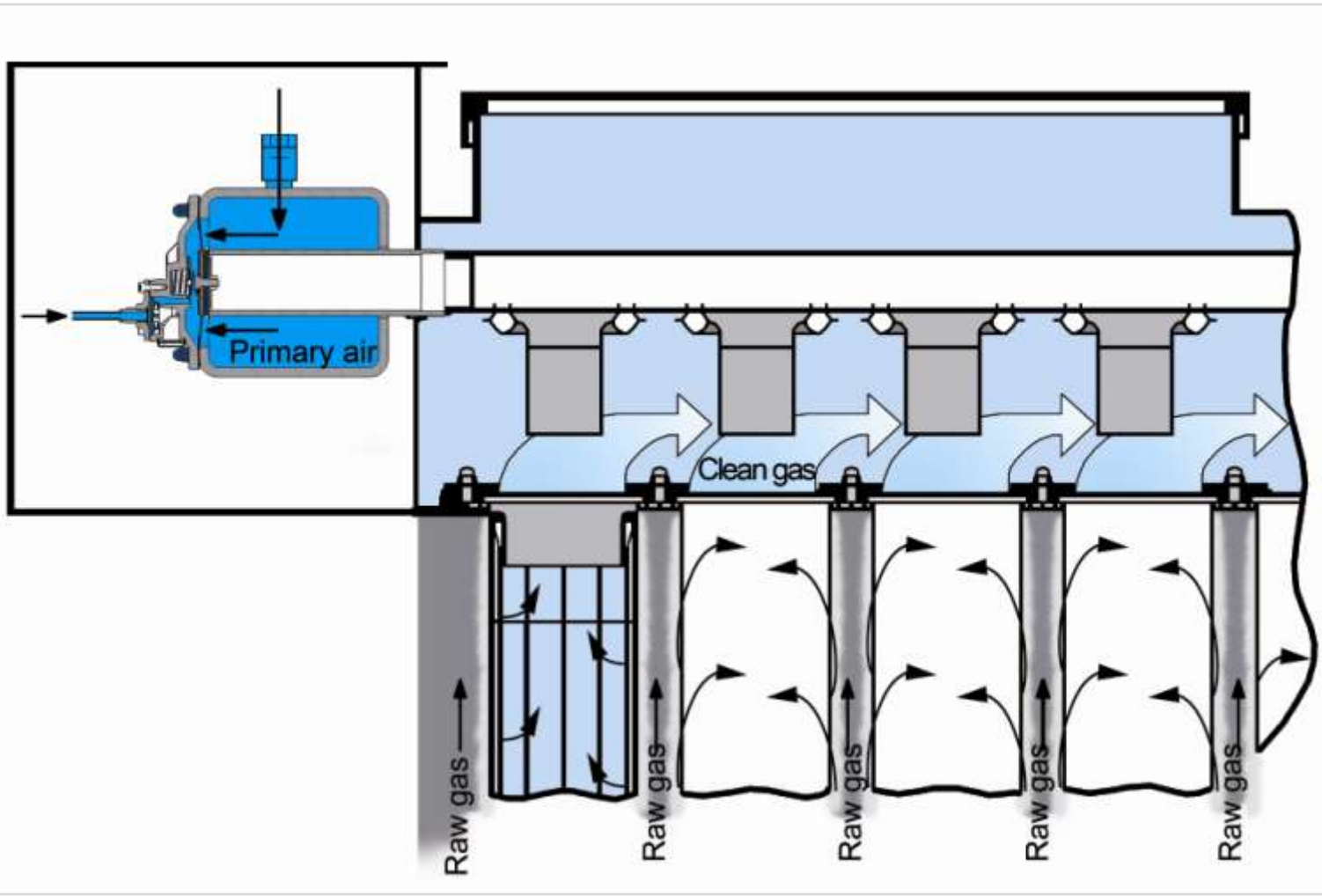
## Jet pulse air cleaner (online operation mode)
## Schematic illustration of the Intensiv-Filter basic design



