bioenergy for business

Supply with biomass heat

Experiences from practice

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November 4th 2016
CRES

Profitability of wood combustion dependencies

Heat requirement

•Room heating
• Swimming pool
• Hot water requirement
•Technical Heat Demand

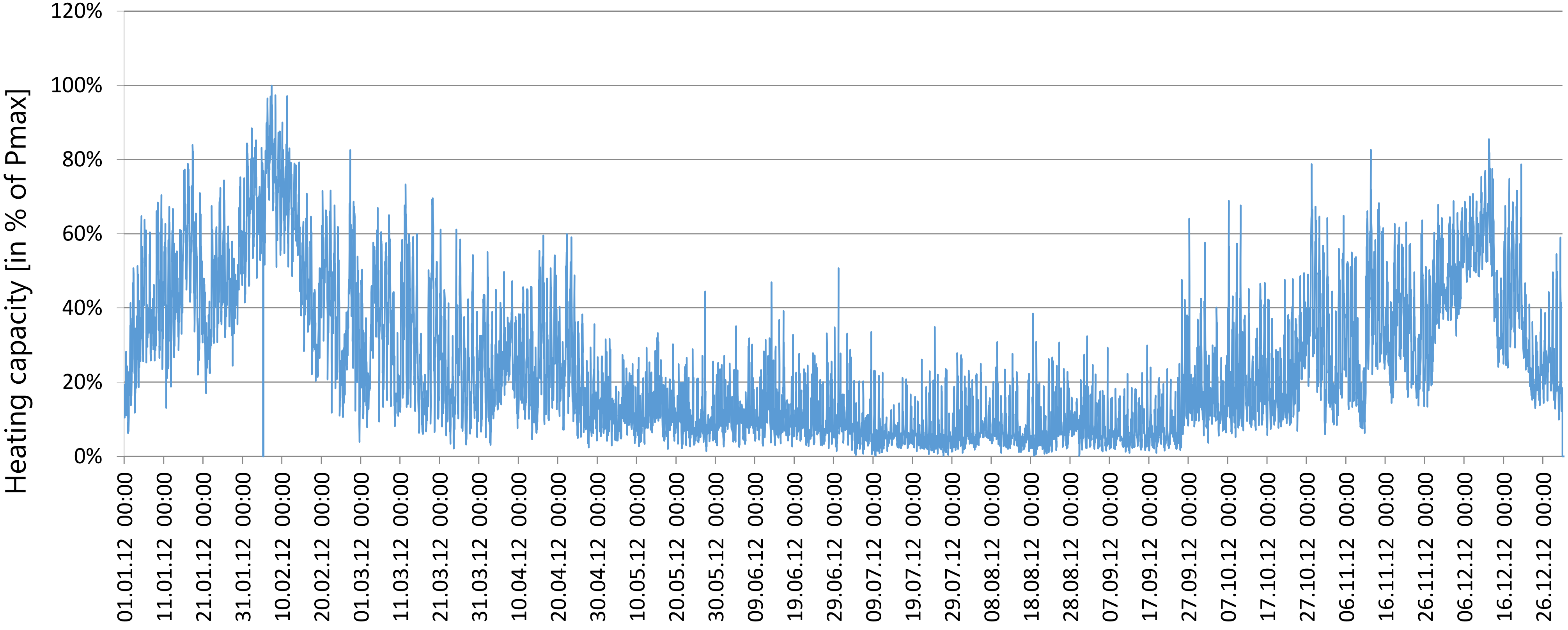
Fuel

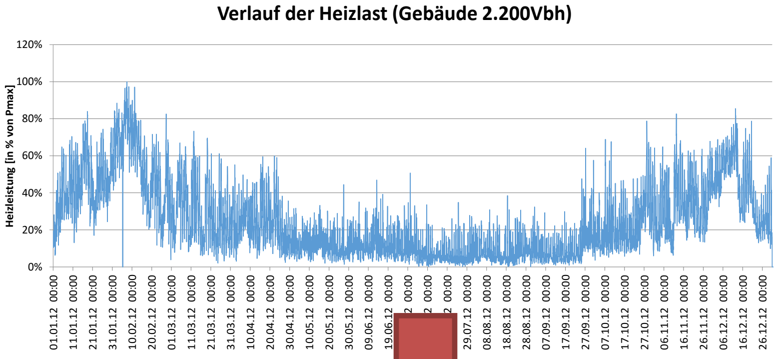
•Water contend
•Size
•Wood type
•Origin

Local conditions

•Storage facilities
• Delivery vehicles
• Technology

Time course of heat load (building with 2.200 full hours of operation




Verlauf der Heizlast (Gebäude 2.200Vbh)
Heizleistung [in % von Pmax]
120%
100%
80%
60%
40%
20%
0%
01.01.12 00:00
11.01.12 00:00
21.01.12 00:00
31.01.12 00:00
10.02.12 00:00
20.02.12 00:00
01.03.12 00:00
11.03.12 00:00
21.03.12 00:00
31.03.12 00:00
10.04.12 00:00
20.04.12 00:00
30.04.12 00:00
10.05.12 00:00
20.05.12 00:00
30.05.12 00:00
09.06.12 00:00
29.07.12 00:00
08.08.12 00:00
18.08.12 00:00
28.08.12 00:00
07.09.12 00:00
17.09.12 00:00
27.09.12 00:00
07.10.12 00:00
17.10.12 00:00
27.10.12 00:00
06.11.12 00:00
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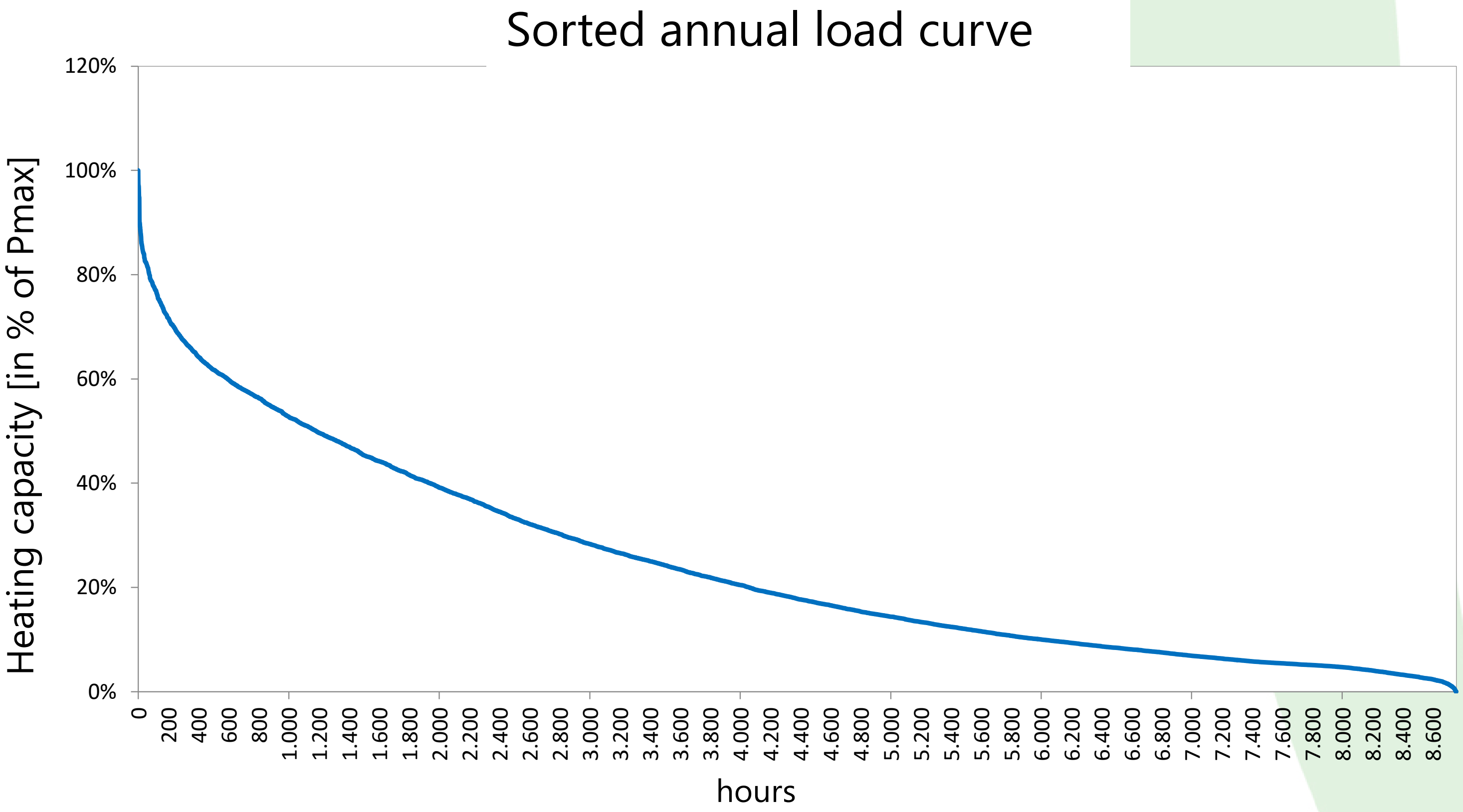
26.12.12 00:00


Sorted annual load curve
Heating capacity [in % of Pmax]
120%
100%
80%
60%
40%
20%
0%
0
200
400
600
800
1.000
1.200
1.400
1.600
1.800
2.000
2.200
2.400
2.600
2.800
3.000
3.200
3.400
3.600
3.800
4.000
4.200
4.400
4.600
4.800
5.000
5.200
5.400
5.600
5.800
6.000
6.200
6.400
6.600
6.800
7.000
7.200
7.400
7.600
7.800
8.000
8.200
8.400
8.600
hours

Pellets or Woodchips ?

