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Availability and viability of small on-farm biogas plants

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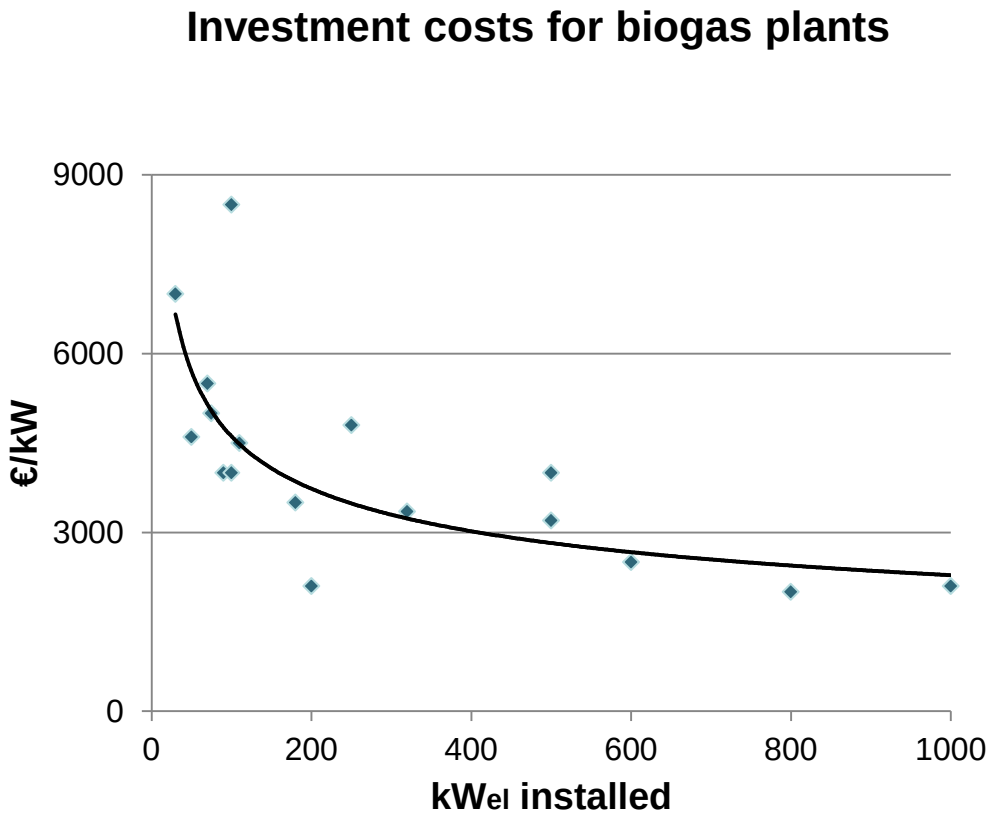
Context

Estimated feedstock potential for biogas production – EU 27:

Origin	Theoretical potential [Mtoe]	Used until 2020 [%]	Realistic potential [Mtoe]
Agriculture			
Agricultural crops	23.3	100	23.4
Agricultural by-products (straw, manure, …)	27.2	28	7.9
Waste			
Biodegradable fraction of municipal solid waste (including biowaste), landfill gas	8.6	40	3.4
Biodegradable fraction of industrial waste (including paper, pallets, …)	2.6	50	1.3
Sewage sludge	5.1	66	3.4
Total	**66.8**	**59**	**39.5**