# Enhanced Energy Efficiency Solutions for Bag Filters

1) Introduction

## Functional principle of the Intensiv-Filter jet pulse cleaning

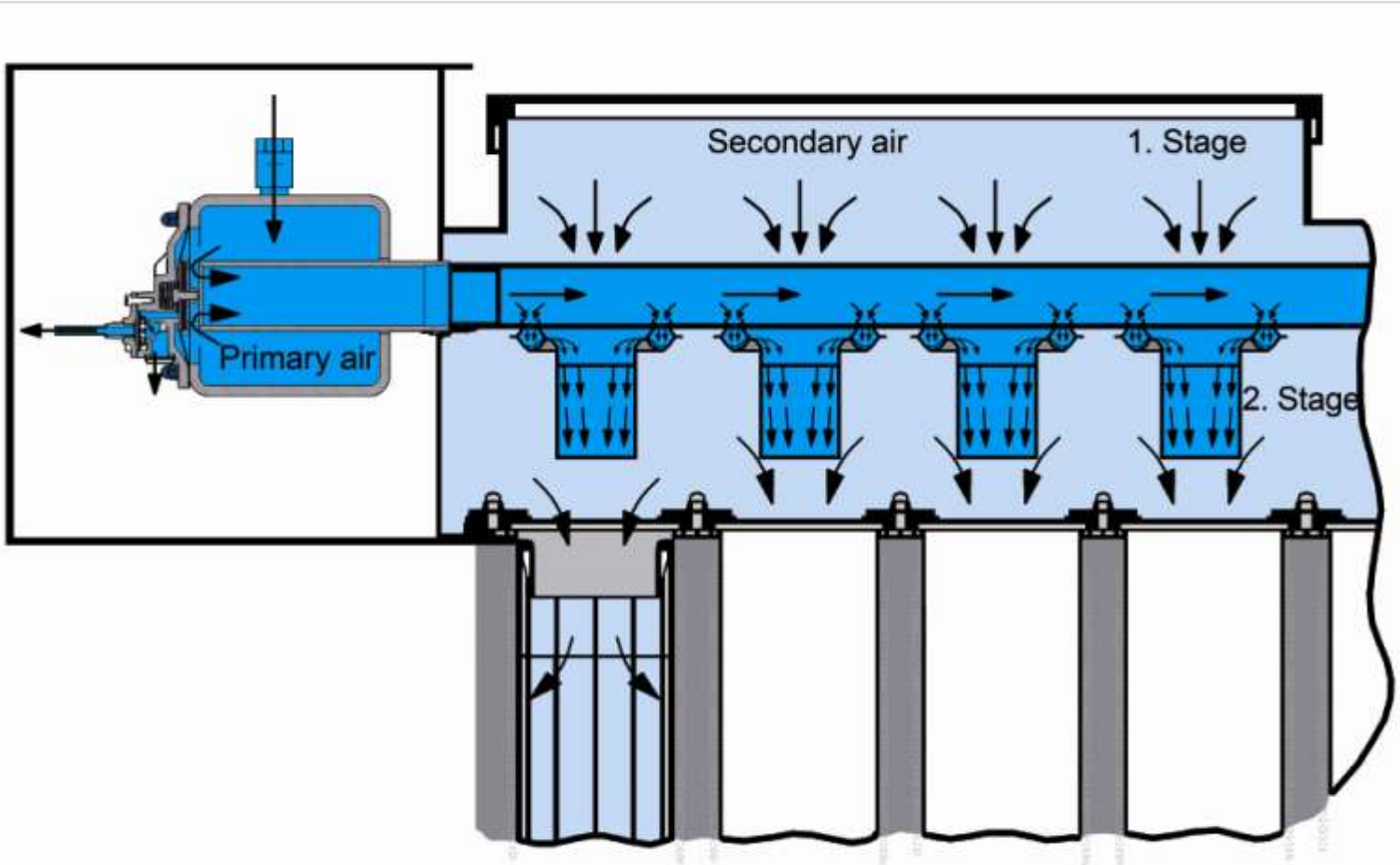



**Filtration phase**

# Enhanced Energy Efficiency Solutions for Bag Filters

1) Introduction

## Functional principle of the Intensiv-Filter jet pulse cleaning

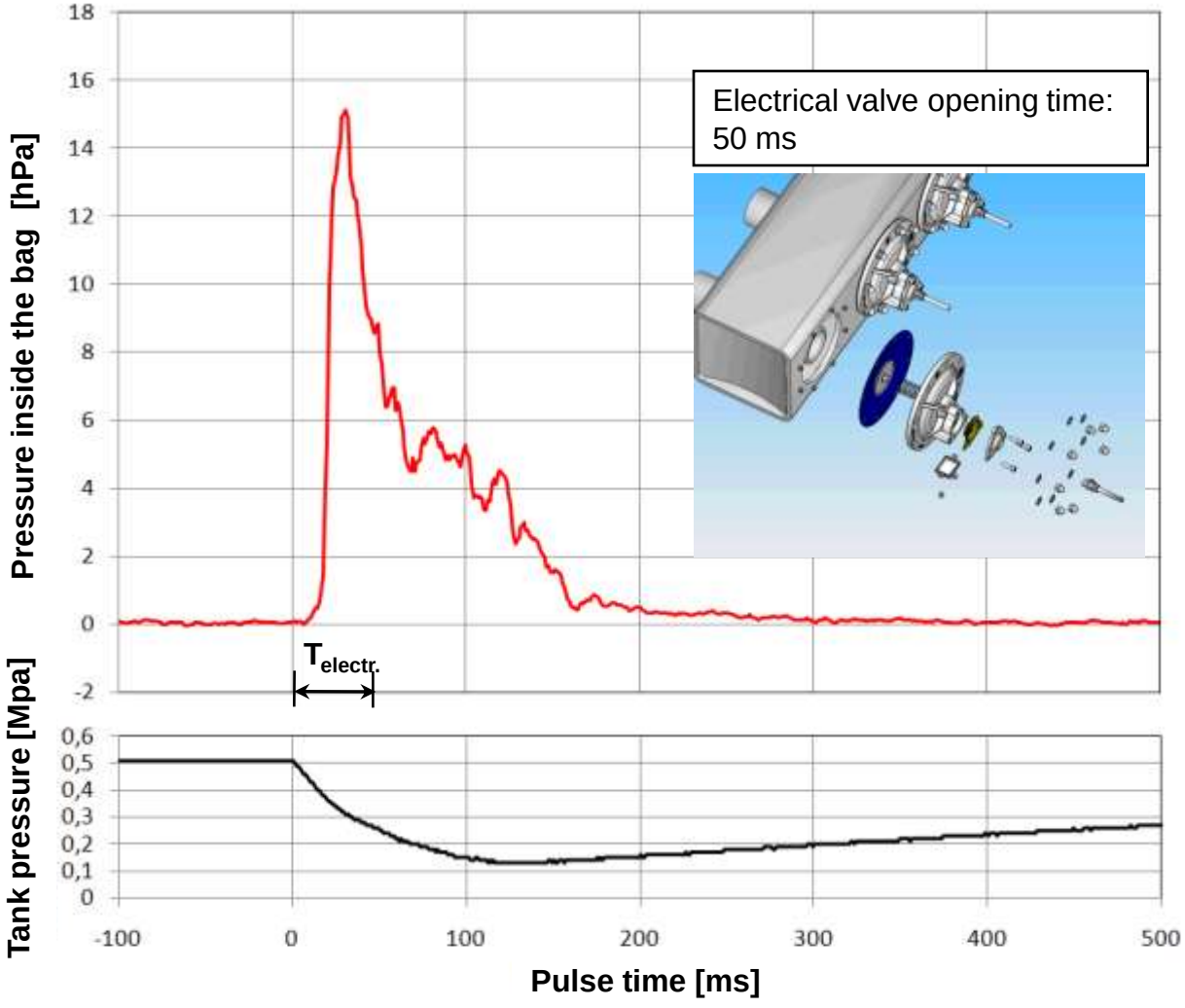


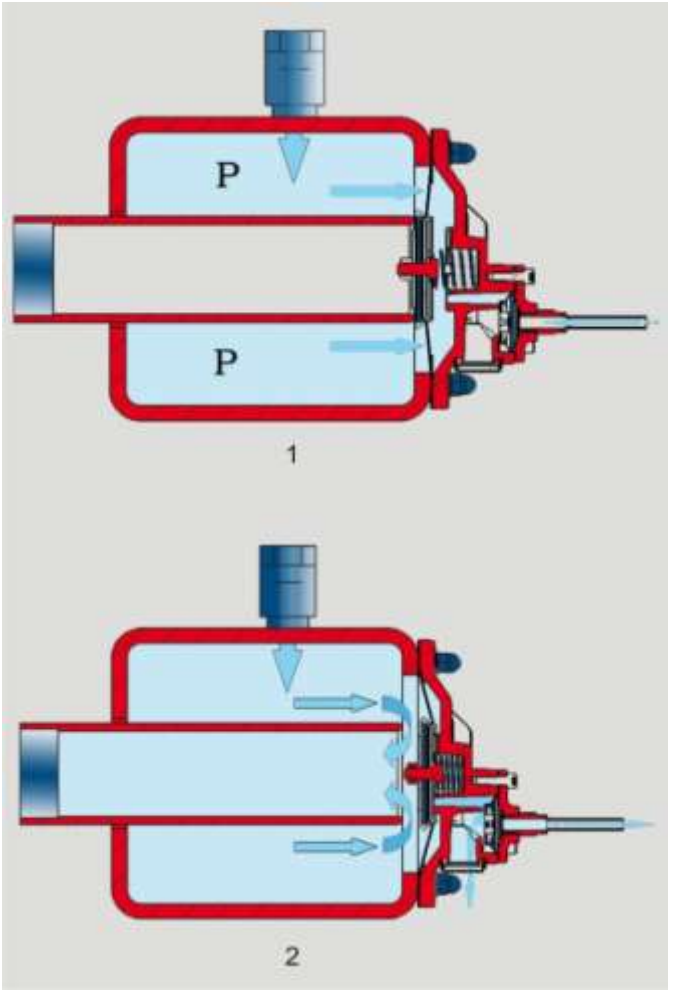

**Cleaning phase**

# Enhanced Energy Efficiency Solutions for Bag Filters

## 1) Introduction

## The Intensiv-Filter air tank membrane and blowpipe system

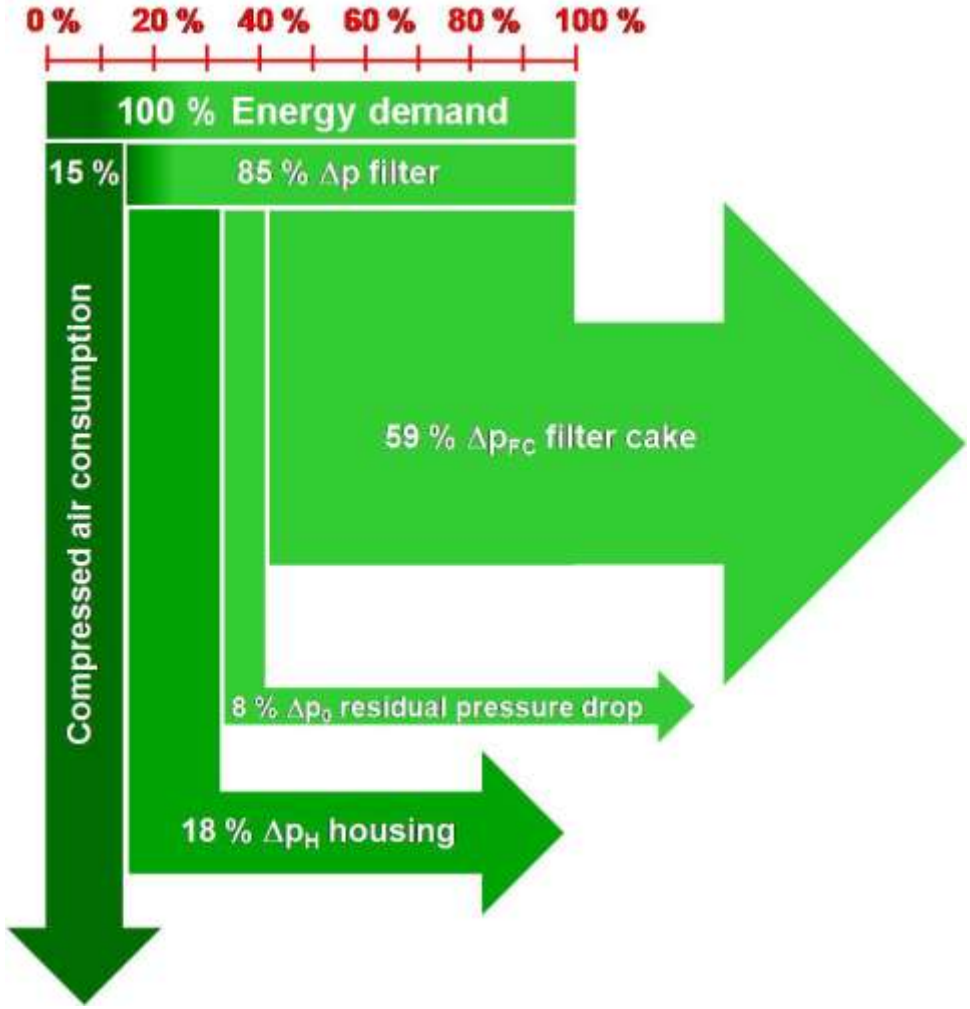


# Enhanced Energy Efficiency Solutions for Bag Filters

## 1) Introduction

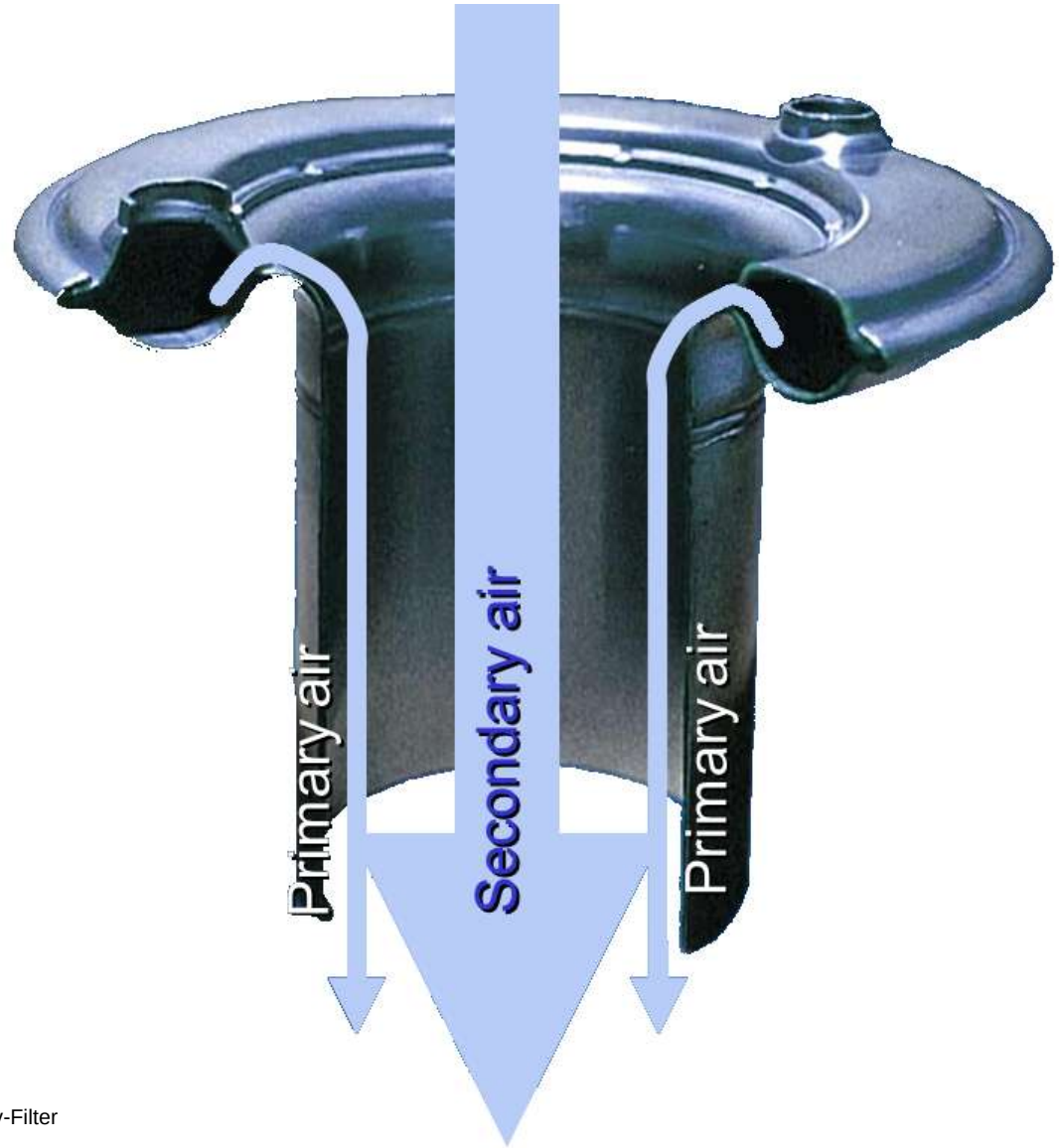
### Energy flow diagram of a state-of-the-art jet pulse bag filter (online)



# Enhanced Energy Efficiency Solutions for Bag Filters

## 2) Offline operation mode – ProJet mega®

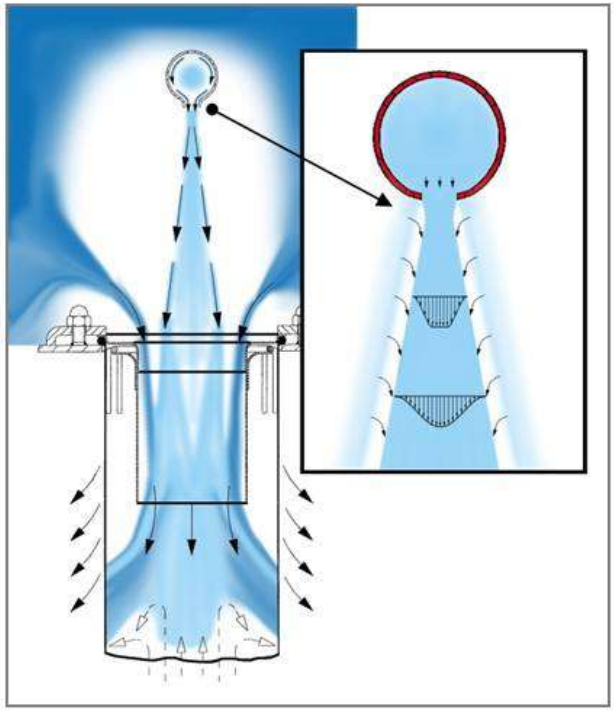
**The patented Intensiv-Filter Coanda Injector**



