Athens2014

Technological advancements in small scale biomass gasification: case study of South Tyrol

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Athens, June 12th 2014

The GAST project

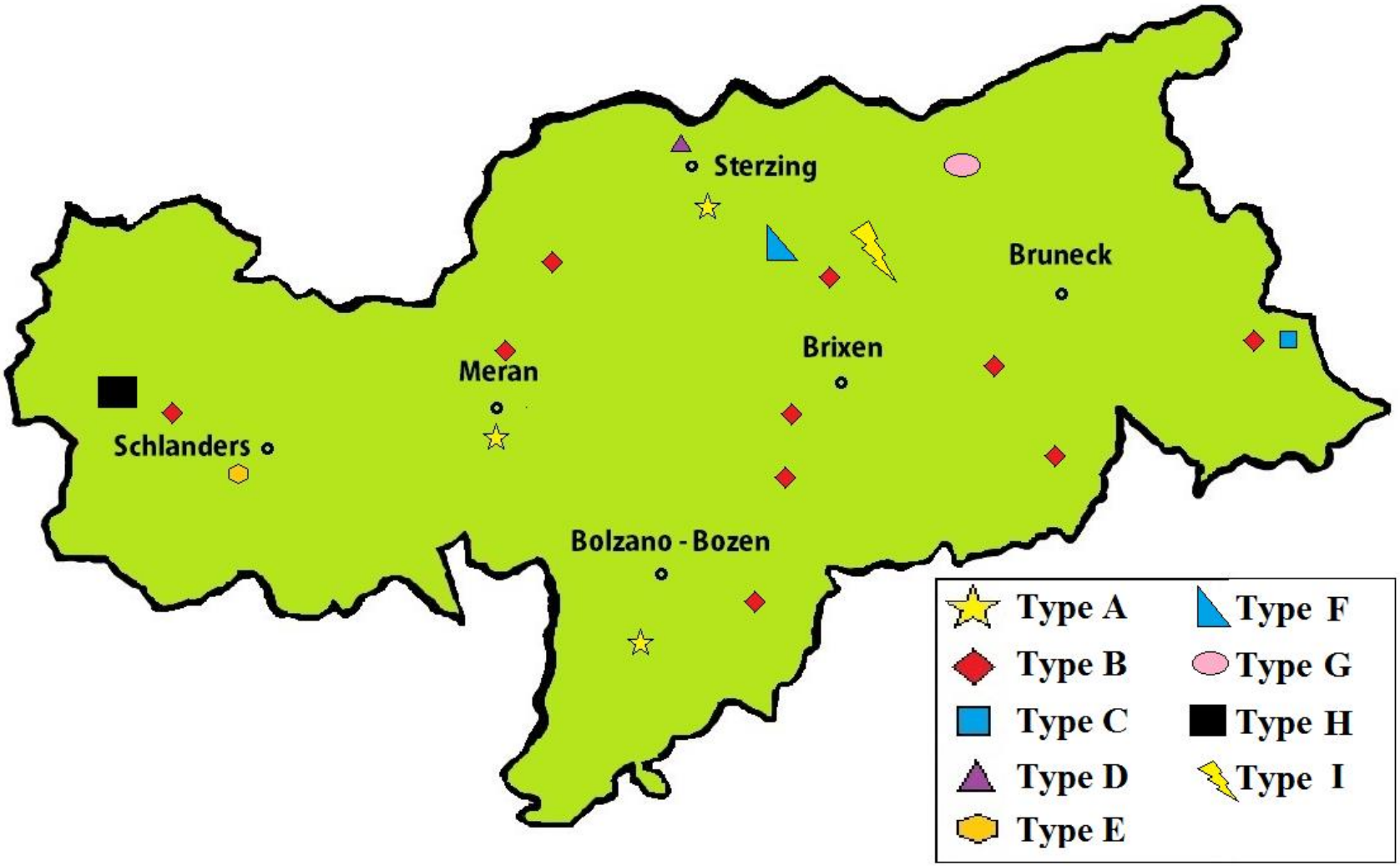
- Funded by the Autonomous Province of South Tyrol
- Small scale biomass gasification plants