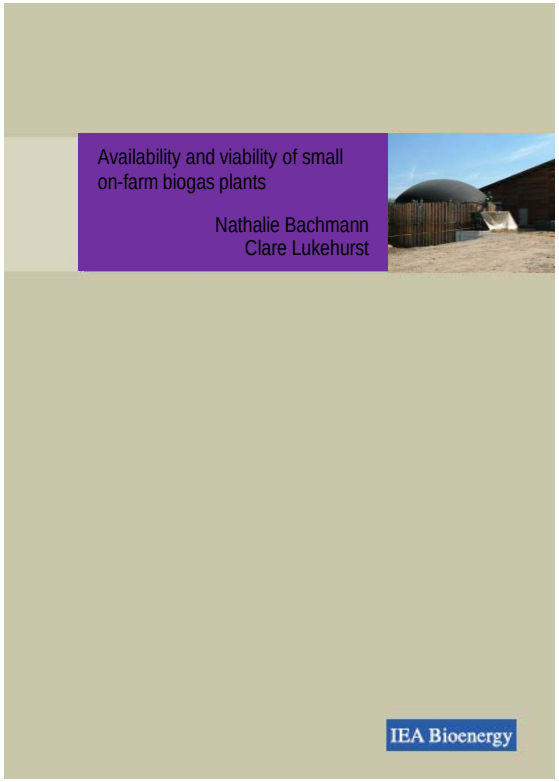
(Based on AEBIOM, 2009)

Context


Investment costs for biogas plants
9000
6000
3000
0
€/kW
0
200
400
600
800
1000
kWel installed

Objectives

- *Illustrate existing technologies for small-scale plants & possibilities to reduce investment costs*
- *Necessary and favourable framework conditions*
- *Management and operation to improve economic viability*

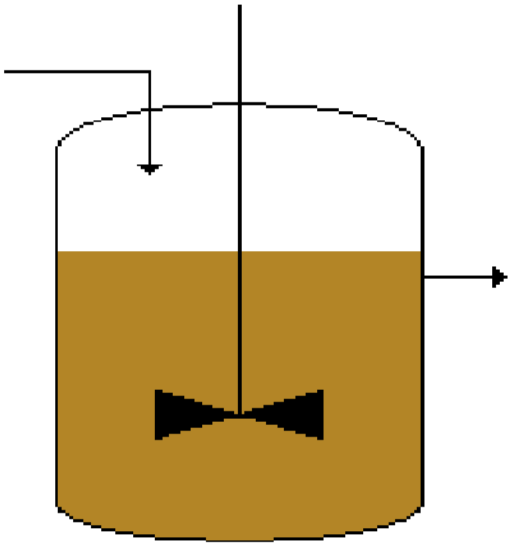


→ **More successful small-scale biogas projects** - new agricultural branch, rural development, improved waste and fertiliser management

→ **Renewable energy production and reduction of GHG emission -** exploitation of the huge agricultural potential