MWh/a

> 1.000 — Hospitals , local heat network

1.000 — Schools , swimming halls, nursing facilites

500 — Town halls, administerial buildings > 50.000 inhabitants, schools

100 — Sport halls, smaler schools, building yard, hotels

50 — Town halls (up to 10.000 inhabitants), sport halls,

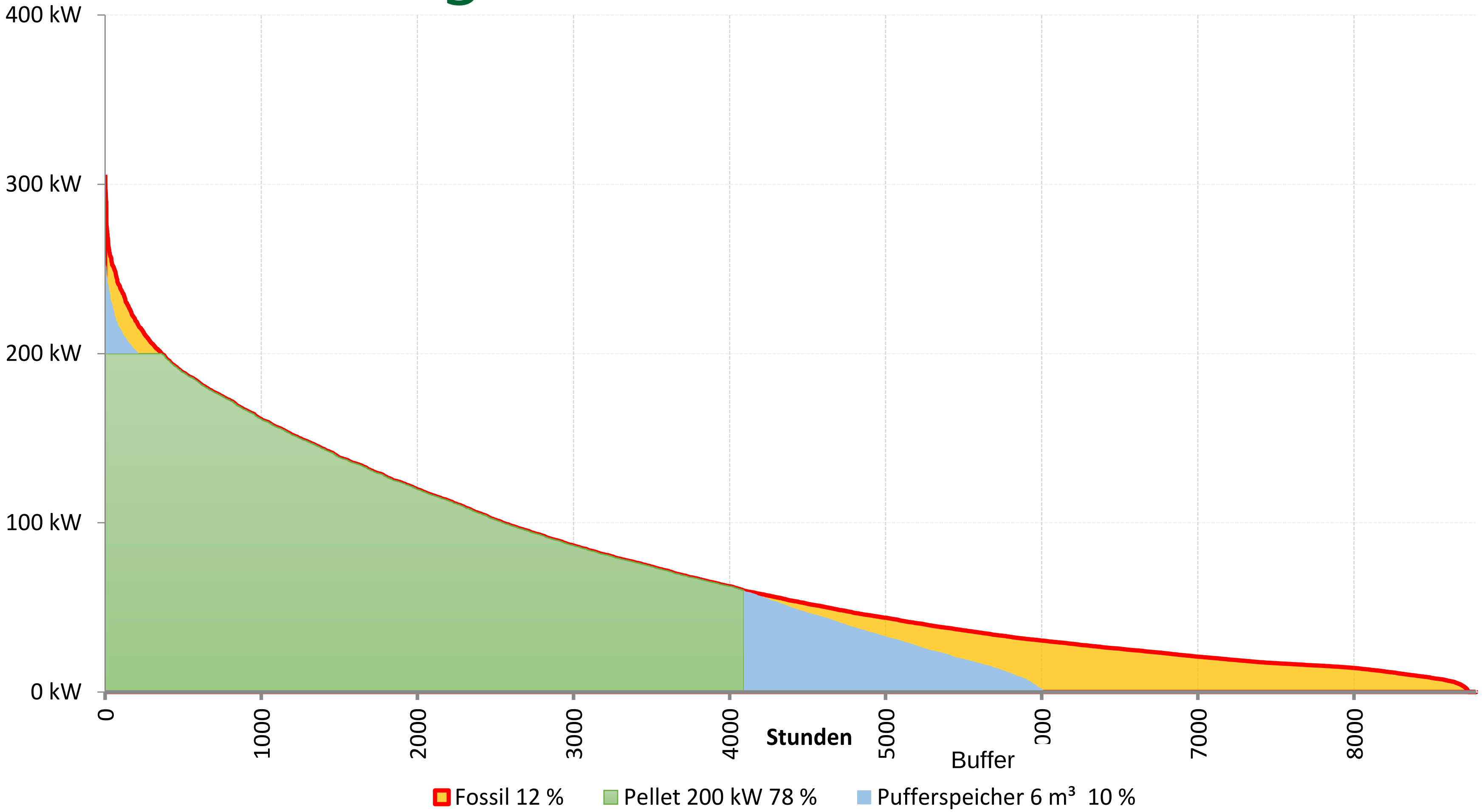
25 — Multi-family -house, Kindergarten

10 — Single-family-house

Dimensioning

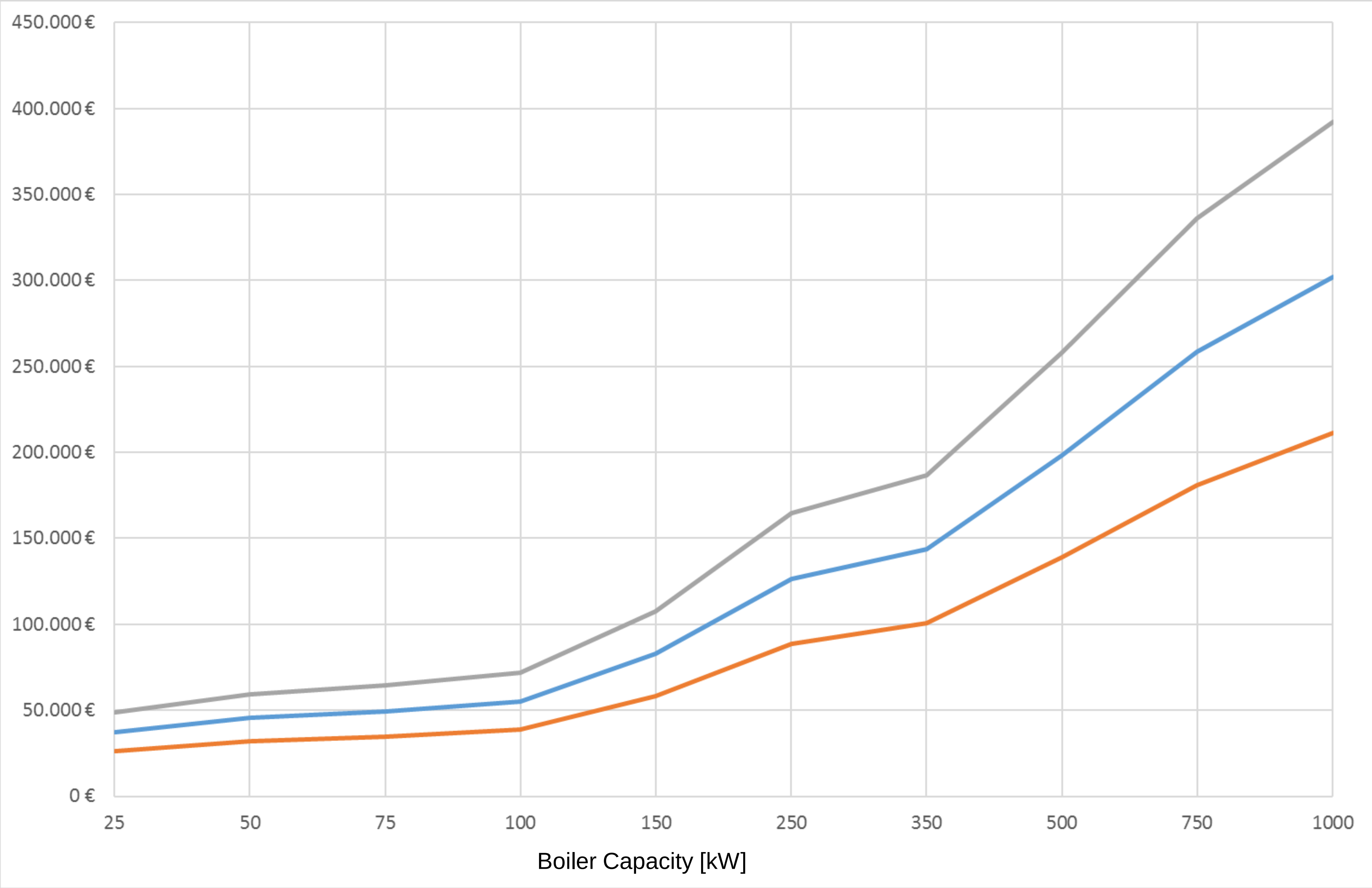
- Technical configuration on the basis of load duration curve
  (30 - 60% of heat capacity demand)
- High boiler utilization hours (> 2,500 h /a)
- Substitution of min. 80% of the annual heating demand with Woodchips
  (buffer storage allows higher cover shares)
- Construction and size Woodchip-Silo
  (Depending on system performance, transport units, (intermediate) storage capacities, terrain, integration into the company, delivery routes)