Project partners

Scope

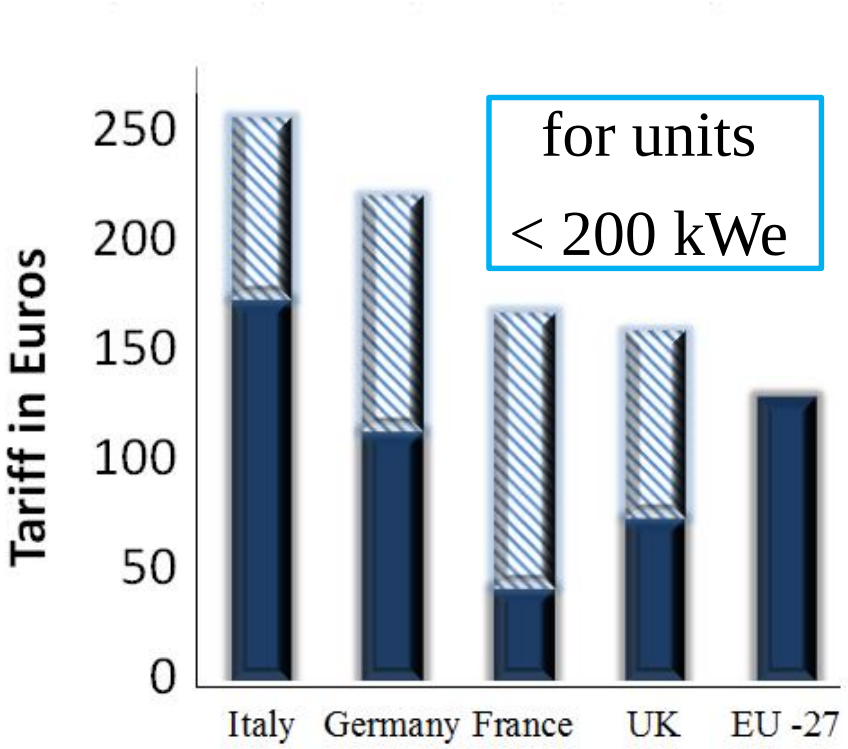
- ✓ Monitoring and assessment
- ✓ Optimization of performance
- ✓ Environmental control

The ‘GAST’ growth (2010 – 2014)