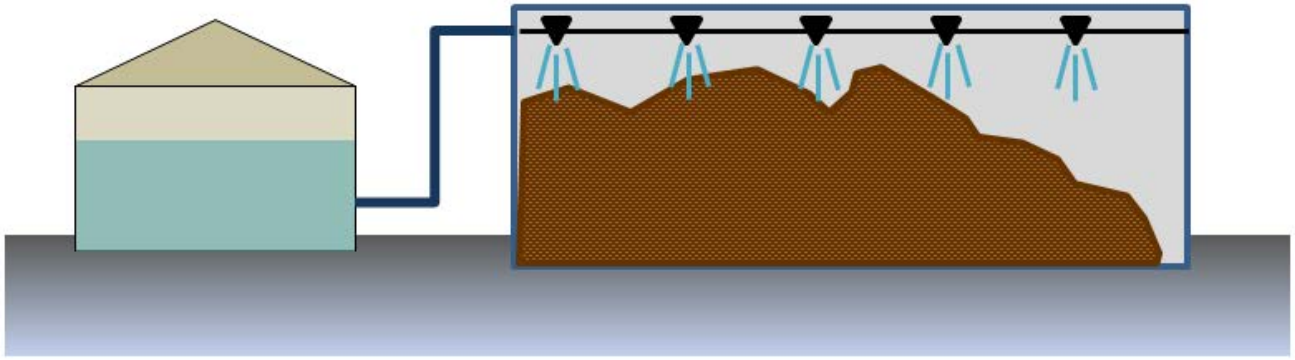
Principal small-scale concepts

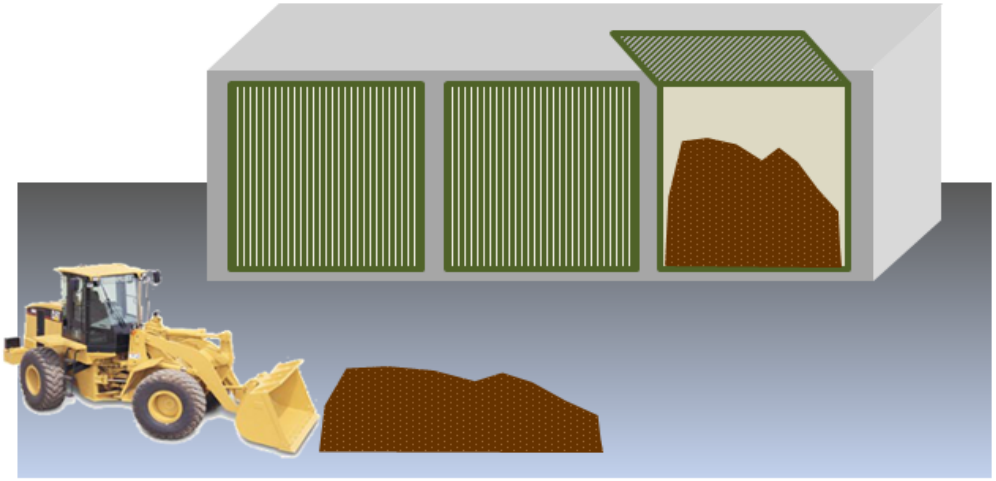
CSTR – Continuously Stirred Tank Reactors



Principal small-scale concepts

Garage reactors

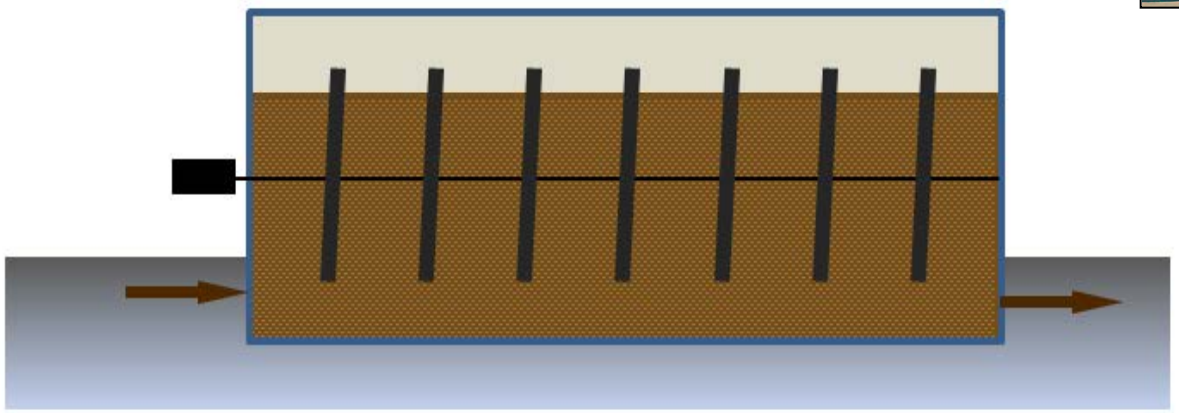




Principal small-scale concepts

Plug-flow reactors

(Source: schmack-biogas.viessmann.com/)



How to choose?