Dimensioning

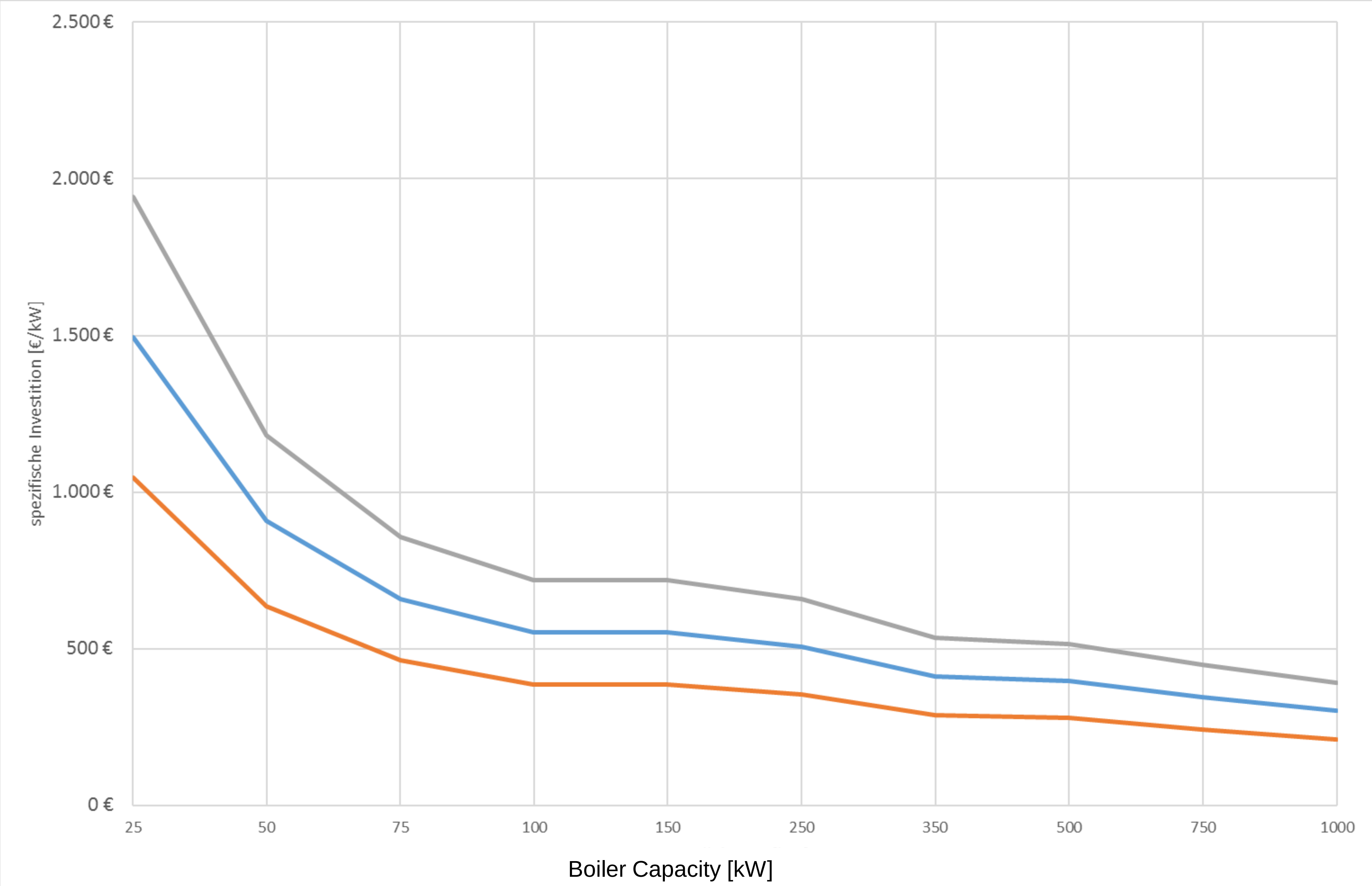


With modulation up to 30% and with the help of a 6,000 liter buffer tank, a 200 kW pellet boiler covers approximately 90% of the heat requirement

Investment in plant engineering as a function of the boiler capacity



Investment in plant engineering as a function of the boiler capacity



Comparison of different plant concepts

Year	Wood	Gas	Total	Wood Share
2013	2.519.000	280.000	2.799.000	90%
2014	1.899.000	343.000	2.242.000	85%
2015	2.087.000	328.000	2.415.000	86%
Average	2.168.333	317.000	2.485.333	

Investment	240.000 €	60.000 €	60.000 €
capital service	19.384 €	4.846 €	4.846 €
maintenance	4.000 €	475 €	475 €
fuel	88.000 €	19.020 €	149.120 €
Power supply	600 €	- €	- €
staff	7.000 €	- €	- €
chimney sweeper	180 €	120 €	120 €
Cost per year	119.164 €	24.461 €	154.561 €
Heat output [€ / kwh]	0,0550 €	0,0772 €	0,0622 €
Fuel costs [€/kWh]	0,0406 €	0,0600 €	0,0600 €

Comparison of different plant concepts

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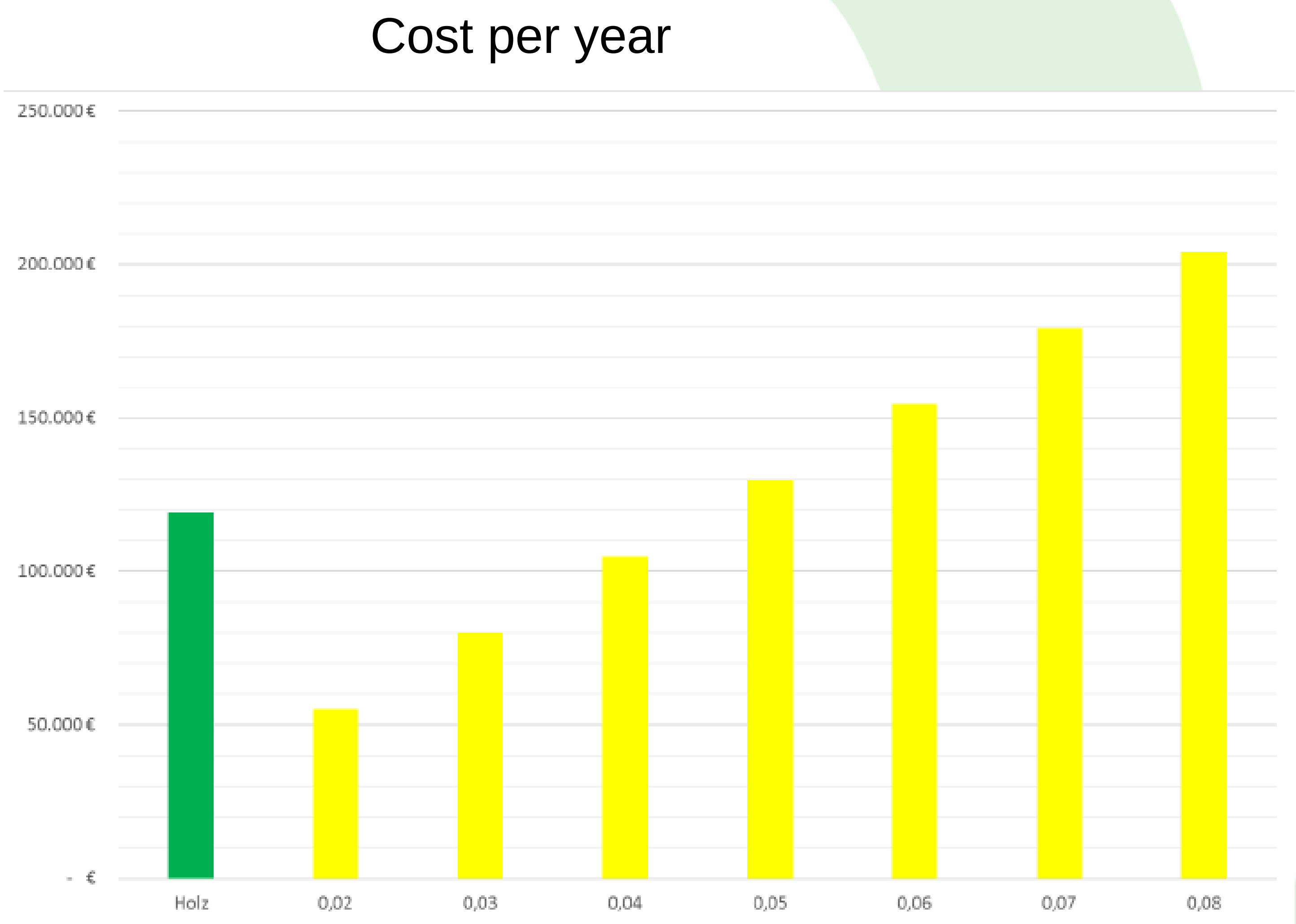
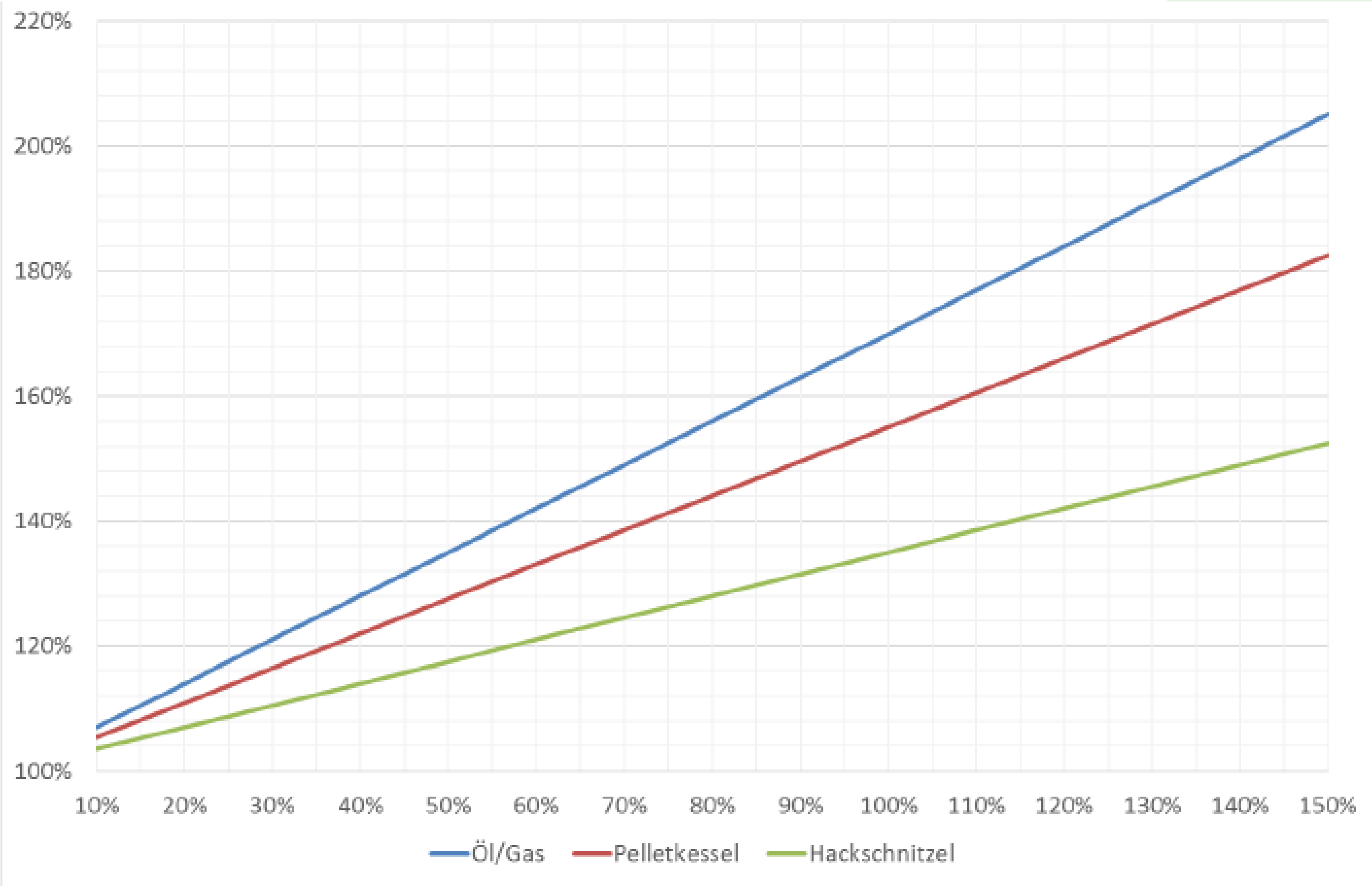
Gas price				
0,02			0,0222 €	55.148 €
0,03			0,0322 €	80.001 €
0,04			0,0422 €	104.854 €
0,05			0,0522 €	129.708 €
0,06			0,0622 €	154.561 €
0,07			0,0722 €	179.414 €
0,08			0,0822 €	204.268 €