Reasons of growth

Feed in Tariffs in EU



Biomass in South Tyrol

48% covered by forest

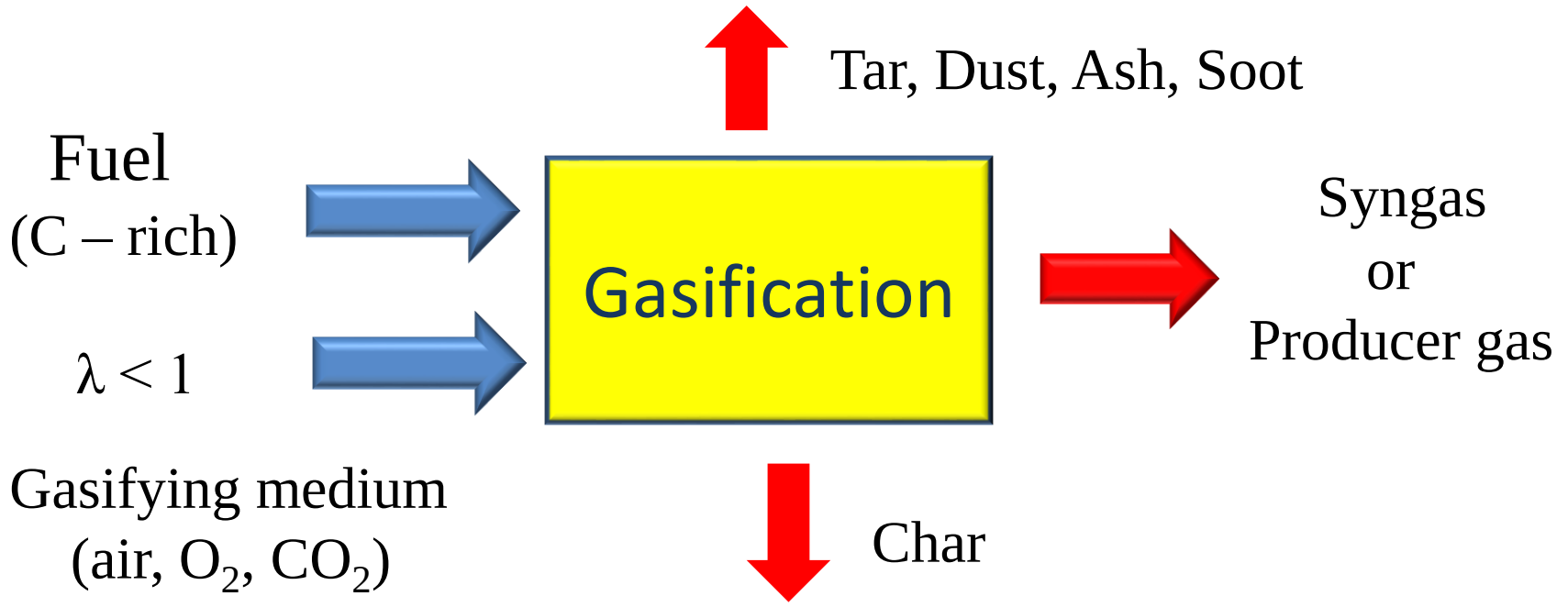
Traditional use of wood