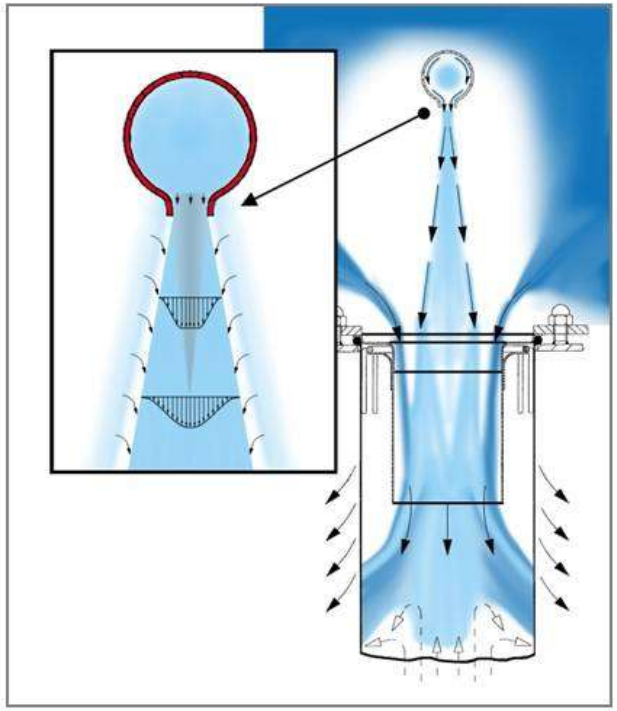
# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

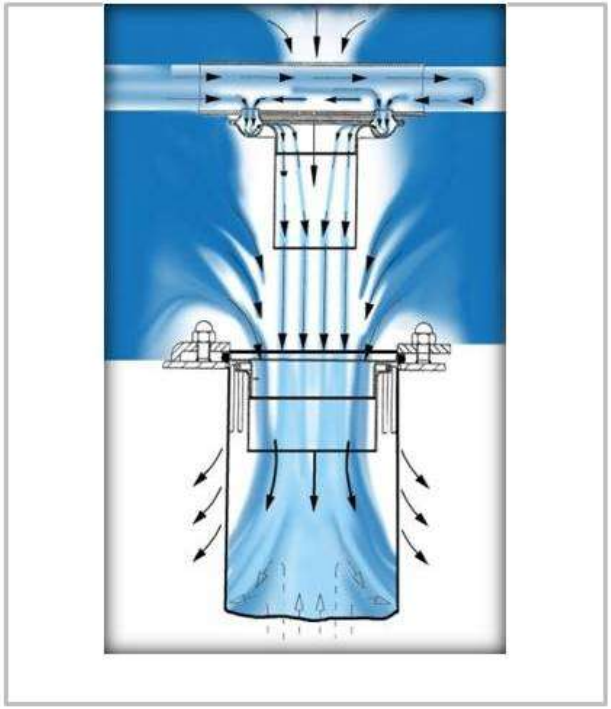
## Comparison of different injector systems



a) Hole type nozzle with inlet nozzle



b) Ideal nozzle with inlet nozzle



c) Coanda Injector with inlet nozzle

# Enhanced Energy Efficiency Solutions for Bag Filters

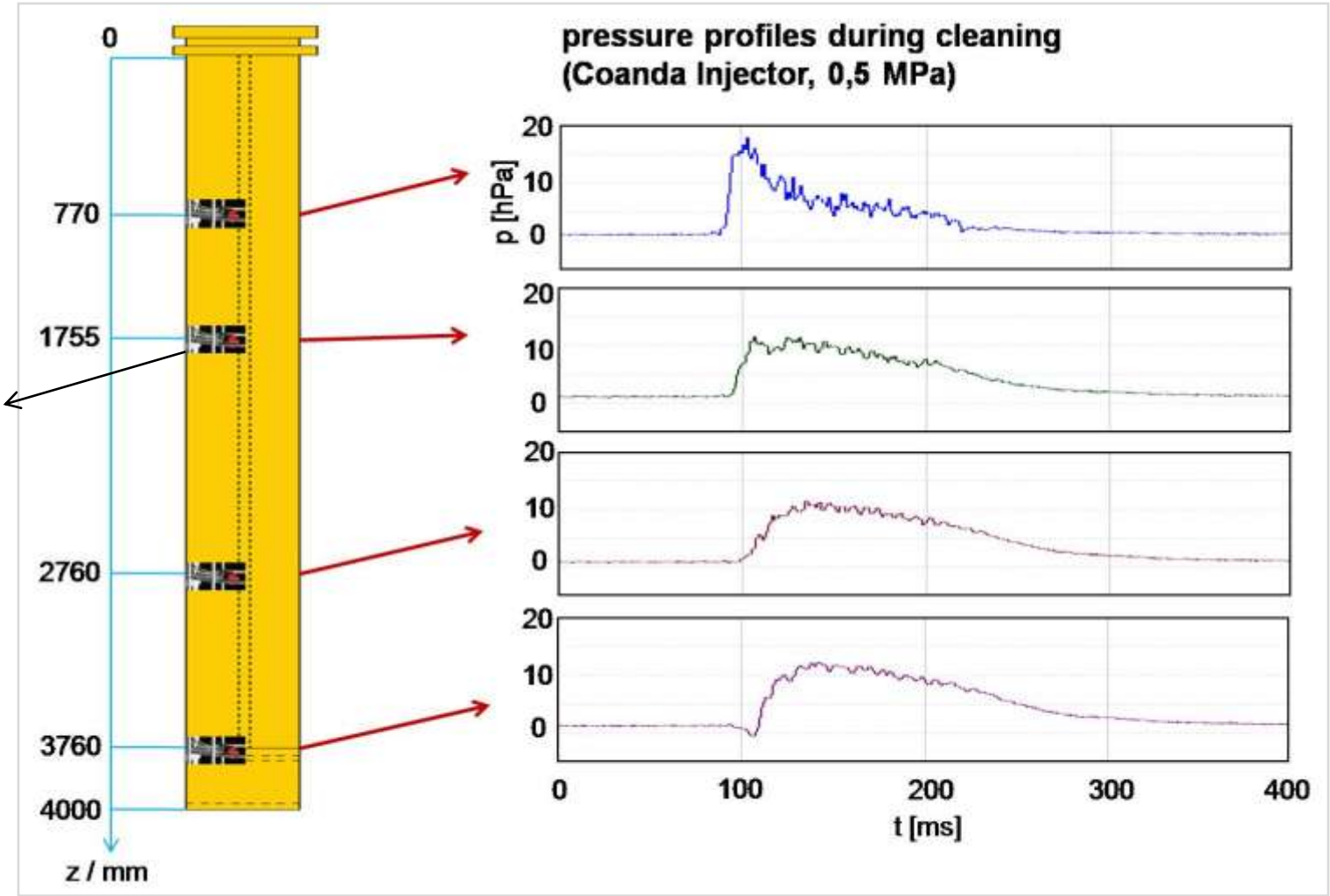
## 2) Offline operation mode – ProJet mega®