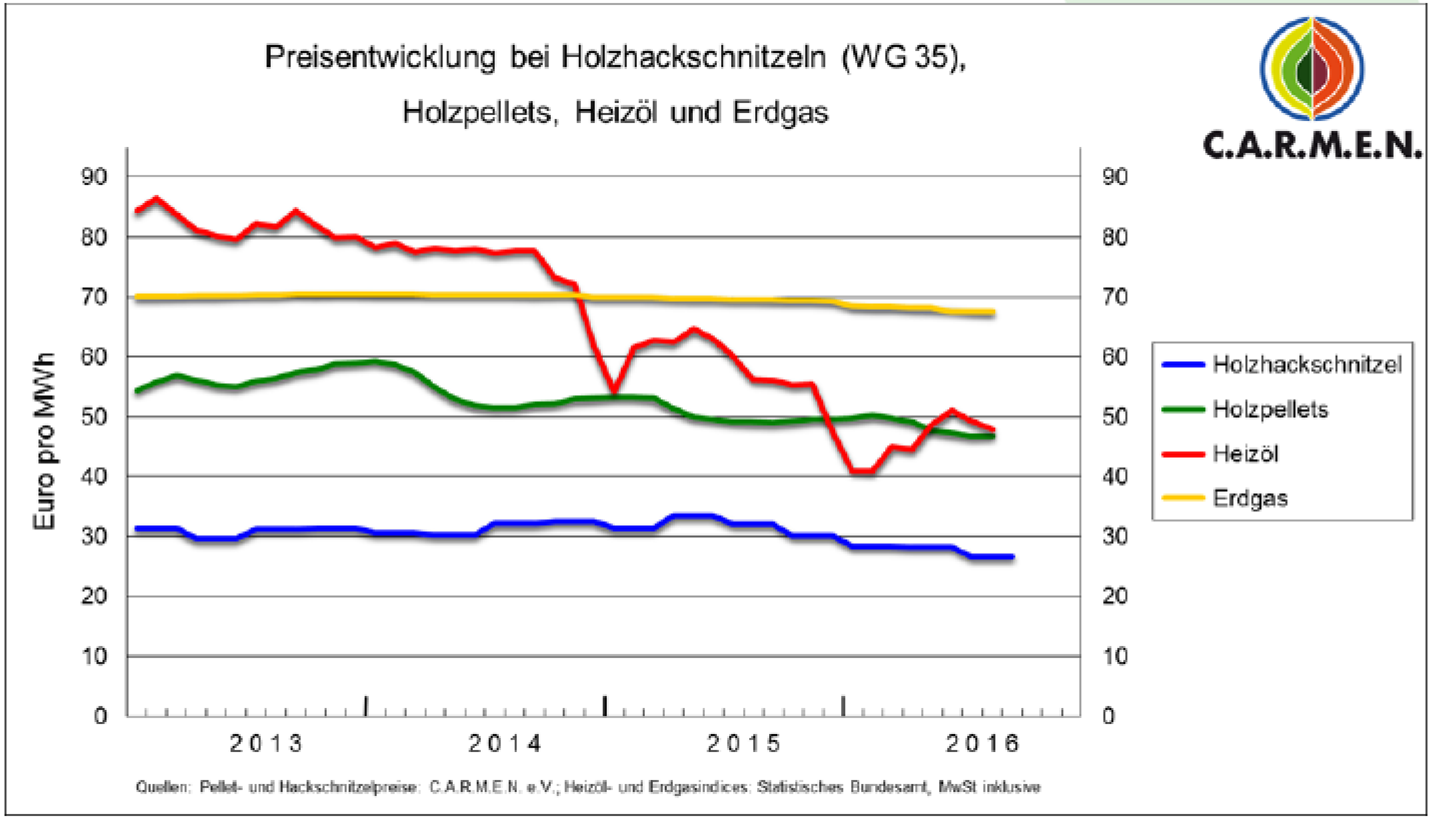
Comparison of different plant concepts



Comparison of different plant concepts

Influence of fuel cost increase on on the heat price





Waldhackschnitzel-Preise WG35 aktuell

Recommendations for heat supply contract

Essential contract contents	Details
Delivery obligations	The heat supplier assumes an obligation to provide the customer with a secure supply of the object, ie to supply heat all year round according to an agreed minimum quantity. The contract should contain a precise definition of heat transfer medium (including the performance, temperature and - in the case of steam - pressures), connection systems and heat transfer facilities, with indication of the property limits. In most cases, a joint revision and standstill plan as well as a disaster and incidents plan are agreed upon between the supplier and the customer.
Purchase Comitment	The heat load is committed to cover its (mostly total) heat demand from the energy provided by the system operator. It is entitled to forward the heat to its tenants. A customer's supply of heat to other third parties, however, should be subject to the supplier's agreement. If the customer sells his property, he is obliged to impose his / her entry into the heat supply contract in accordance with § 32 of the German Heating Act (AVBFernwärmeV).

Recommendations for heat supply contract

Essential contract contents	**Details**
Contract Duration	It is advisable to agree a term of **at least 5 years**. The maximum running time in Germany is ten years, whereby - if neither party terminates the contract in time - an extension for a further five years is deemed tacitly agreed.
Remuneration arrangements	The remuneration arrangements initially comprise the basic charges as well as price-changing factors for the supply and delivery of heat, which may include the reimbursement of the house connection costs, an emergency subsidy and a heat price. Furthermore, the payment dates as well as the effects of a payment default are to be agreed.
Measurement of heat consumption	the heat supplier should normally use measuring devices to determine the consumption according to the legal requirements
Price change clause	The parameters of the price change clause determine the conditions and the extent to which the prices can be increased or reduced. The clause is of the utmost importance because it allows the energy supplier to increase the prices or give the customer the right to demand a reduction in the price.