Only 50%-60% of forest growth is utilized

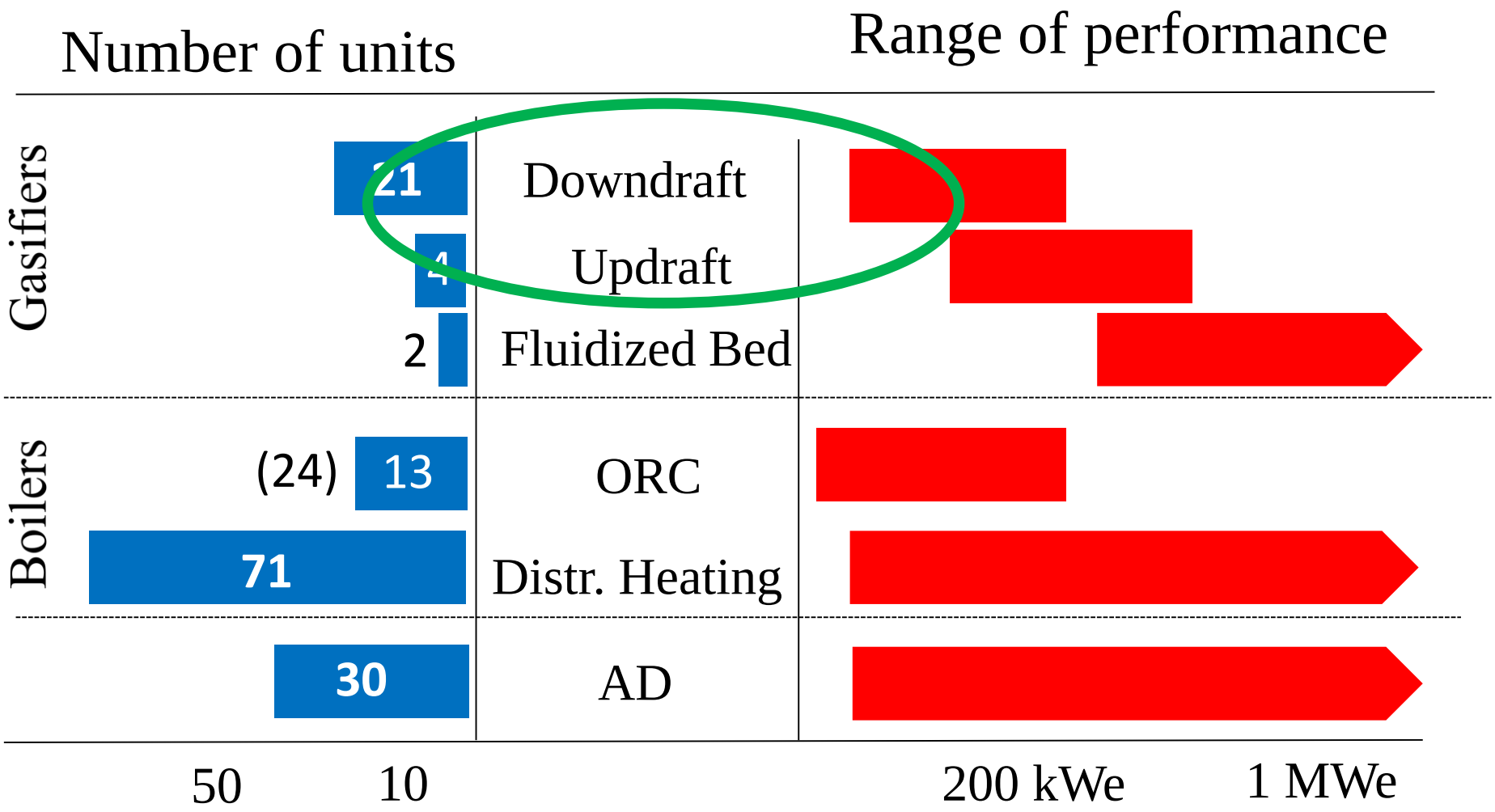
- Most reserves at high altitudes (78% in higher than 1,2 km)
- 25% of biomass imported (maybe higher)