## Comparison of different injector systems


**Piezoresistive pressure sensors**

**Measurement range: -50/50 mbar**

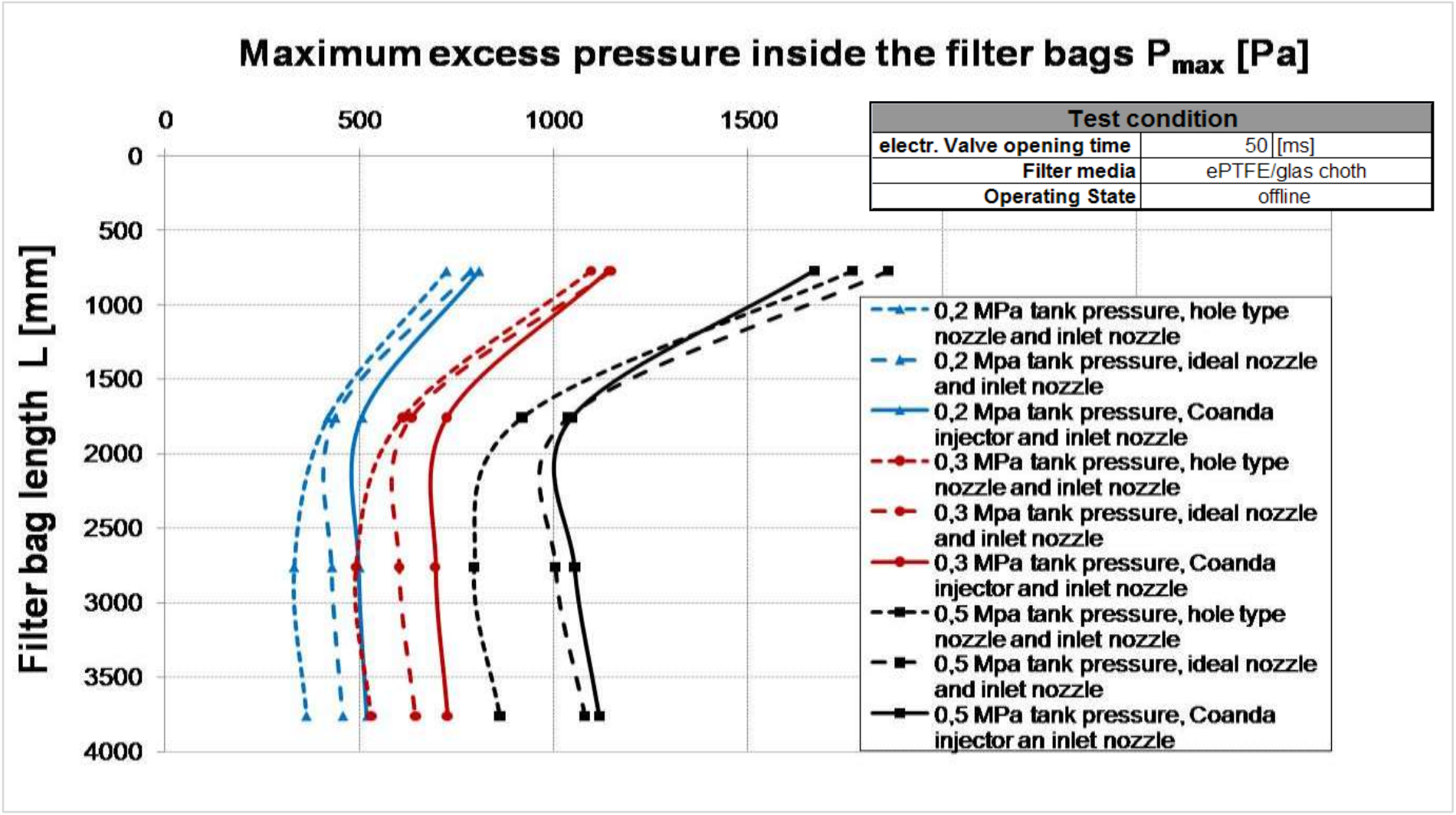
**Test frequency: 1 ms**



# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

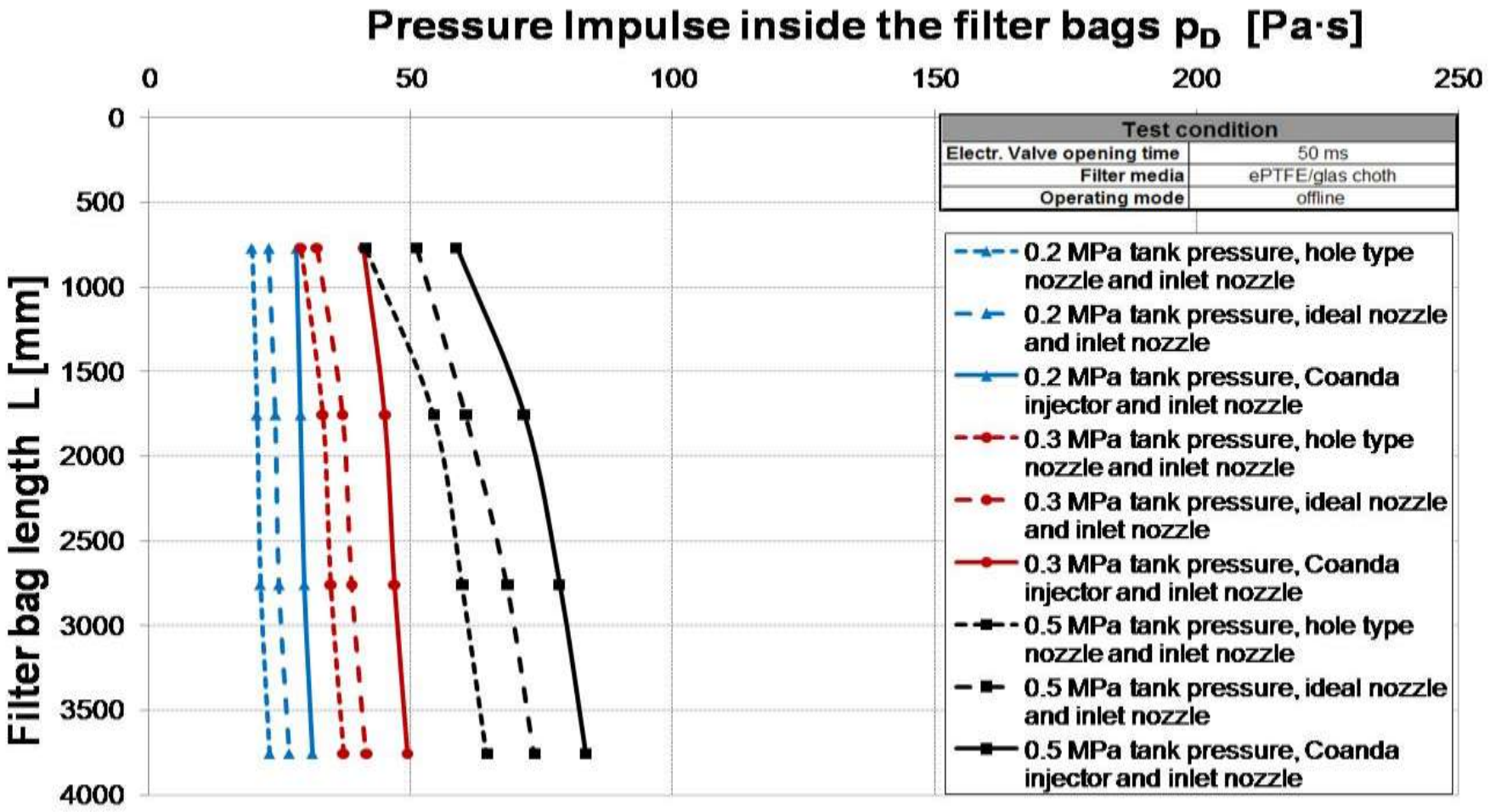
## Comparison of different injector systems



# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

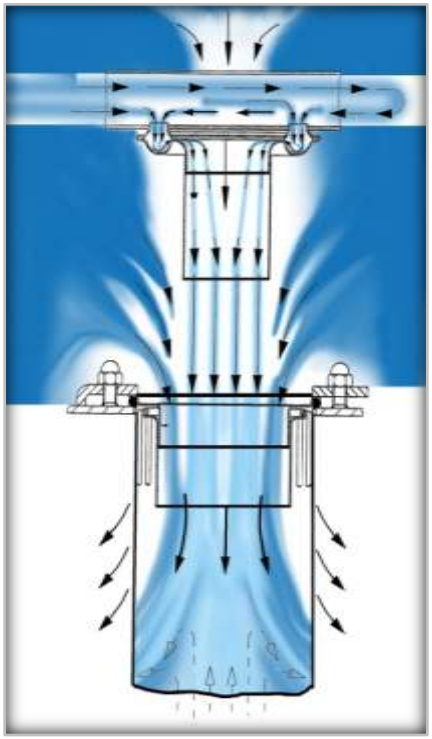
## Comparison of different injector systems



# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

**Influence of an improved injector system on the operating behaviour and the energy efficiency**



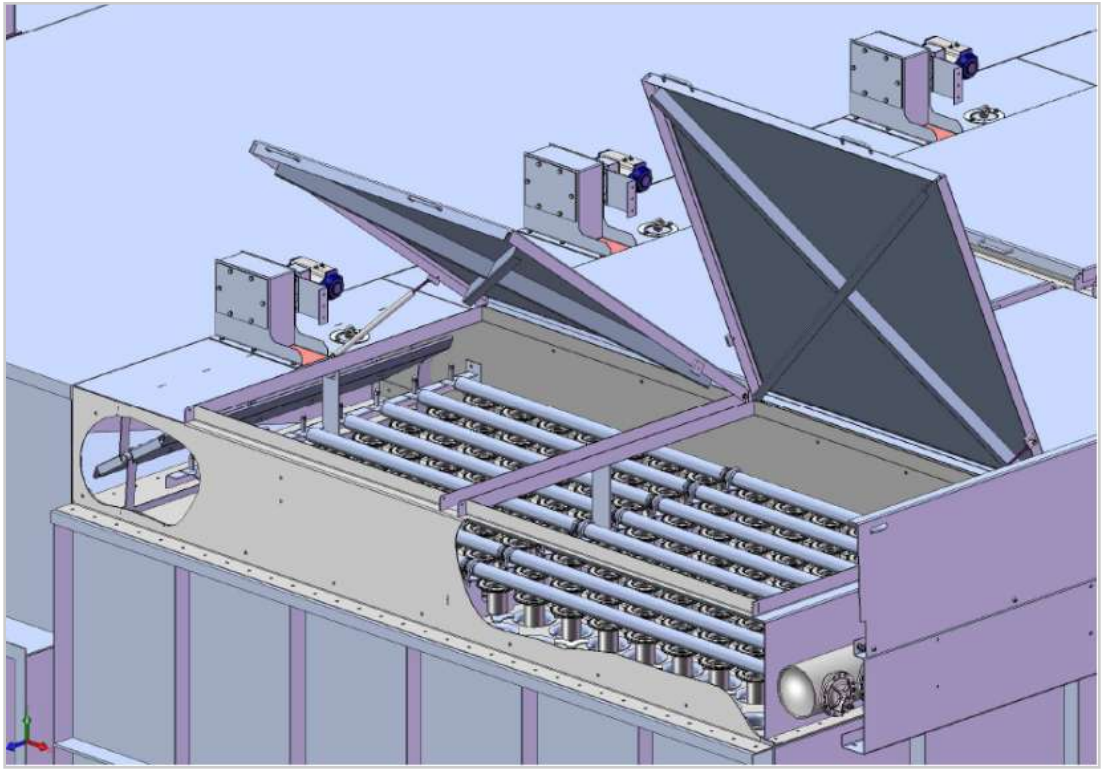
- ✓ **Less depositions per unit area of the filter cake due to more efficient cleaning**
- ✓ **Reduction of the required air tank pressure**
- ✓ **Less mechanical stress to the filter bags (lower emissions, enhanced servive interval)**

# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

## Offline operation mode – Intensiv-Filter design

**Sectional design of the filter housing with disruption of the raw gas flow during cleaning (offline operation mode)**



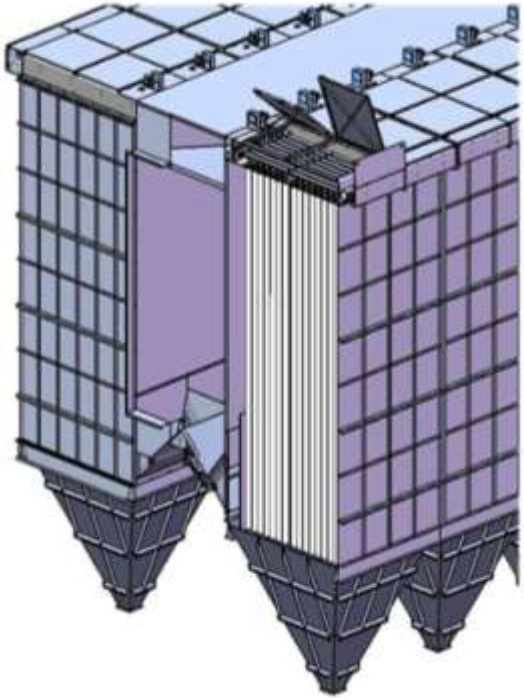
**Offline mode:**
Raw and clean gas shut-off valves

**Semi-offline mode:**
Clean gas shut-off valves

# Enhanced Energy Efficiency Solutions for Bag Filters

## 2) Offline operation mode – ProJet mega®

**Influence of an improved offline filter design on the operating behaviour and the energy efficiency**



- ✓ **Improved sedimentation of the released filter cake and particles → Reduction $\Delta p_{FC}$**
- ✓ **Reduction of the necessary tank pressure for cleaning**
- ✓ **Less mechanical stress to the filter bags (lower emissions, enhanced service interval)**
- ✓ **Reduced pressure loss of the filter housing due to flow optimization measures of filter components**

# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

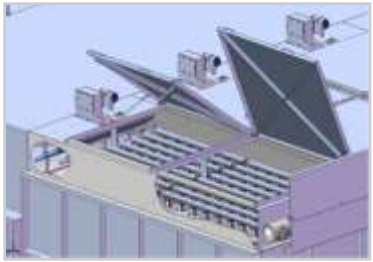
## Characteristics of the improved Intensiv-Filter jet-pulse bag filter generation with offline operation mode (ProJet mega®)

### 1. Injector technology

- ✓ Fast switching membrane valves
- ✓ Double-stage Coanda Injector or ideal nozzle with inlet nozzle


### 2. Offline design

- ✓ Sectional filter design and offline operation mode
- ✓ Flow-optimized filter components