	Key parameter	Options
Reactor type	Dry matter content of feedstock	- CSTR for liquid substrates - Plug-flow or batch digester for solid substrates
Reactor temperature	Risk for pathogens	- Mesophilic temperature when no risk for pathogens - Thermophilic temperatures when risk for pathogens (organic house waste)
Number of phases	Composition of substrates, acidification risk	- One phase systems when no acidification risk - Two-phase system for substrates with a high content of sugar, starch or proteins
Agitation system	Dry matter content of feedstock	- Mechanical agitators for high solids concentration in the digester - Mechanical, hydraulic or pneumatic agitation systems for low solids concentration in the digester

Viability of small-scale plants

Framework conditions

Plant management

Local framework:

Farm and surroundings

Feedstock management

Legislative framework:

Administrative procedure, state support

Economic viability of small-scale plants

Operation control

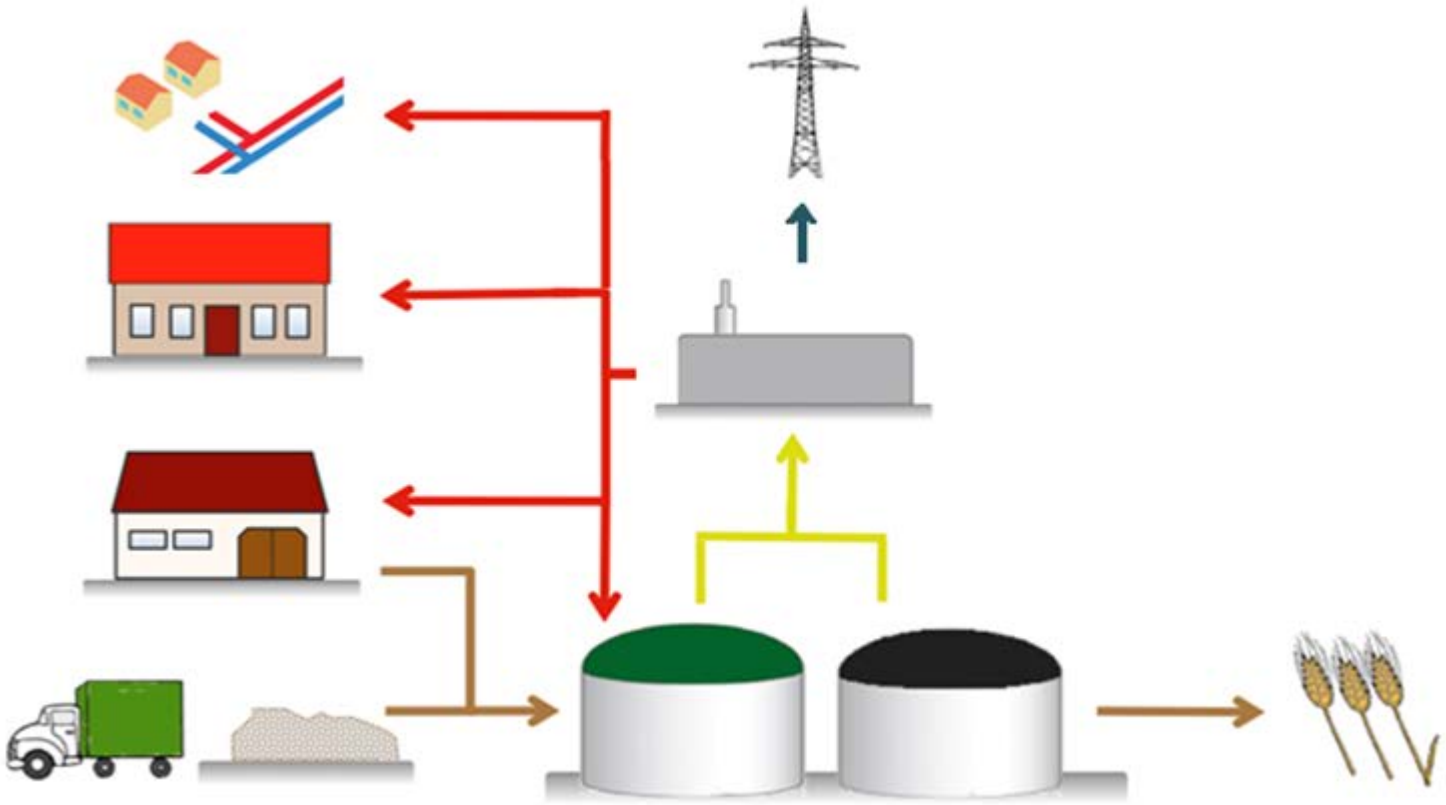
Institutional framework:

Plant constructors, engineering offices, banks

Digestate and energy management

Local framework

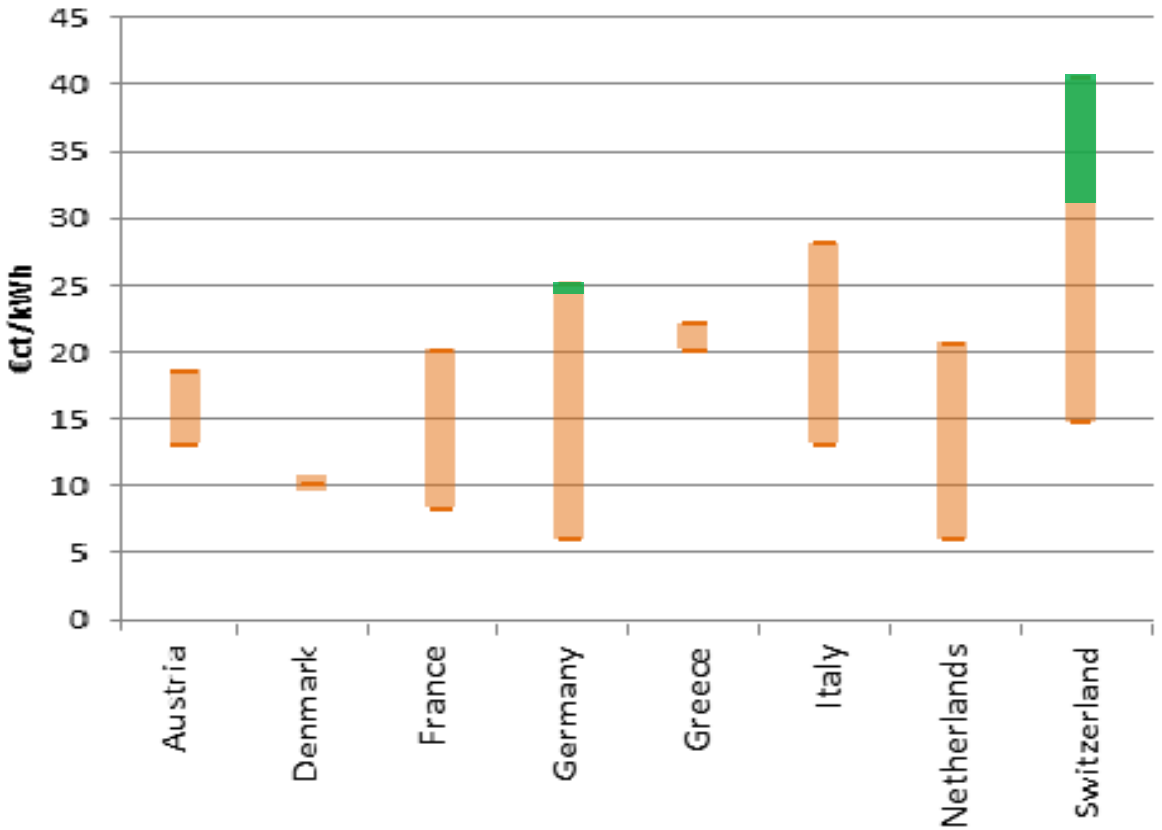
…and energy management



Feed-in tariffs

As an effective state support instrument

reserved for
small-scale plants (<100 kW)