Concept of gasification

Gasification is a thermal process which under sub- stoichiometric conditions “packs” energy into chemical bonds

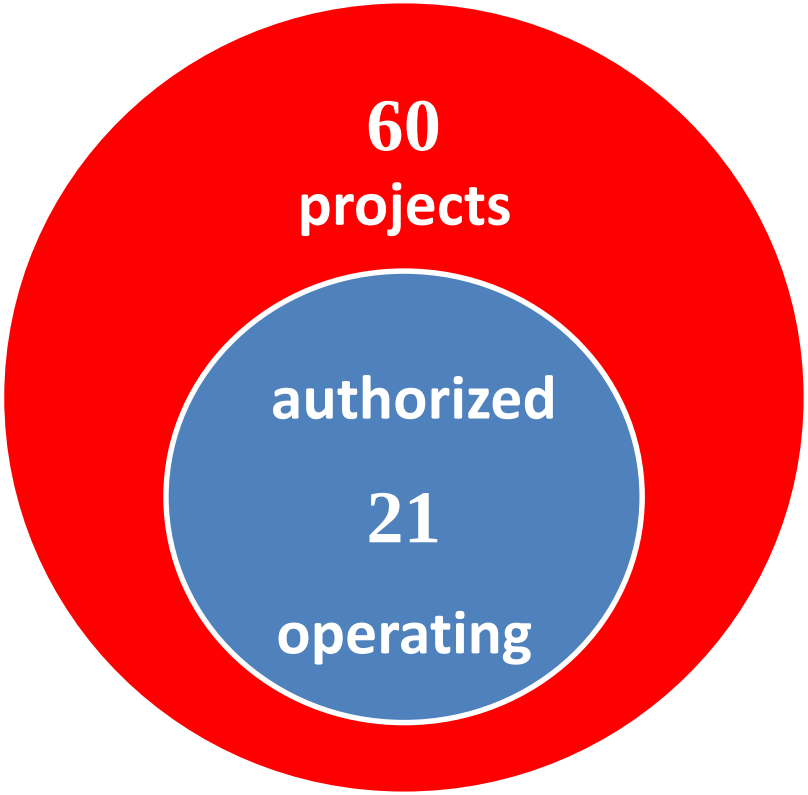


Biomass to energy units



The GAST stats

Overall numbers

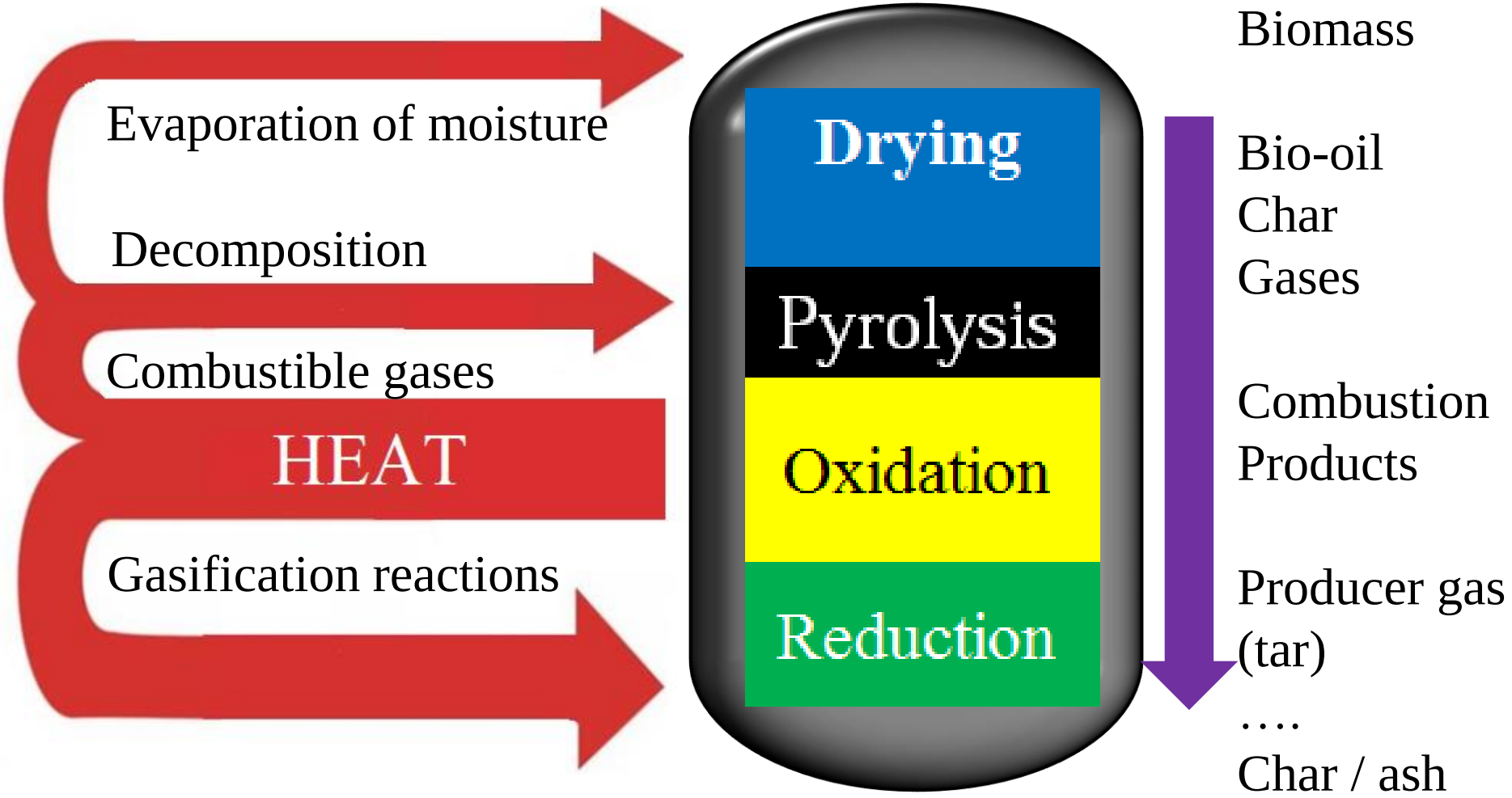


Monitoring campaign

Gasifier	Fuel	Size	Type
Type A	Wood Chips	45 kW_e 120 kW_{th}	Joos
Type B	Wood Chips	135 kW_e 230 kW_{th}	Char Bed
Type C	Pellets	180 kW_e 270 kW_{th}	Rising CC

In total 9 different types of gasifiers

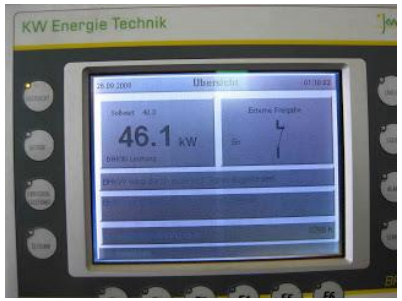
Small scale gasification – downdraft



Characteristics of innovation

Also:
Input specific !

Automation



Modular Form

Patents

Images: 1.Courtesy of Spanner RE (right)
2. Courtesy of Power Lab (center)