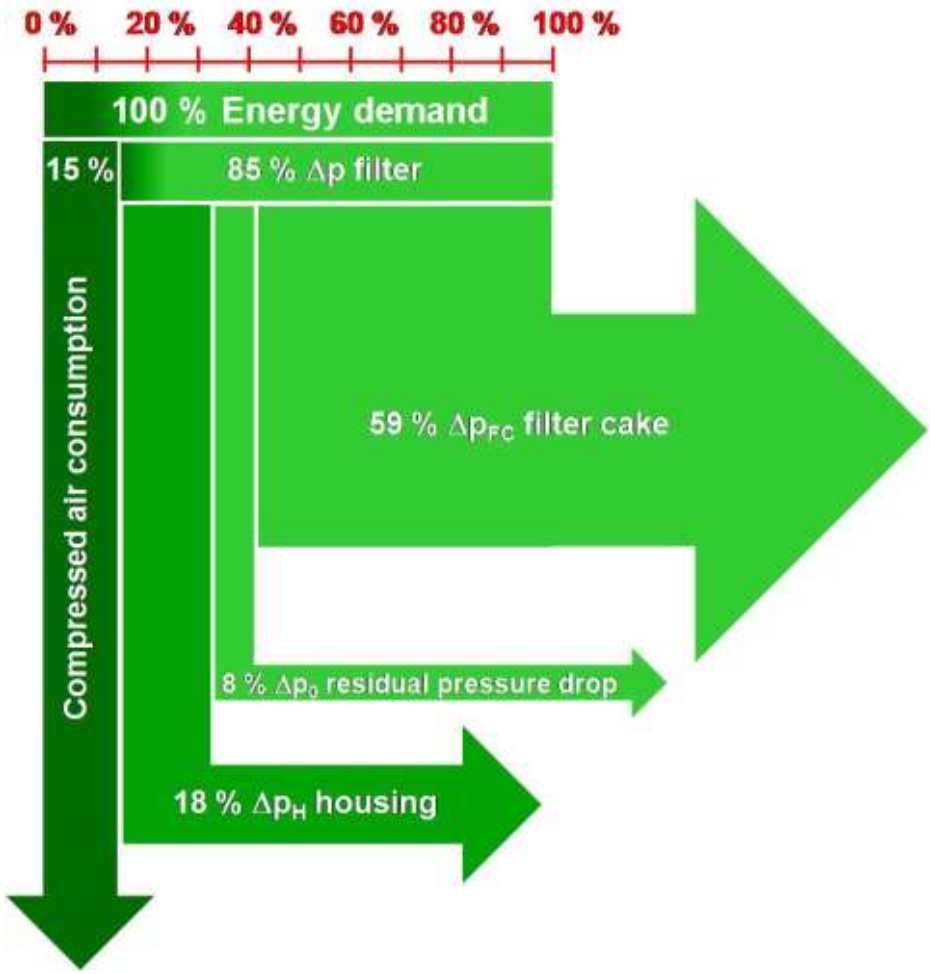
### 3. Cleaning control system

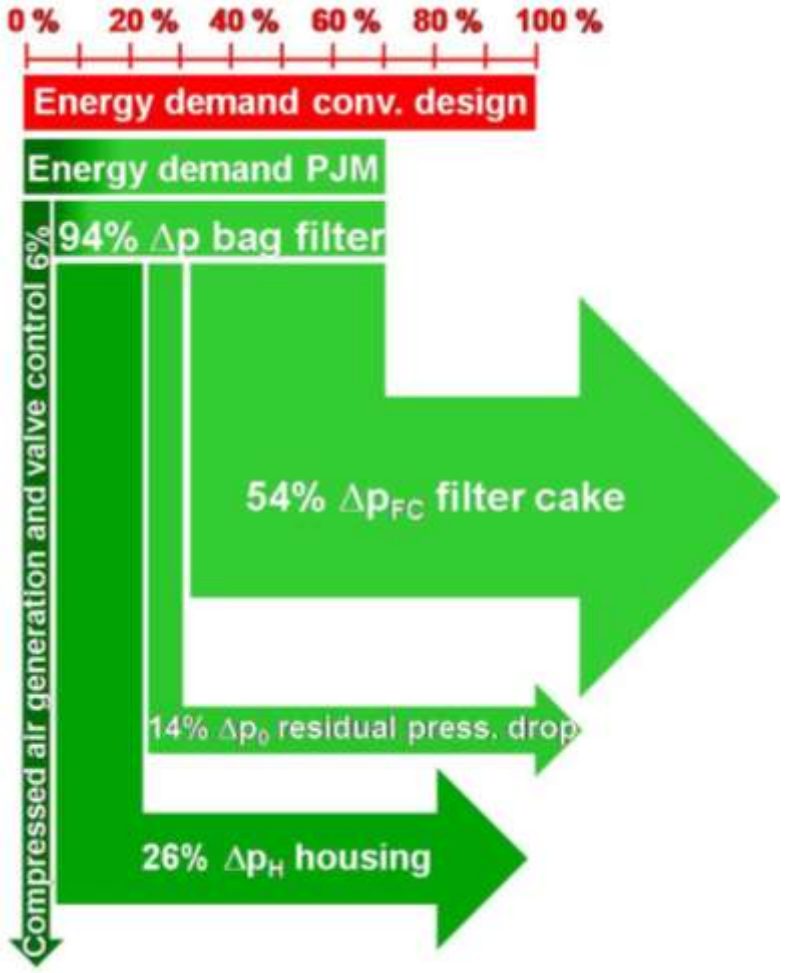
- ✓ Fully variable and optimized cleaning control parameters (Intensiv-Filter JetBus Controller®)

# Enhanced Energy Efficiency Solutions for Bag Filters

## 2) Offline operation mode – ProJet mega®

## Energy flow diagrams: State-of-the-art vs. ProJet mega® (offline – optimized)

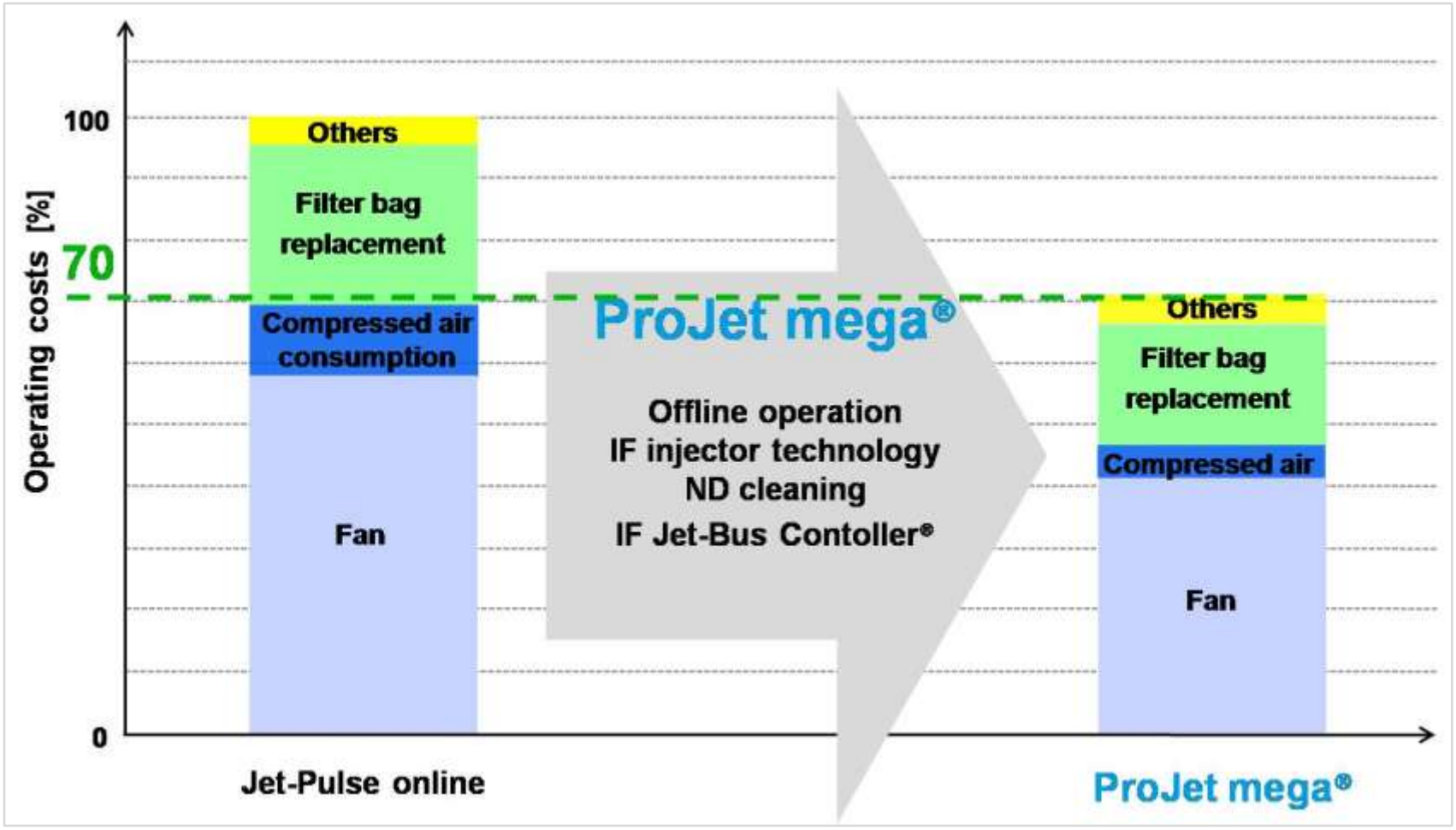


# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

## Operating costs: State-of-the-art vs. ProJet mega® (offline – optimized)



# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

## References (I) – ESP conversion, ProJet mega®, semi-offline

## Dyckerhoff, Deuna Zement: kiln, raw mill and bypass dedusting (commissioning April 2008)

Installation

After commissioning

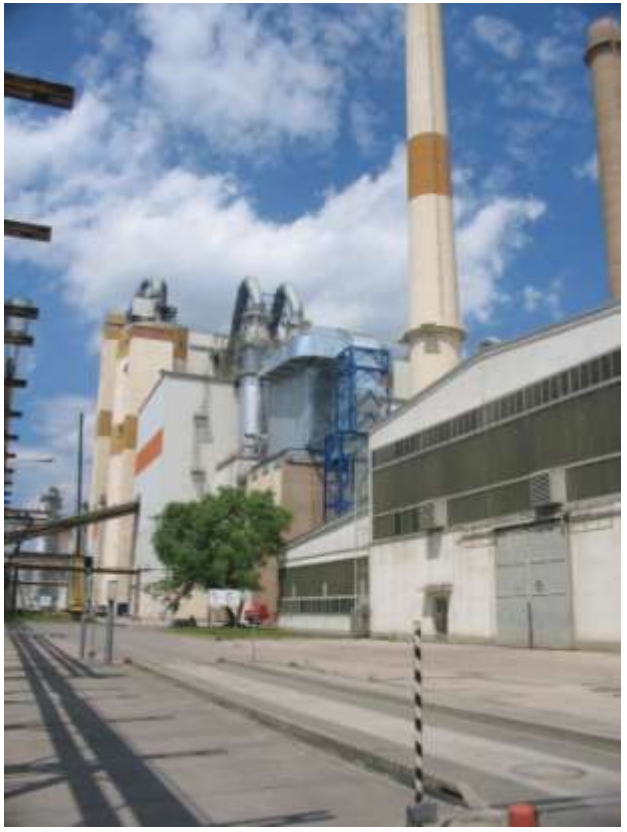
# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

## References (I) – ESP conversion, ProJet mega®, semi-offline

## Dyckerhoff, Deuna Zement: kiln, raw mill and bypass dedusting (commissioning April 2008)

| | | |
|---|---|---|
| Gas volume | 550.000 | m³/h a.c. |
| Raw gas dust content | 80 | g /m³ |
| Residual dust content | < 8 | mg/ m³ n. c. dry |
| Filter surface area | 9.300 | m² |
| Injector / cleaning mode | Ideal nozzle | semi-offline |
| Cleaning system | JetBus Controller® | Pre pressure control |
| Cleaning pressure | 0,2 – 0,3 | MPa |
| Pressure loss | < 1.000 | Pa |



# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

## References (II) – ESP replacement, ProJet mega® , semi-offline

## Heidelberg Cement, Gotland, Sweden, kiln, raw meal dedusting (commissioning October 2009)

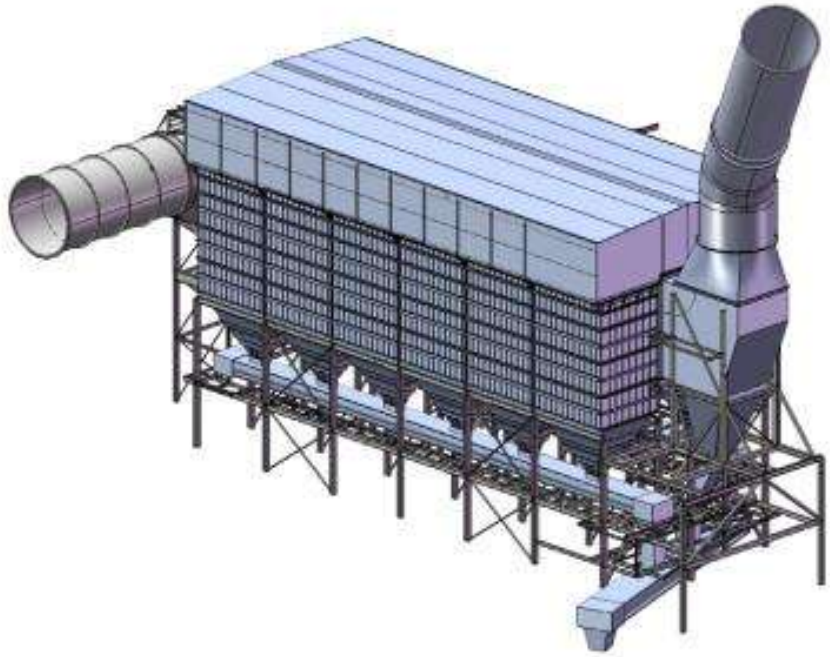
# Enhanced Energy Efficiency Solutions for Bag Filters