Recommendations Design of heat price

Essential contract contents	**Details**
Basic price	Basic price in € per kW (connected load) and year: Billing according to the ordered heat output. If this is exceeded, the measured hourly output is used.
Price per kWh	Working rate in € per kWh and year: Billing over the heat quantities measured with heat meters. Minimum size is the minimum heat quantity according to acceptance obligation.
Annual Price for the measurement of heat consumption	Determination according to the re-acquisition values of the heat quantity counters and the costs for their read-out.

Conclusions

The following basic rules apply for profitability:

- The larger the boiler capacity, the lower the specific investment
- The more shareholder hours the lower the share of capital costs in heat production costs
- Wood is not as volatile as fuel oil and thus offers cost-protection
- Wood is an economic alternative where there is no natural gas.

Thank you

Essential components of heat supply contracts

Technikauswahl beim Holzkessel in Abhängigkeit vom eingesetzten Brennstoff und der Leistung

Brennstofftransport, -förderung

Schubboden, Drehfeder, Drehgelenkaustragung, Sonderbauformen

Schnecken, Kratzketten, (hydraulische) Schubsender, Schieber

Biomassefeuerung / Verbrennung

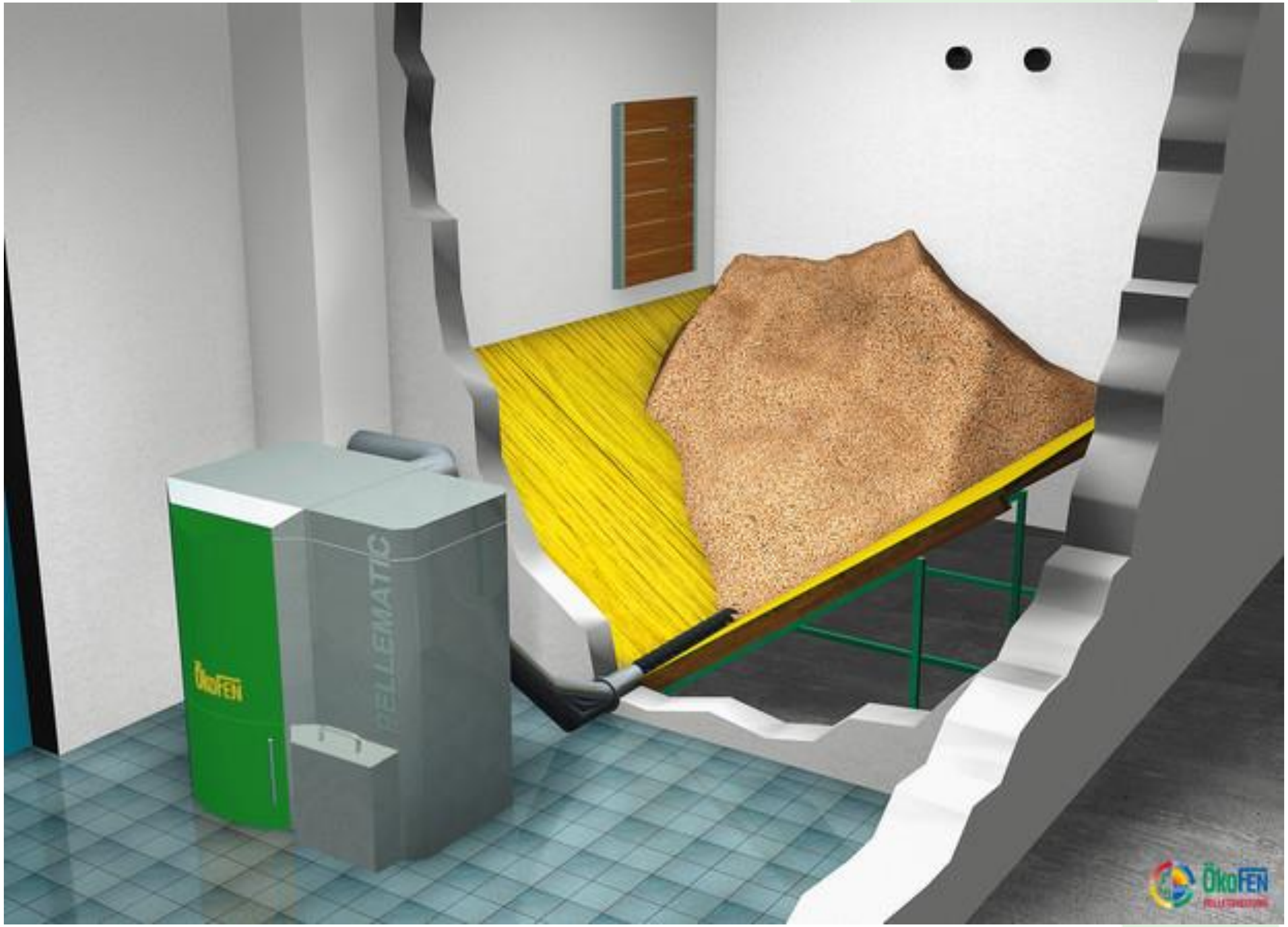
Unterschubfeuerung, Vorschubrost, Vorschubtreppenrost,

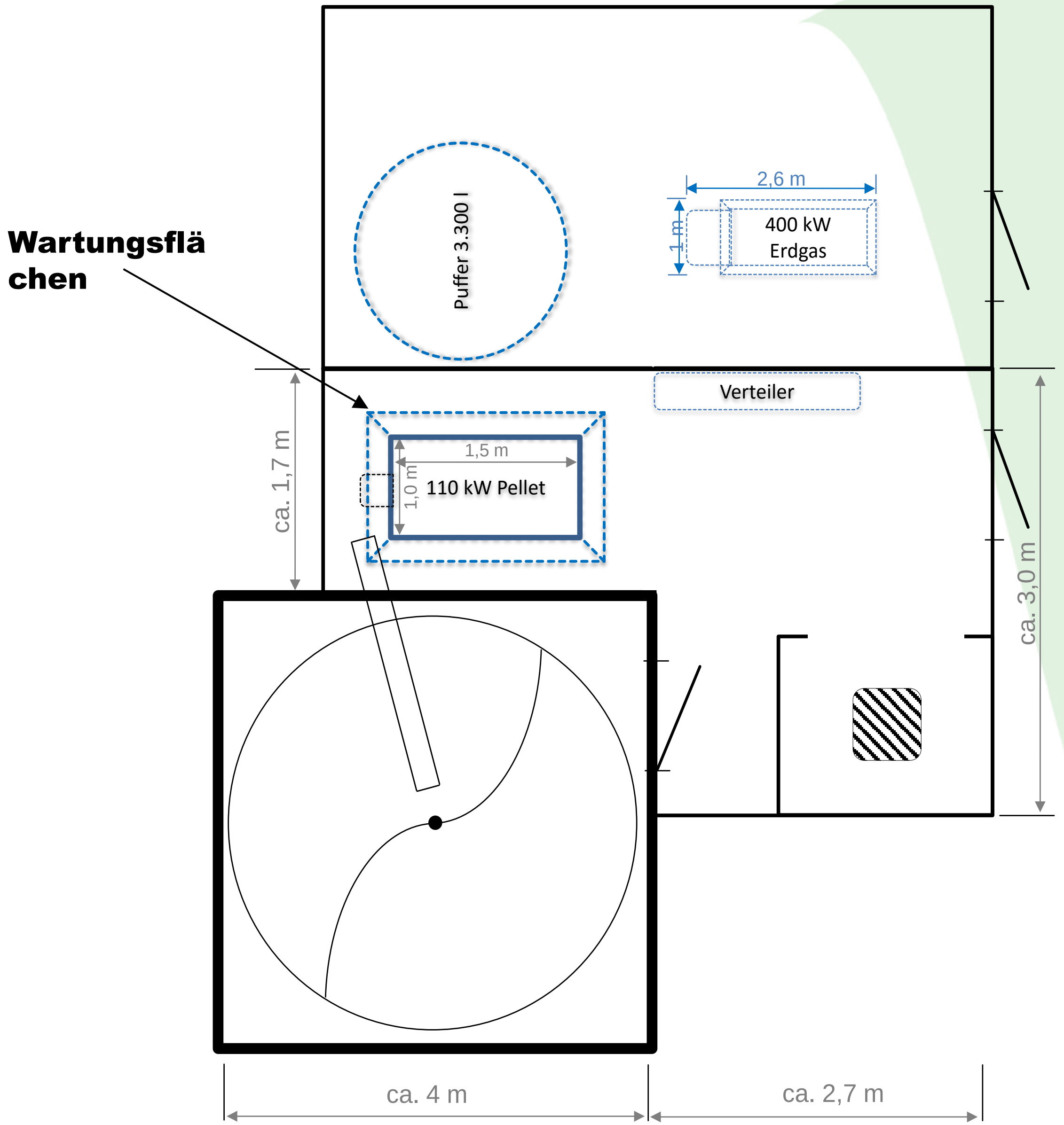
Schamottierung, Ascheaustrag, Rauchgasreinigung, Regelung