Technological innovations 1

Joos Gasifier

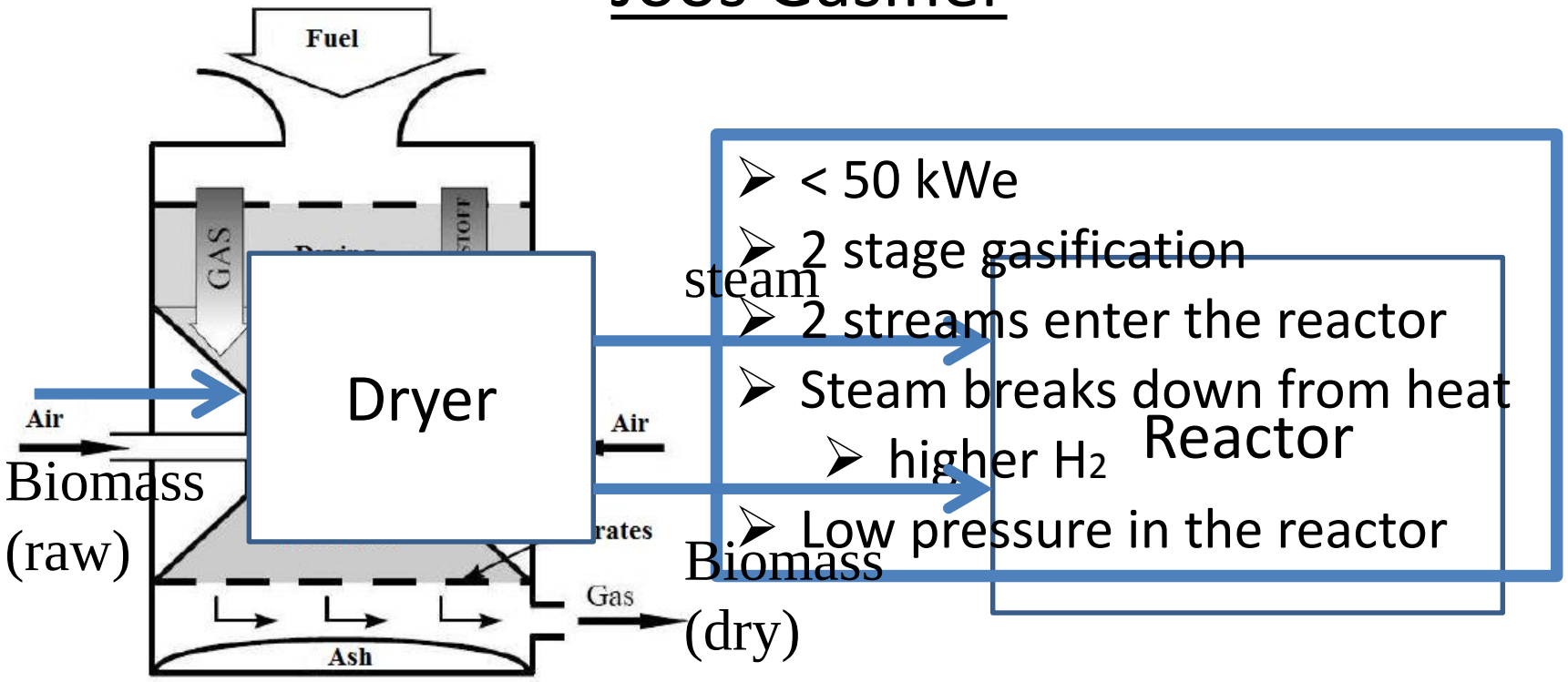
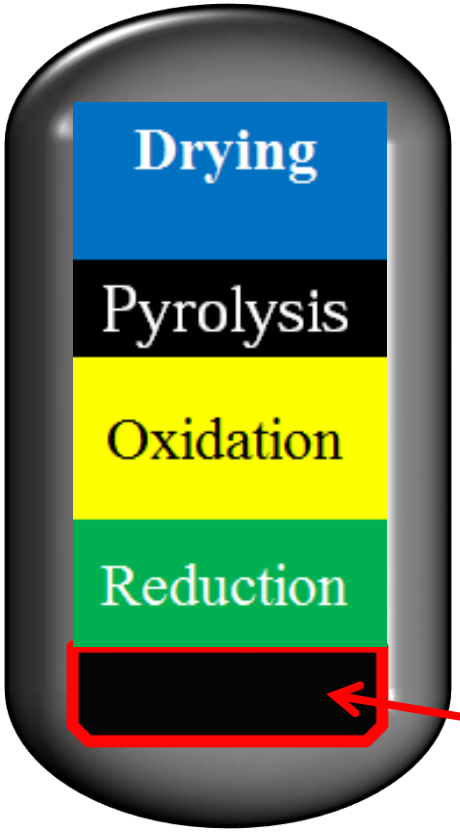


Image: Courtesy of Spanner RE

Technological innovations 2

Hot Char Bed Gasifier



- Advanced Char-Gas Reactions
- Catalytic-like behaviour of char
- Hot filtering stage
- Recirculation of Char
- Lower air-fuel ER

but.. Low T in Char Bed

Technological innovations 3

Rising Co-Current Gasifier

- Bottom fed
- Higher retention time
- Char works as fluidized bed
- High temperature in reduction
- Pellet fed
- Dual-fuel engine