2) Offline operation mode – ProJet mega®

## References (II) – ESP replacement, ProJet mega® , semi-offline

## Heidelberg Cement, Gotland, Sweden, kiln, raw meal dedusting (commissioning October 2009)

| | | |
|---|---|---|
| Gas volume | 1.200.000 | m³/h a.c. |
| Raw gas dust content | 900 | g /m³ |
| Residual dust content | < 10 | mg/ m³ n.c. dry |
| Filter surface area | 20.300 | m² |
| Injector / cleaning mode | Coanda | semi-offline |
| Cleaning system | JetBus Controller® | Pre pressure control |
| Cleaning pressure | 0,2 – 0,3 | MPa |
| Pressure loss | < 1.000 | Pa |

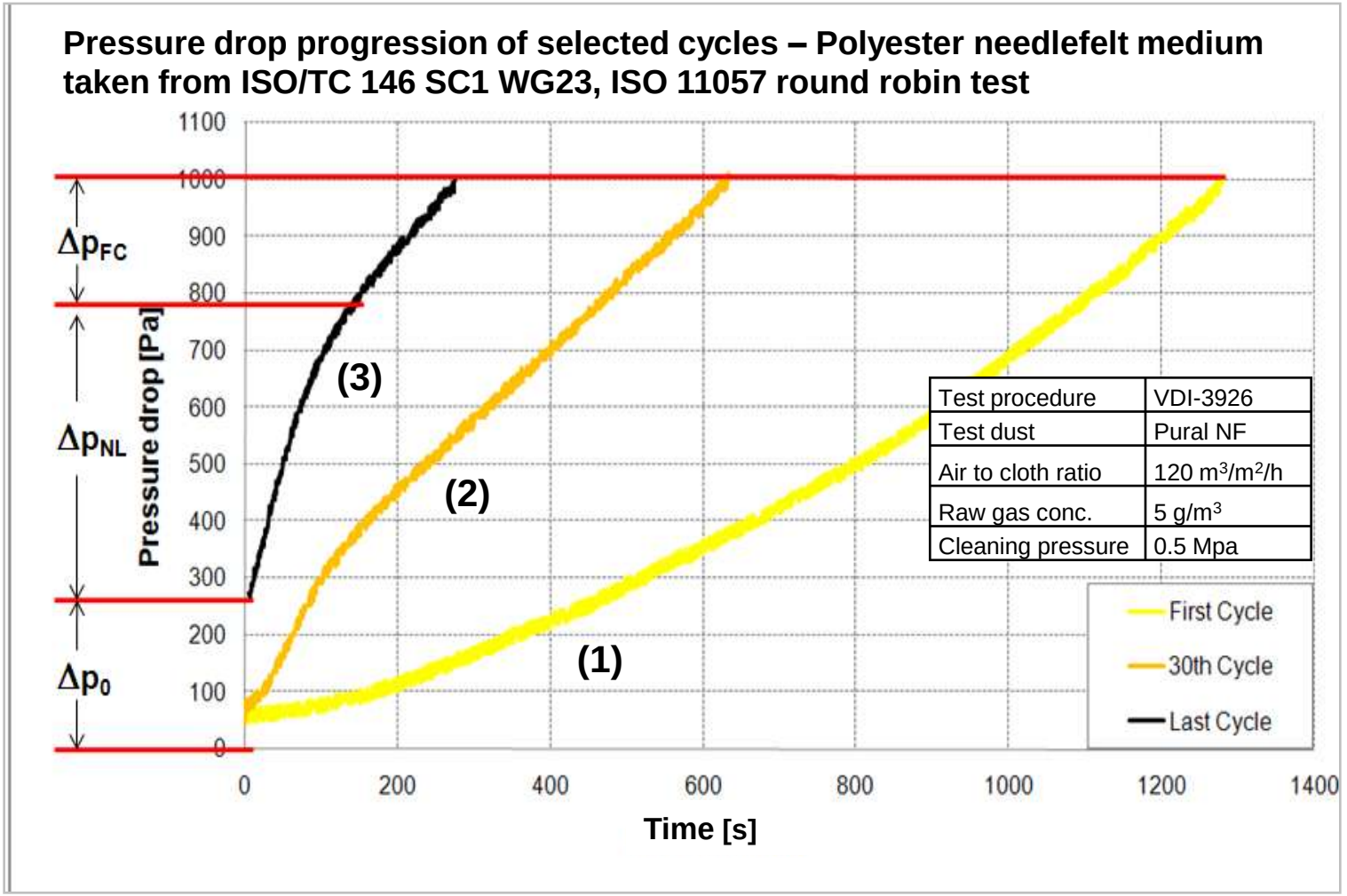


# Enhanced Energy Efficiency Solutions for Bag Filters

## 3) Three E technology with ProTex filtermedia

### Mechanisms of particle deposition

**Pressure drop progression of selected cycles – Polyester needlefelt medium taken from ISO/TC 146 SC1 WG23, ISO 11057 round robin test**




**(1) New condition**

**(2) Preloaded, not saturated**

**(3) Preloaded, saturated**

# Enhanced Energy Efficiency Solutions for Bag Filters

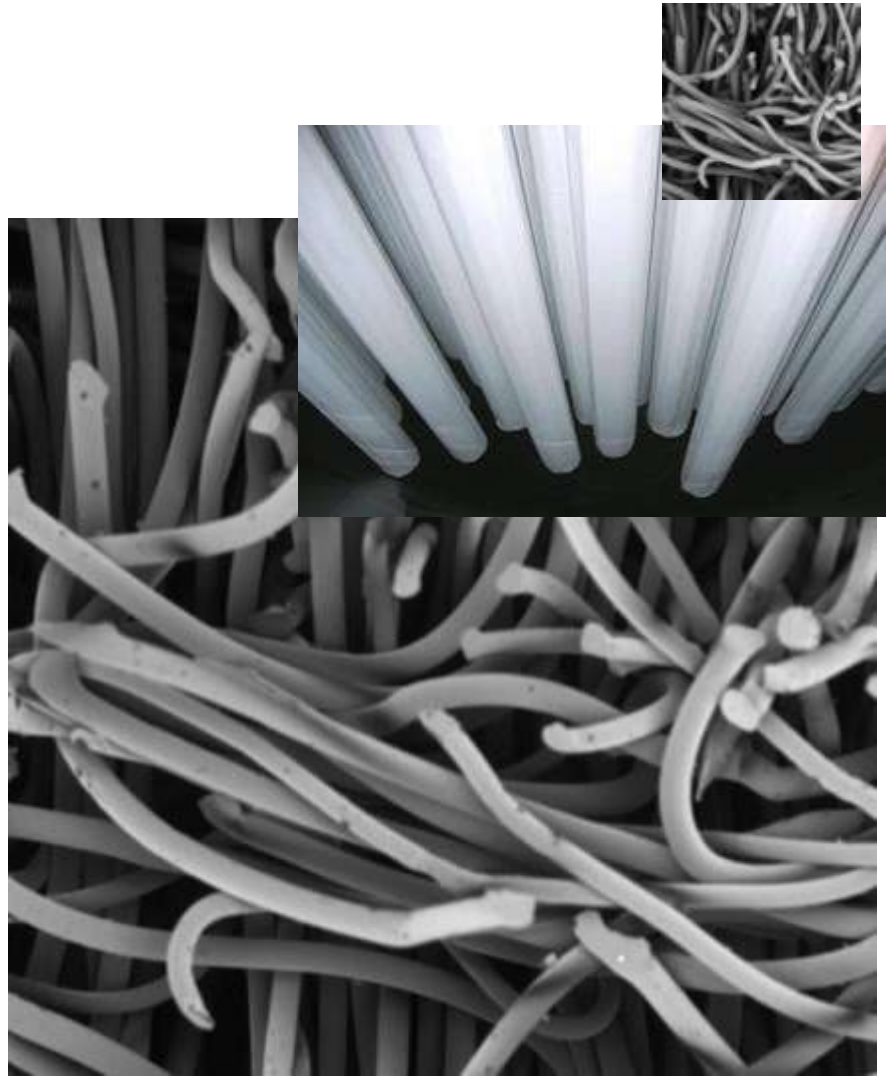
3) Three E technology with ProTex filtermedia

## ProTex filtermedia and Three E technology

**ProTex**
New microfibre based filtermedia generation, developed by Intensiv-Filter.

The average differential pressure of one filtration cycle is clearly reduced compared to other bag filter media. This is achieved by a low residual pressure loss and a reduced slope of the differential pressure curve.

**Three E (Enhanced Energy Efficiency)**
Energy saving technology by Intensiv-Filter. The operating parameters were adjusted with the criterion of a minimal energy consumption of the filter plant.



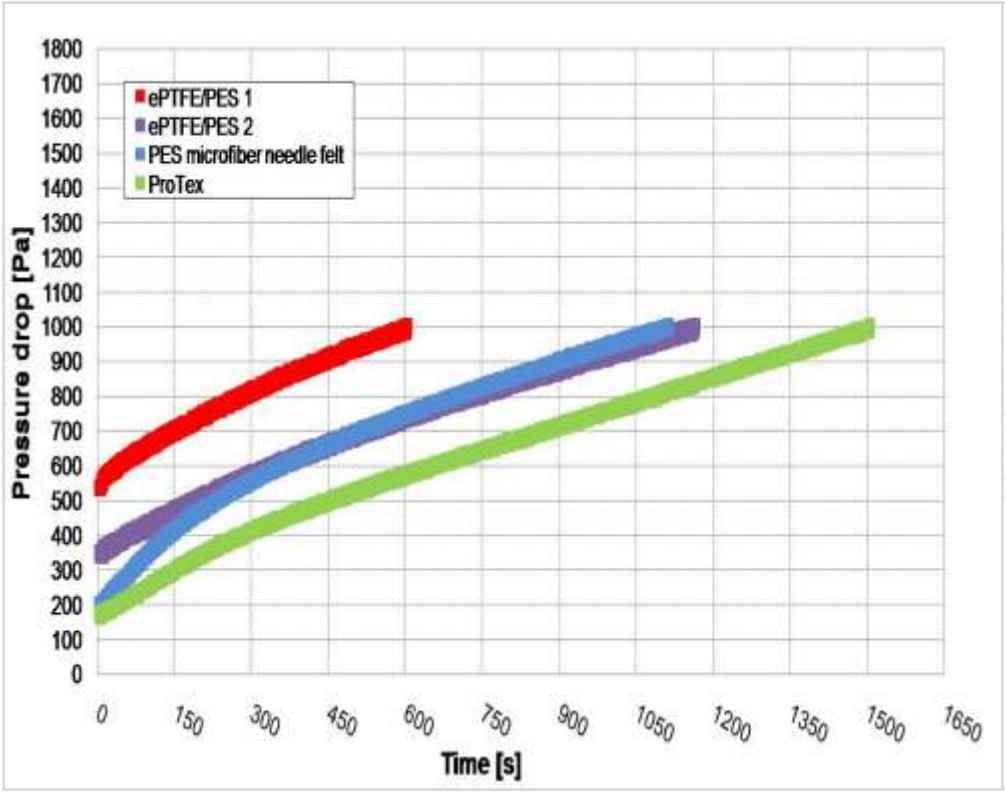
# Enhanced Energy Efficiency Solutions for Bag Filters