=> abgestimmt auf das Brennstoffsortiment

Anlagenbeispiele 1

Lagerraumgestaltung
Schrägboden mit Schneckenaustragung

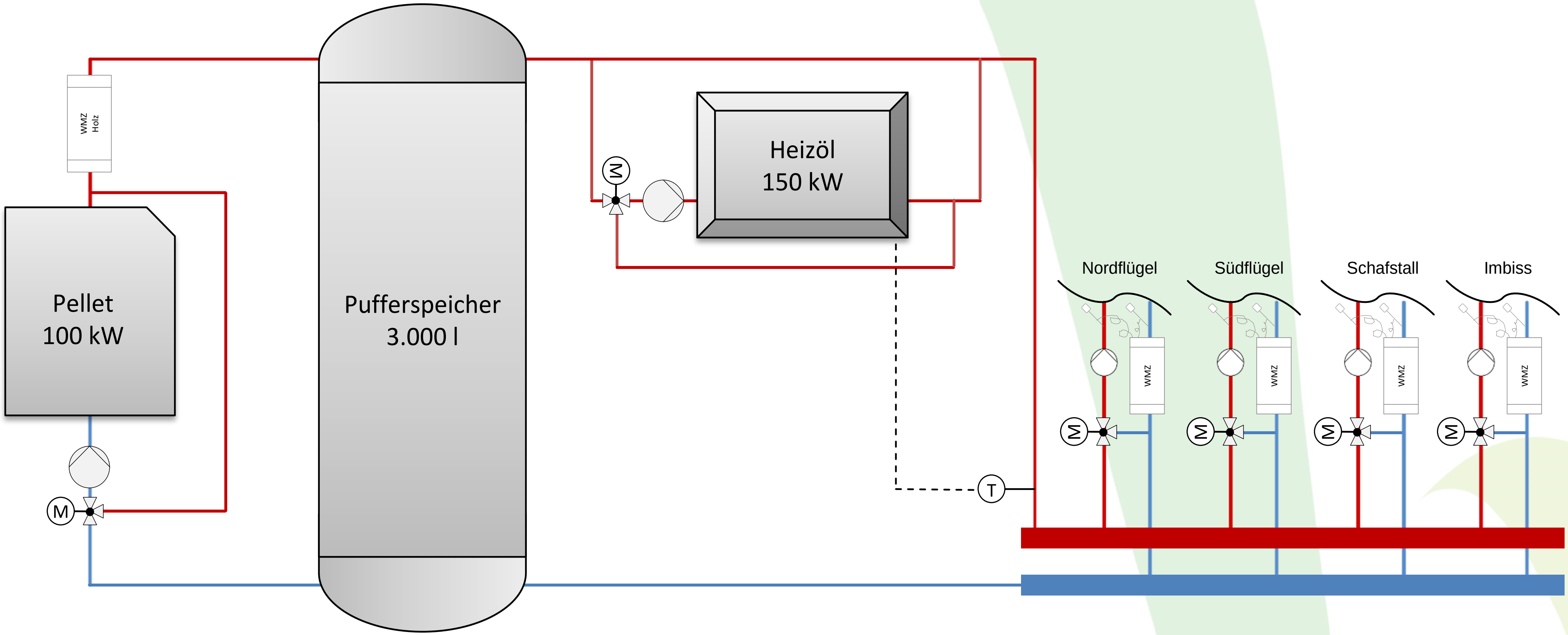




Wartungsflä
chen
Puffer 3.300 l
2,6 m
1 m
400 kW
Erdgas
Verteiler
1,5 m
1,0 m
110 kW Pellet
ca. 1,7 m
ca. 3,0 m
ca. 4 m
ca. 2,7 m

Anlagenbeispiele 2

Anlagenbeispiele 3


WMZ Holz
Pellet 100 kW
M
Pufferspeicher 3.000 l
Heizöl 150 kW
M
T
Nordflügel
Südflügel
Schafstall
Imbiss
WMZ
WMZ
WMZ
WMZ
M
M
M
M

Prinzipielle Darstellung der Wärmeerzeugung im Heizkessel verglichen mit der Wärme- und Stromerzeugung in einer KWK-Anlage

Wärme aus Heizkessel mit Erdgas

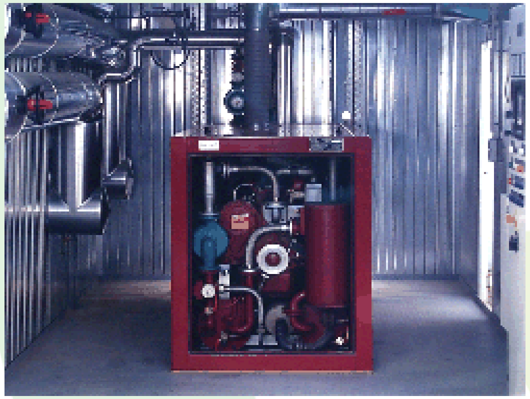
Wärme aus KWK mit Erdgas

Erdgas

Erdgas

Wärme

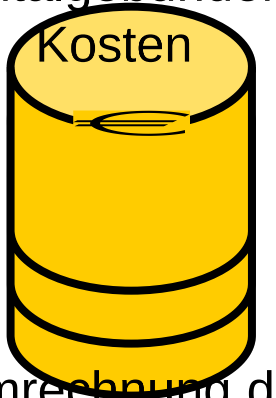
Wärme



Stromnetz

Kosten der Wärmebereitstellung

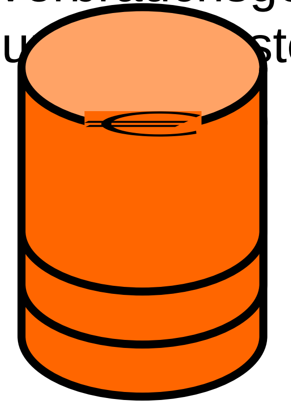
Kapitalgebundene Kosten



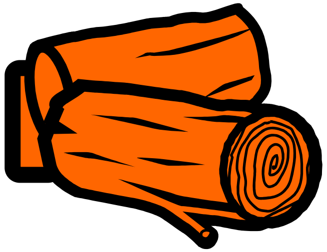
Umrechnung der Investition und Installation in jährliche Kosten