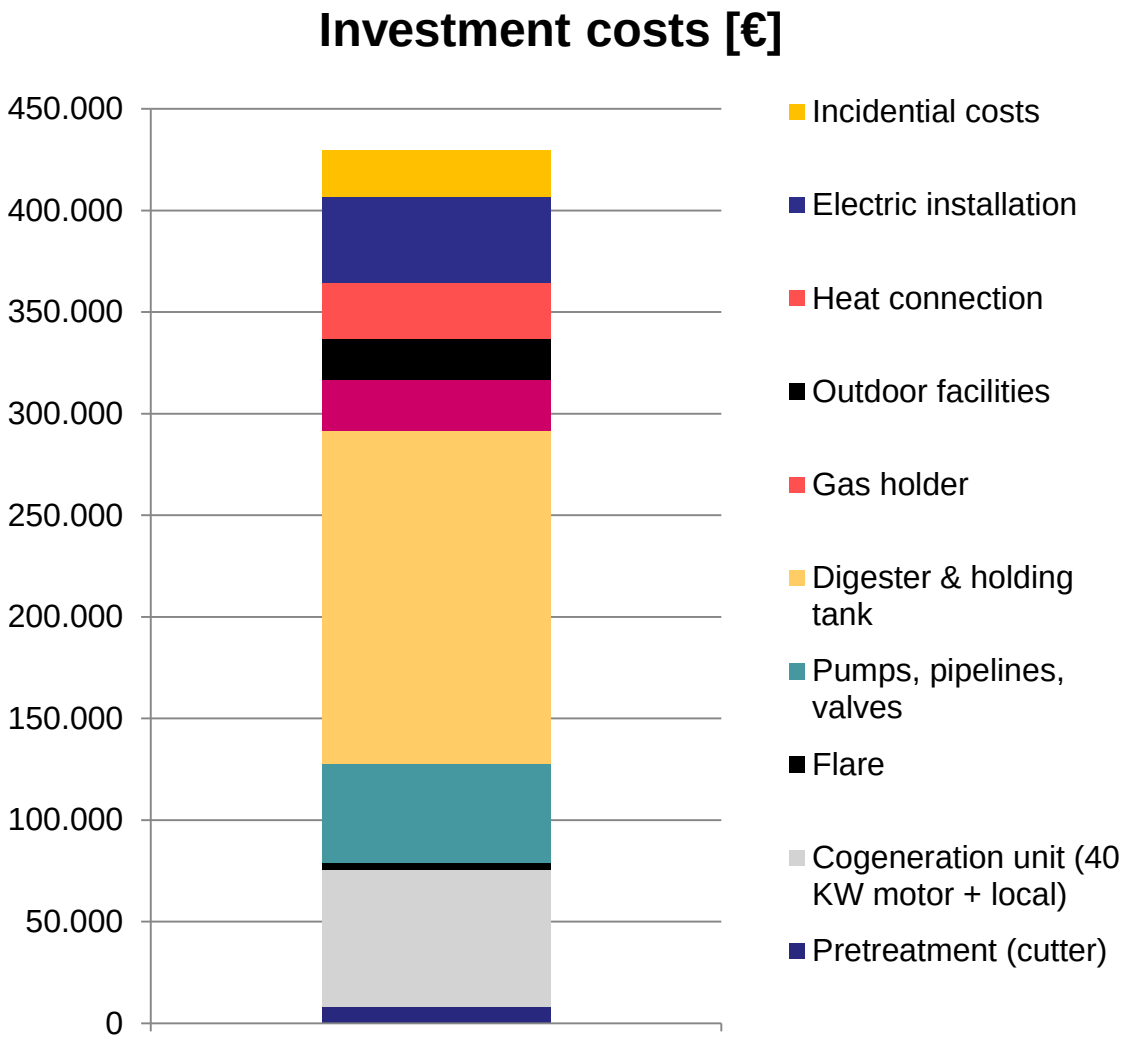


Example of economics

CHP 45 kWel

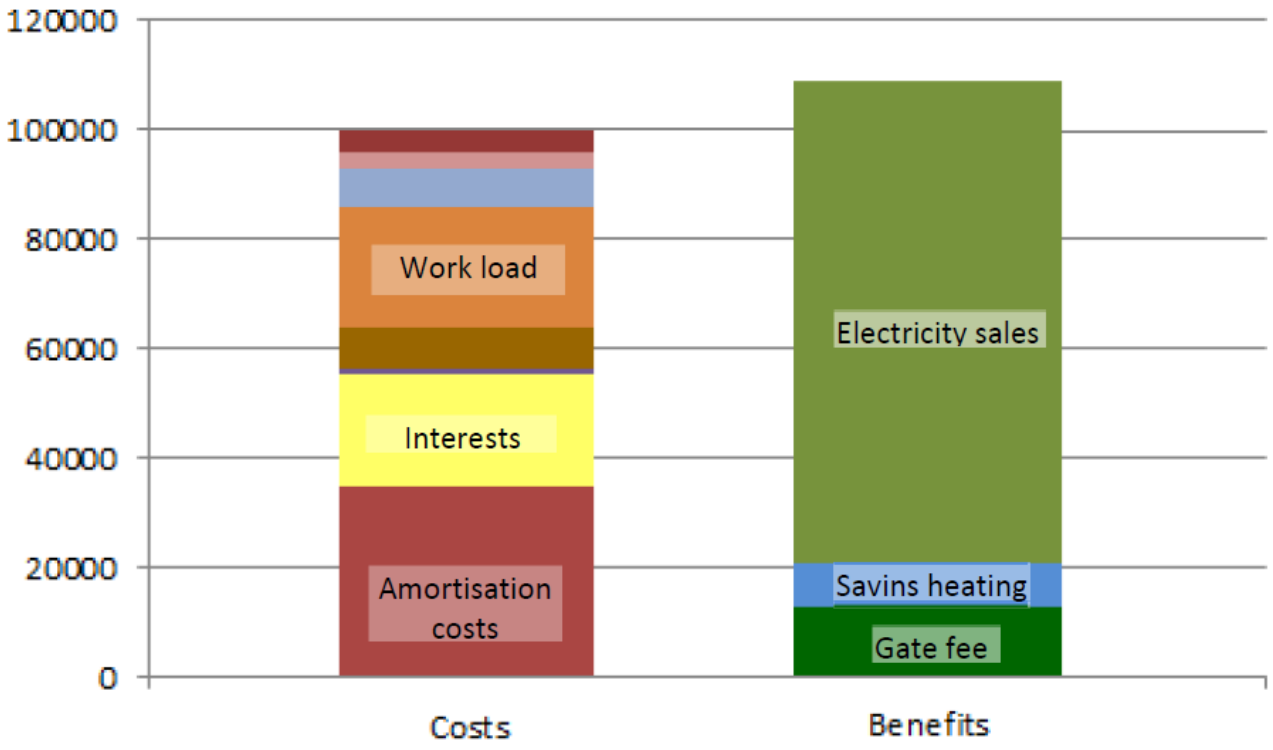
Total:
430’000 €

> 9’000 € / $kW_{installed}$!



Economics – Plant operation

Example - CHP 45 kWel



Benefit:

9’000 €/a

Example from Switzerland

Conditions:

- 80% borrowed capital
- 4.5 % interest rate
- 60 CHF/t gate fee
- Feed-in tariff: 40 €ct/kWh

Conclusions

Availability

- *Vast technological options*
- *Many new plant suppliers – references must be checked carefully*
- *Don’t choose the cheapest option, but the most adequate for your situation*

Viability

- *Good framework conditions are necessary*
- *Careful evaluation*
- *Full energy recovery - creative solutions are often beneficial!*

Thank you for your attention!