3) Three E technology with ProTex filtermedia

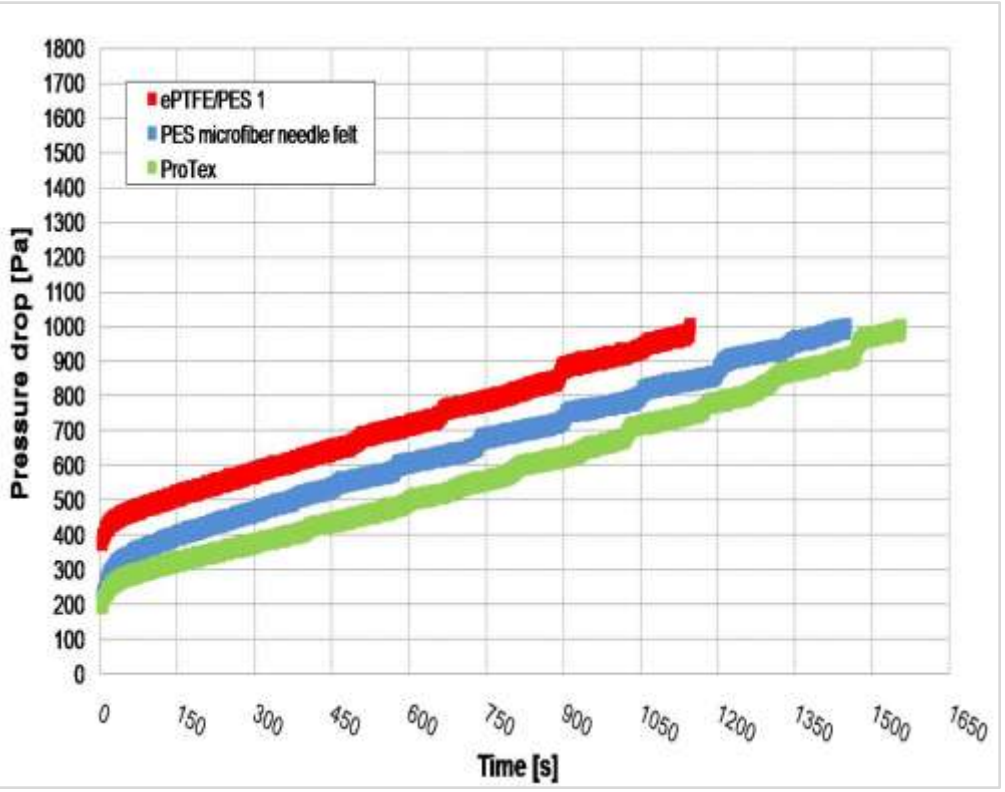
## The Intensiv-Filter ProTex filtermedia technology

**Pressure drop of ProTex vs. other media within one filtration cycle according to VDI 3926, v = 120 $m^3$ / ($m^2$ h), $c_{RG}$ = 10 g / $m^3$, p = 0,5 MPa**