Geräte

Verbrauchsge-
bu[illegible]sten

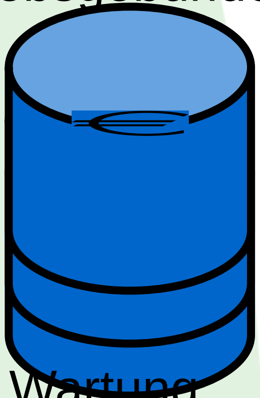


Energie, Hilfsenergie



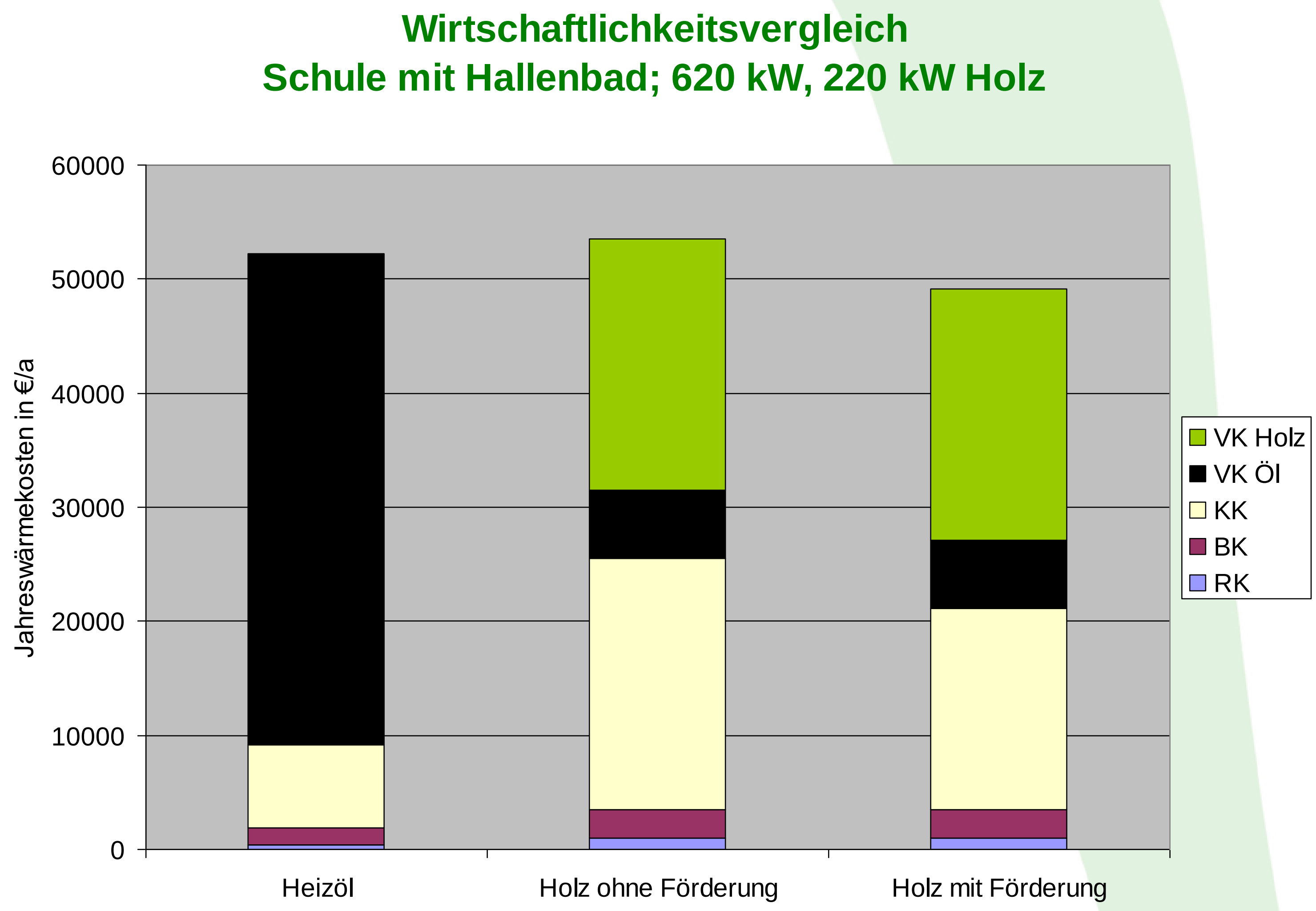
Energie

Betriebsgebundene

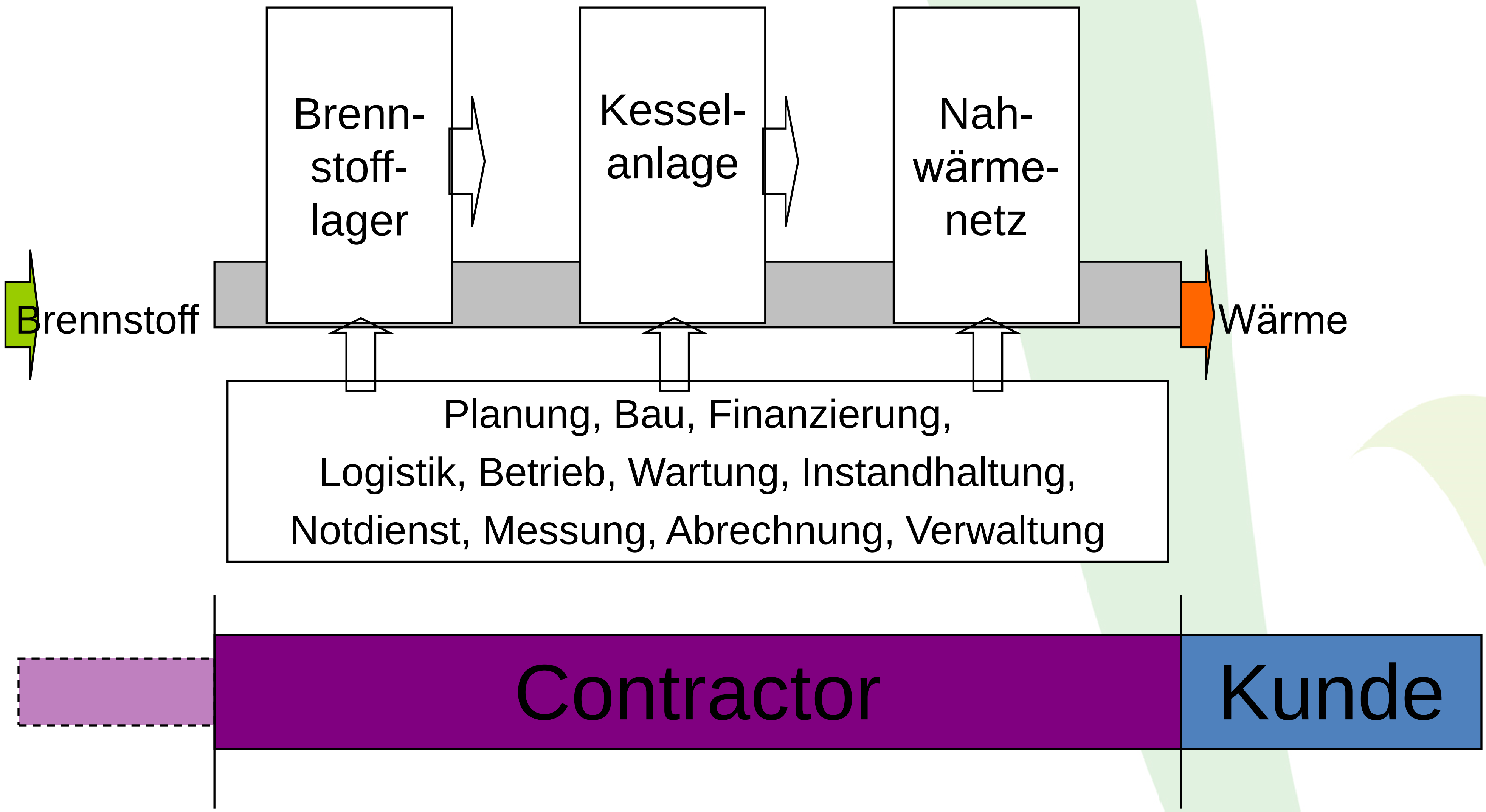


Wartung, Instandhaltung, Bedienung

Wartung


Wirtschaftlichkeitsvergleich
Schule mit Hallenbad; 620 kW, 220 kW Holz
Jahreswärmekosten in €/a
60000
50000
40000
30000
20000
10000
0
Heizöl
Holz ohne Förderung
Holz mit Förderung
VK Holz
VK Öl
KK
BK
RK

Wärmelieferung im Contracting



Auswirkungen von Maßnahmen der energetischen Sanierung

Wärmedämmung der Fassade — ca. -25%

Dachausbau mit Wärmedämmung (24 cm) — ca. -11%

Wärmedämmung der Kellerdecke — ca. -6%

Wärmeschutzverglasung (3-fach Verglasung) — ca. -10%

Stromeffizienzmaßnahmen, hocheffiziente Heizungspumpen, Energiesparlampen, stromeffiziente Haushaltsgeräte — ca. -15%

www.hessische-energiesparaktion.de - Die Hessische Energiespar-Aktion ist eine Aktion des Hessischen Ministeriums für Wirtschaft, Verkehr und Landesentwicklung. Bild Stromzähler:© KfW-Bildarchiv / Fotograf: Thomas Klewar

Förderung und Vorfeldberatung

Gefördert werden alle natürlichen und juristischen Personen sowie Energiedienstleister (Kontraktoren)

Zuschuss für Biomassefeuerungsanlagen

- 36 EUR/kW bis einschließlich 100 kW
- 30 % der zurechenbaren Netto-Investitionskosten ab101 kW

Vorfeldberatung / OC bei konkreten Vorhaben von:

automatischen Holzfeuerungsanlagen (HHS, Pellets) & Nahwärmenetzen Blockheizkraftwerken

- Optimierung des Vorhabens/Anlagenkonzeptes im Vorfeld der Investitionsentscheidung
- Ortstermin, wenn erforderlich
- Kurzbericht mit den wesentlichen Beratungsergebnissen
- liefert keine Planungsleistungen

- The heat supply agreement is concluded between the customer and the heating power plant operator and provides the legal basis for the private connection to a heating power plant and the supply of heat. This contract regulates the prices and other conditions on which heat is supplied and And thereby determines the rights and obligations of the heat supplier and the customer.

Recommendations for biomass delivery contract

Essential contract contents	Details
delivery obligations	• Sufficient specification of the solid biomass fuel in terms of its content of plant species and the way of its conditioning • Requirements for the minimum standards of quality (water content, contamination, etc.) • Agreements on minimum delivery volumes and their temporal distribution (e.g. in the form of weekly or monthly plans). • Release or indemnification from delivery promise, e.g. in case of adverse weather and crop conditions
	·**TIP** *In addition, extraordinary deliveries can be arranged, in case the stock of biomass fuel is running out or a shortage of fuel supply is foreseen*
purchase commitment	• Release or indemnification in case of non-culpable plant standstill. • Right to obtain biomass from third parties, if the supplier fails to meet its obligations.
remuneration arrangement	• Determination of the price of fuel delivery to the plant for the year of initial start up • Regulations adjusting the basic fuel price in case of deviating (from the agreed base case) fuel qualities and agreed delivery times as well as regulations for future price changes (price change clauses) • Dates of payment and consequences of default in payment
contract duration	Start and end of contract
	TIP *It is recommended to arrange an as long as possible contract period of at least five years with an option for an extension of the contract. This leads both parties to a calculable residual risk assessment. Most financial institutions demand long supply contracts, before they issue a credit, as well.* *3 year contracts are common in DK. The straw supply is subject of large variation depending on climatic conditions. In some years there are excessive amounts of straw, pressing down the prices. In other years there are shortages and prices go up. The 3 year period is kind of a compromise between buyers and suppliers to ensure stable supply and foreseeable (fair) prices.*

- el
  The guide is intended to enable the user to assess variants of the local heating supply as well as to recognize technically and economically interesting options.
  The main focus here is on the system-wide optimization, which must consider the technical dependencies and interactions between heat generation, distribution and consumption.