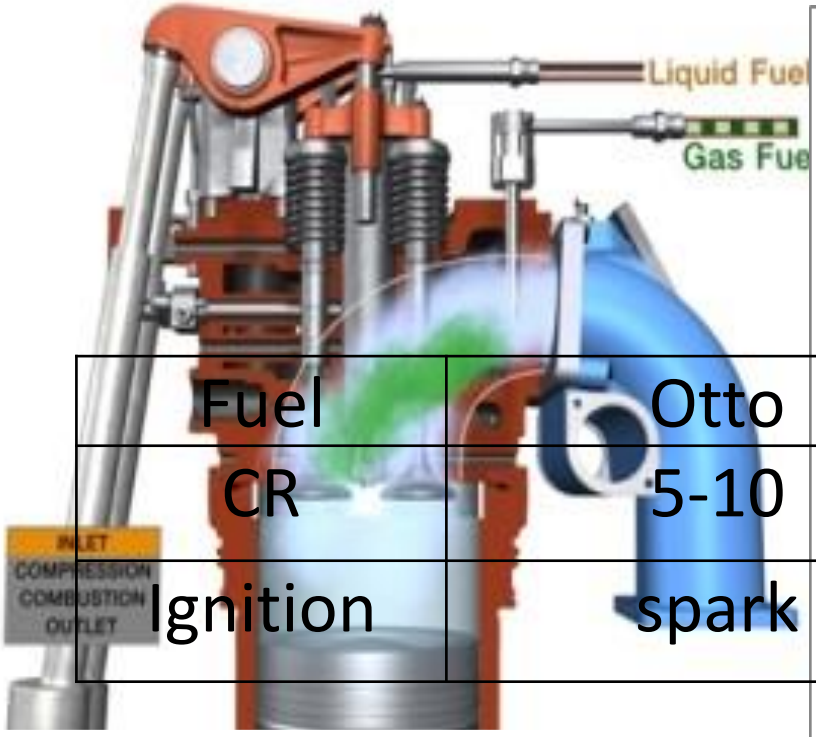
Gas composition –various technologies

Composition	Compound	Gasifier technologies			
		Range *	Joos	Hot Char Bed	Rising CC
	H_2	12 - 20	17,2	15	19
	CO	17 - 22	21,8	20	28
	N_2	50 - 54	51,6	49	40
	CO_2	9 - 15	7,8	15	11
	CH_4	2 - 3	1,6	1	2

*Typical values for producer gas from small scale downdraft gasification (FAO)