### $Al_2O_3$ , Pural SB




### Cement, 10.000 Blaine

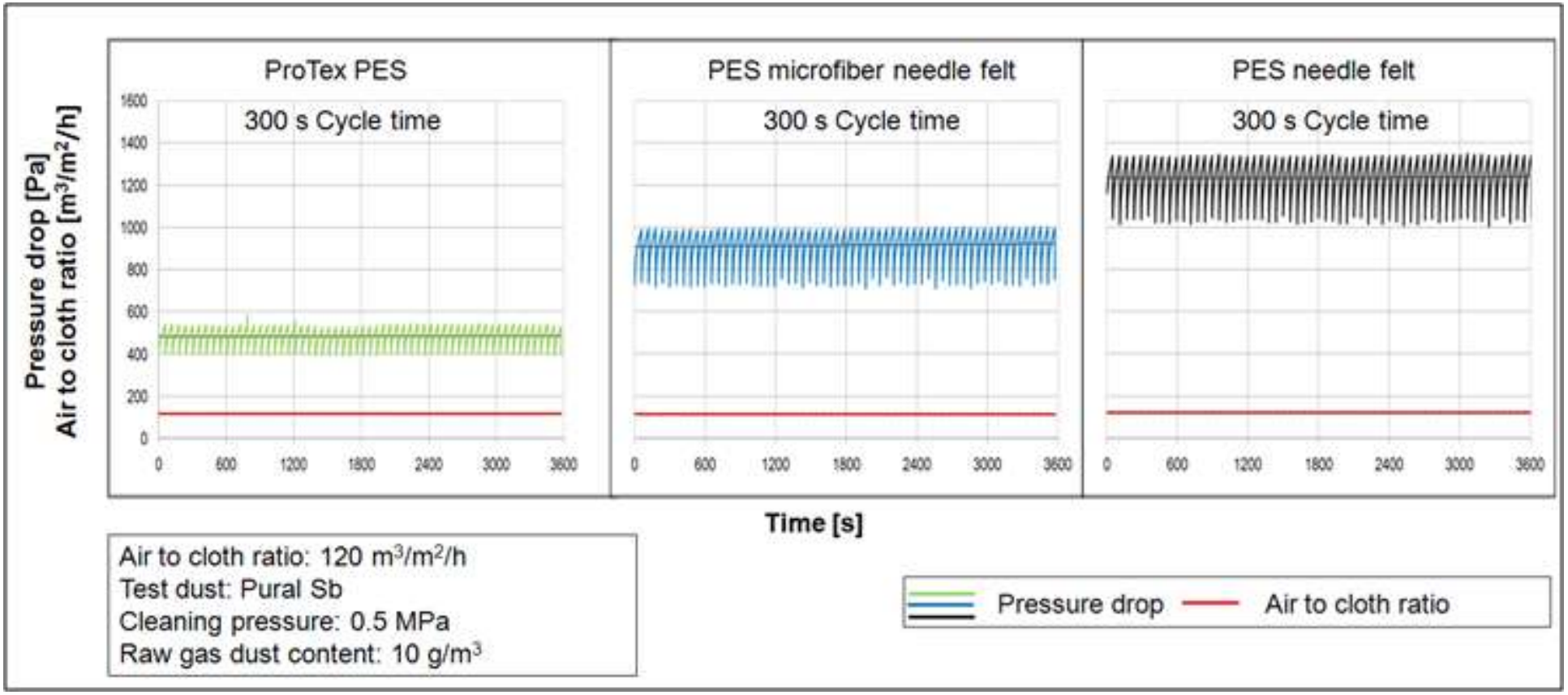


# Enhanced Energy Efficiency Solutions for Bag Filters

3) Three E technology with ProTex filtermedia

## The Intensiv-Filter ProTex filtermedia technology

### Pilot plant trials (10 bags x 4 m) – ProTex, variation of the cycle time

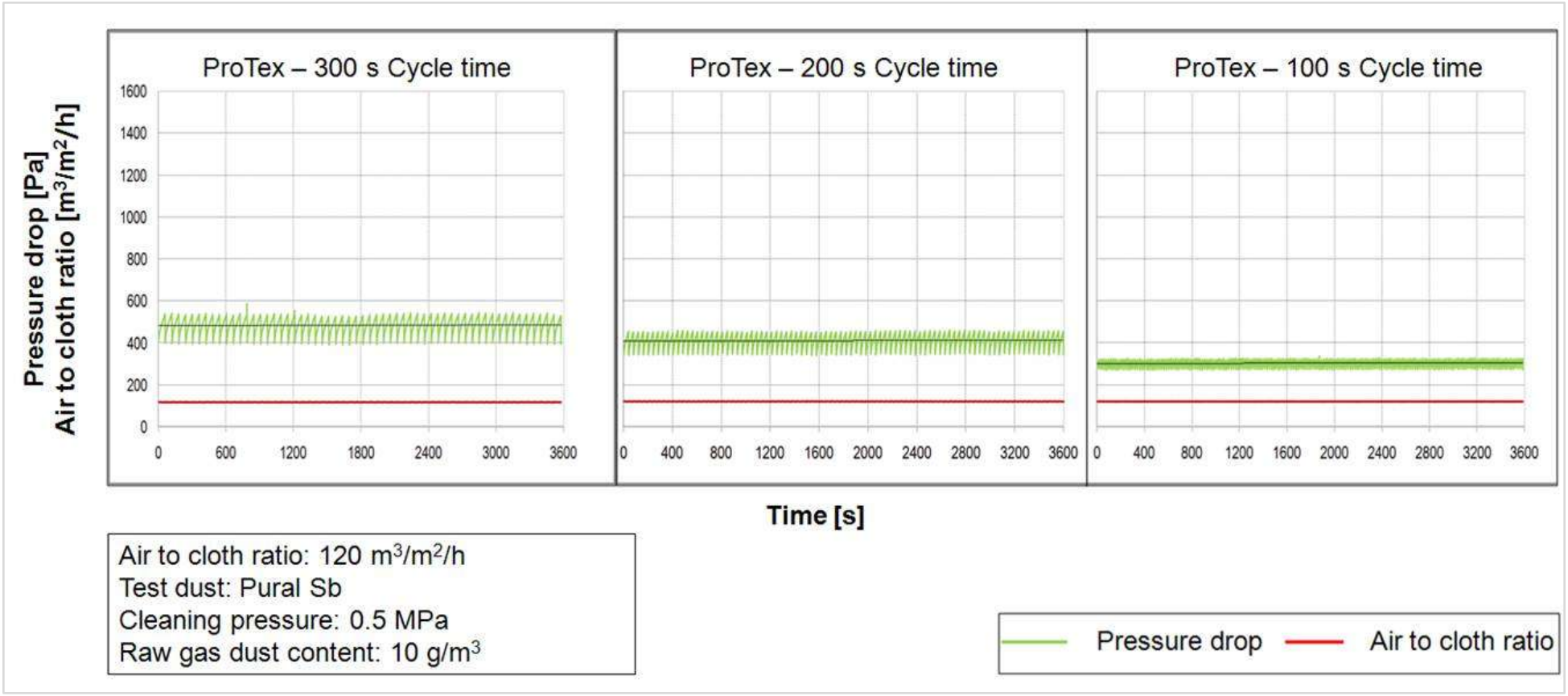


# Enhanced Energy Efficiency Solutions for Bag Filters

3) Three E technology with ProTex filtermedia

## Three E technology with ProTex filtermedia

### Pilot plant trials (10 bags x 4 m) – ProTex, variation of the cycle time

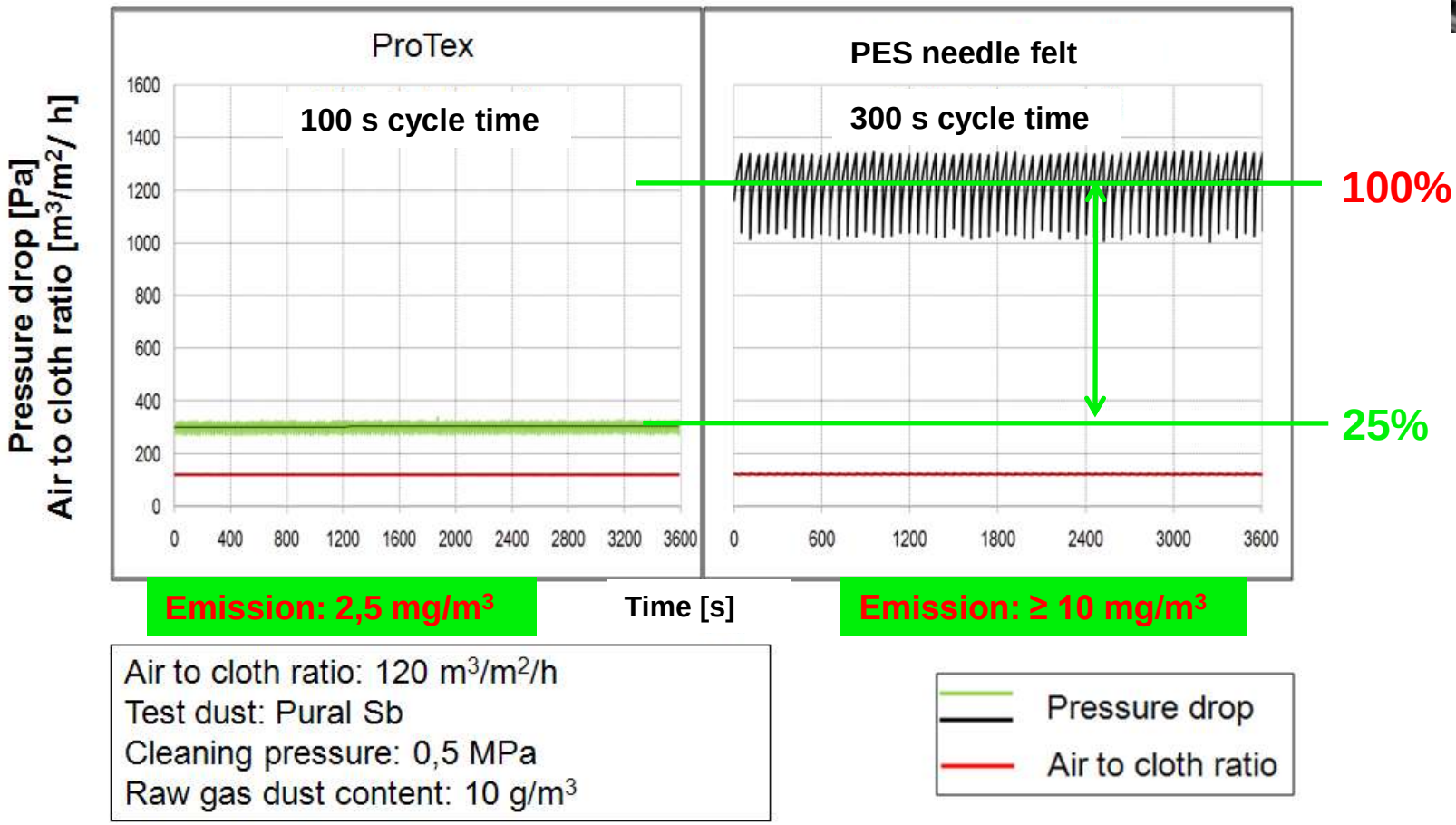


# Enhanced Energy Efficiency Solutions for Bag Filters

3) Three E technology with ProTex filtermedia

## Three E technology with ProTex filtermedia

### Δp reduction potential

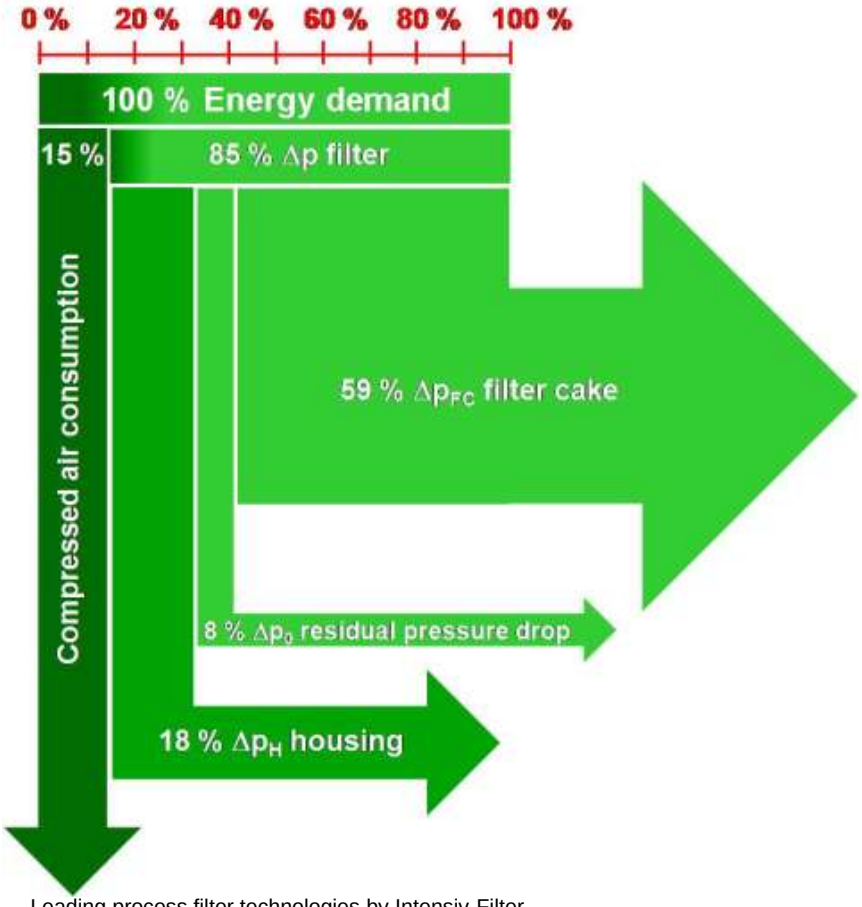


# Enhanced Energy Efficiency Solutions for Bag Filters

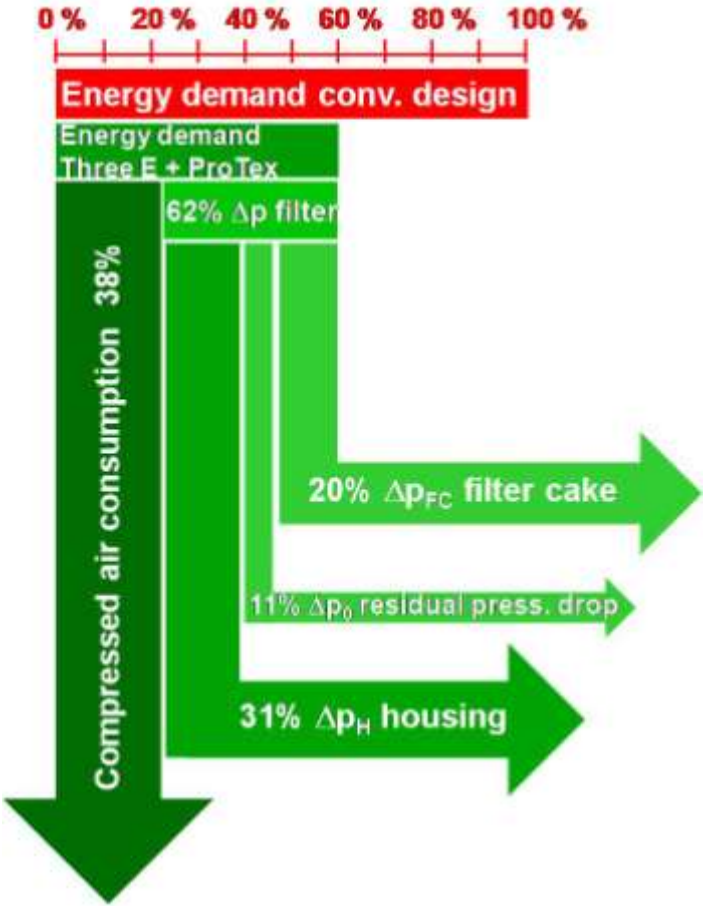
3) Three E technology with ProTex filtermedia

## Energy flow diagrams: State-of-the-art vs. Three E / ProTex

### Standard conditions (online)



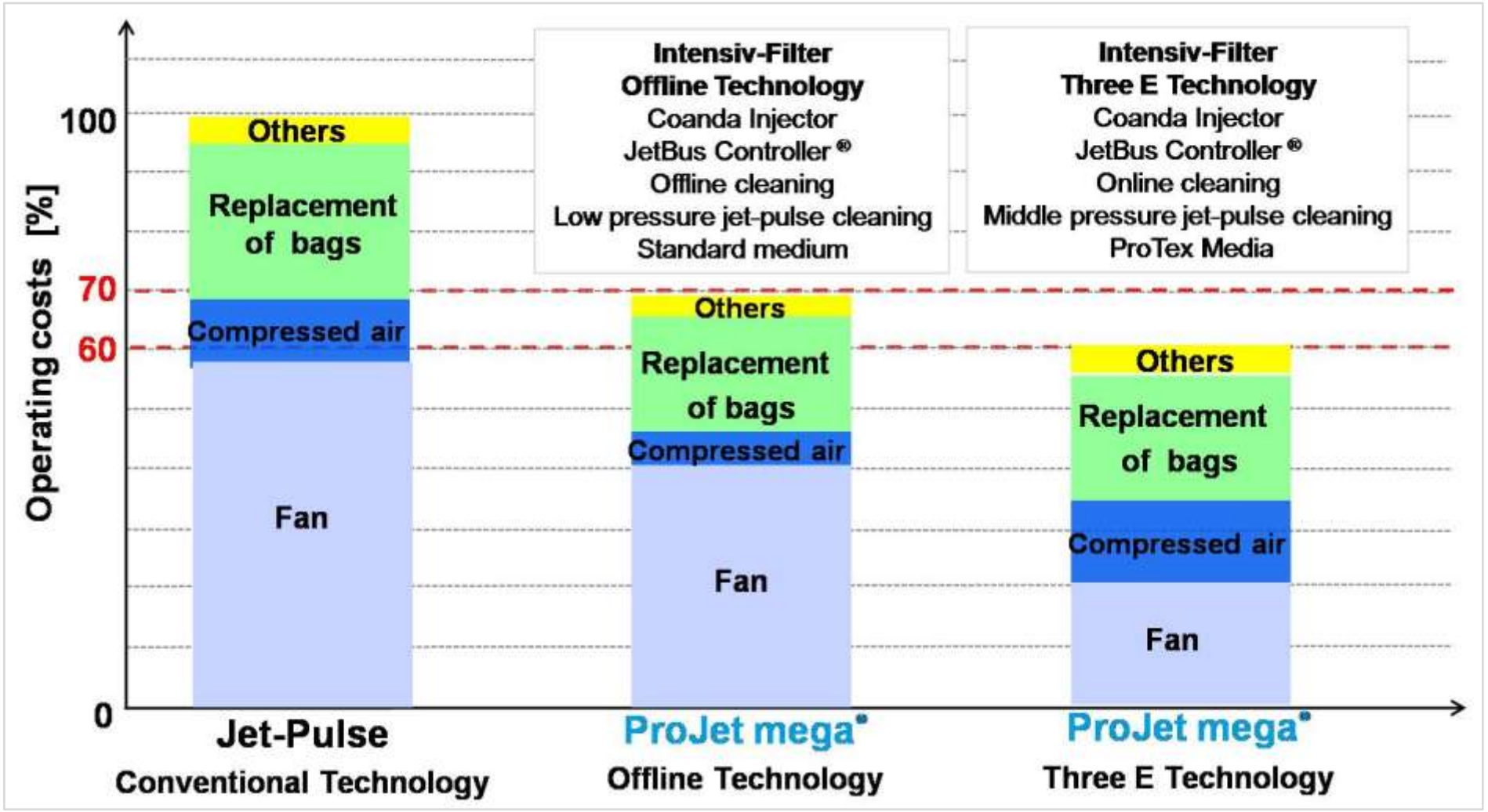

### Three E / ProTex (online)



# Enhanced Energy Efficiency Solutions for Bag Filters

4) Conclusion and summary

## The Intensiv-Filter energy saving technologies – Summary




www.intensiv-filter.com