Technological innovations 4

Internal Combustion Engines



Fuel	Otto	Diesel
CR	5-10	16-24
Ignition	spark	compression

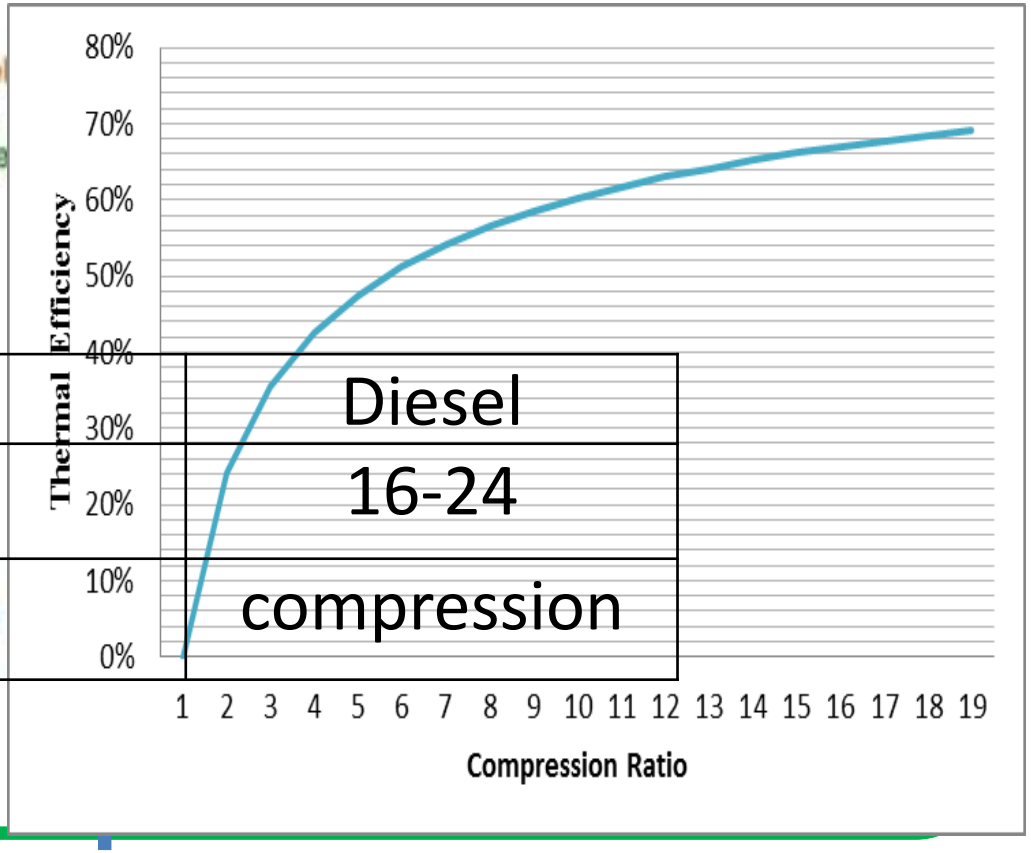
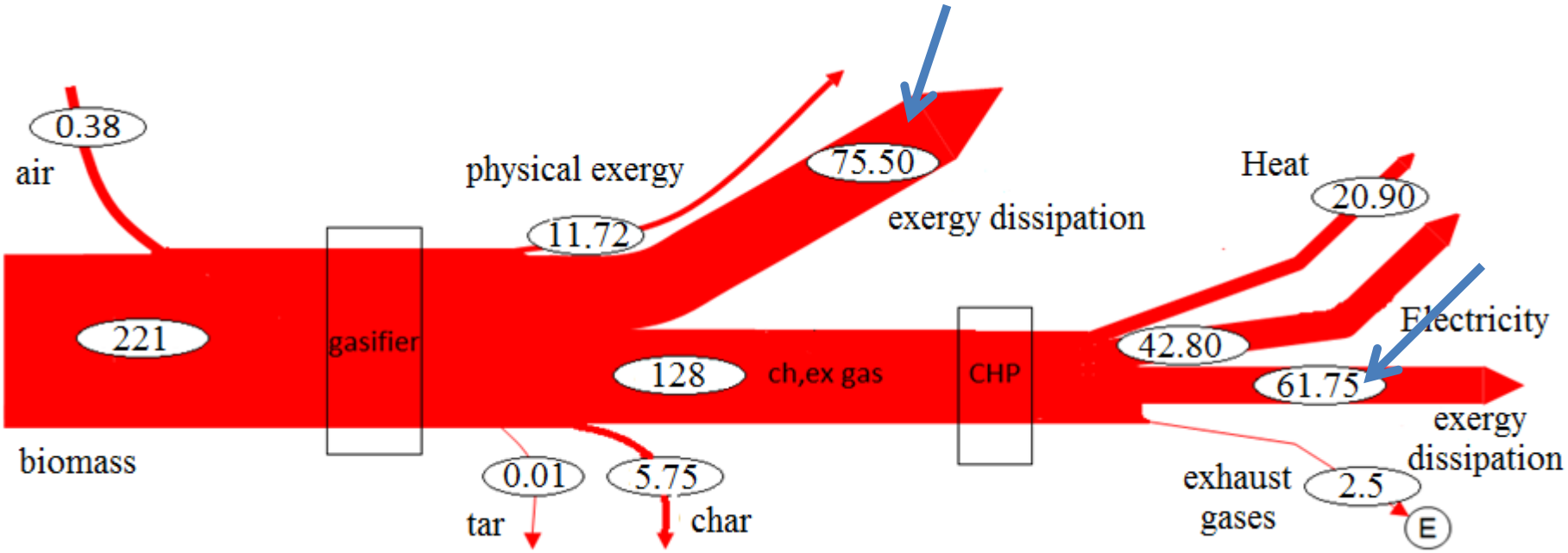


Image: Courtesy of GE Jenbach

Losses in small scale gasification

Dissipation of exergy throughout the production chain of a small scale gasification plant (downdraft gasifier, Joos)



Conclusions

- Rapid development of small scale biomass gasifiers in South Tyrol
  - Incentives, traditional biomass utilization in the area
- Gasifiers optimized for specific input parameters
  - Also: operating conditions, size
- Integration of patents and novel designs
  - production of a better quality gas
  - cogeneration plants have also other product streams
- Technological advancements in the design of the reactors have been coupled with more efficient engines

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Thank you for your attention!

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