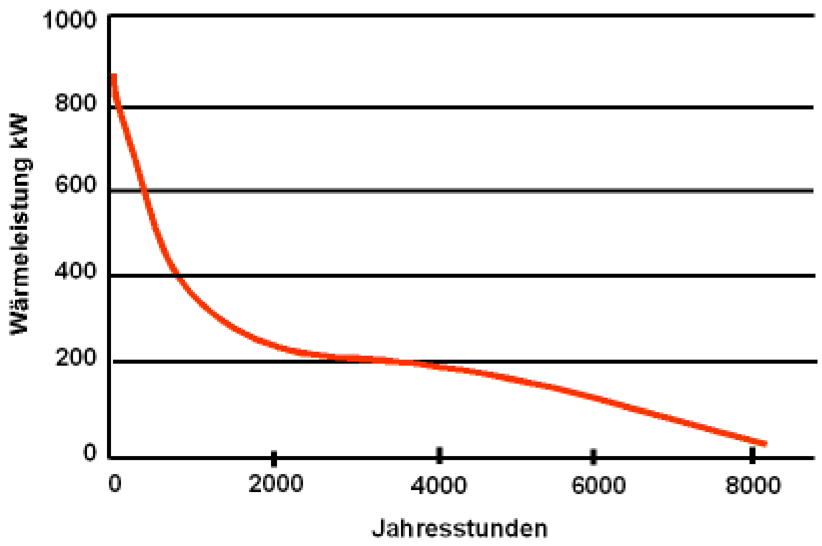
- Selection of heat generators
- When selecting and dimensioning the technical variants for the system components, their technical limits of use and the mutual influence must be observed. These aspects are taken into account when explaining the various technologies, thus laying the foundations for overall optimization. When selecting heat generators, it must be taken into

- ntroduction

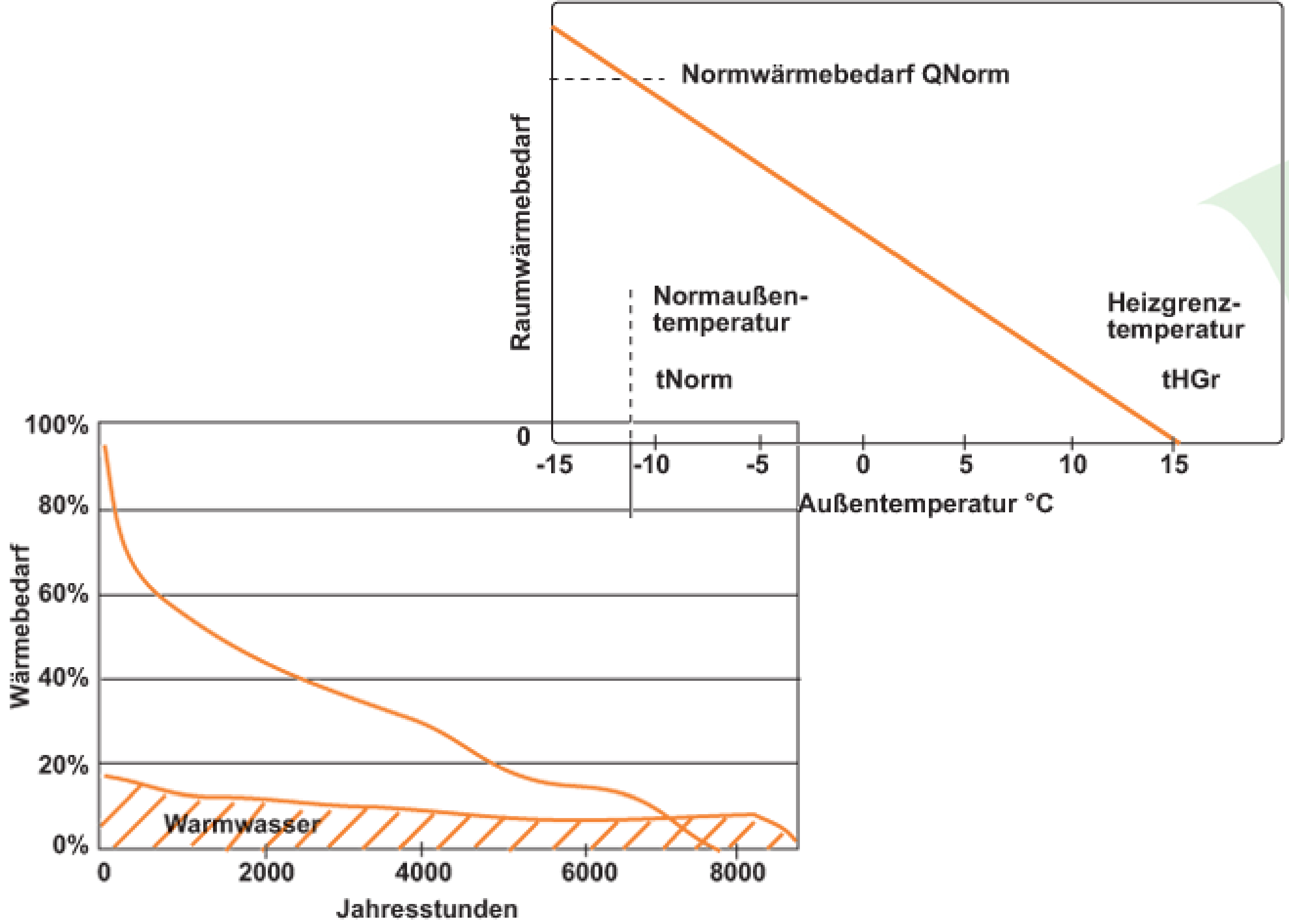
  The total heat requirement includes the room heat demand and the heat demand for DHW heating (TWE). Due to the 2nd amendment of the German Heat Insulation Ordinance (WSchV) of 1994, up to 30% reductions in space heating requirements were achieved, while drinking water demand remained approximately constant.

- Strategic preliminary decisions

  Since the efficiency of a local heating network increases with the number of connected buildings per area, a possible 100% degree of connection is aimed at; In local heating systems in new construction areas. A connection constraint was considered.
  This measure has advocates (



1000
800
600
400
200
0
Wärmeleistung kW
0
2000
4000
6000
8000
Jahresstunden



Normwärmebedarf QNorm
Raumwärmebedarf
Normaußen-
temperatur
tNorm
Heizgrenz-
temperatur
tHGr
0
-15
-10
-5
0
5
10
15
Außentemperatur °C
100%
80%
60%
40%
20%
0%
Wärmebedarf
Warmwasser
0
2000
4000
6000
8000
Jahresstunden

- Taking into account a near-linear relation between the external temperature and heat demand and the equilibrium of the standard heat demand with the maximum heat demand, the heat-time duration curve can be derived from the annual duration of the outside temperature. The standard outside temperature tNorm and the frequency of the various outside temperatures which are associated with

- Standardized procedures (Typtag procedures according to VDI guideline 2067) or procedures based on monthly, annual or specific daily consumption values are used to determine the annual duration.
  However, no consumption values can be used for new buildings.
  On the assumption of an approximate linear dependence between the external

- inancing models

  In addition to a technically and economically viable concept, the organization and financing of the respective projects are of equal importance. The following problems often arise:

  Too little capital cover or too tight funding

Recommendations for biomass delivery contract

Objectives of the plant operator

Why I contract should be drafted?

- For a **long-lasting economic operation** of their systems, operators of heating (power) plants have to ensure a longest possible supply with biomass fuel.
- In many cases the conclusion of a long-term supply contract **is a basic prerequisite for bank lending** anyway.
- Only by keeping a defined fuel quality, matching to the specific heating plant, a **low-disruption operation** can be guaranteed.
- specify the delivery quantity, delivery times and quality of fuel suitable for the selected firing system, the remuneration and other rights and obligations of each party. Price escalation clauses bear the general market trend into account and facilitate the **conclusion of long-term contracts**.

→ Depending on the type of fuel, the number of suppliers and the willingness / ability of the plant operator to internal labour there are differences with respect to the contract contents.

Recommendations for biomass delivery contract

Possible Billing models

Volume	This method has the **least effort**. The volume can be **determined from the dimension of the hold** (bulk goods) or in case of straw bales of the **number and the dimensions of the bales.** In an clearing on volume, even the type of wood has to be considered. The **accuracy of this method is low**, because the bulk density of fuel assortments can differ, which have a major impact on the measurement result. Therefore this method is **only recommended for homogenous fuel assortments**.
weight and water content	The weight determination is **done mostly with in-house scales** and is often more complicated than the volume determination. Because of the disadvantages mentioned above this billing model is **more suitable for inhomogeneous fuels.** To increase the accuracy in the determination of the energy content an additional **water content measurement is required.** In a clearing on the weight and water content, the type of wood is negligible, as all wood species have an almost identical calorific value per kilogram of wood.
generated heat quantity	The advantages of this method are the **reduced metrological effort at the fuel delivery** (a quality control can usually not yet discontinued) and **high measurement accuracy.** However, **systematic measurement errors may be occur during the operation of the plant;** contamination of the boilers´ flues can result in higher temperatures and thus in lower effectiveness. This method is **only useful when the reference biomass is delivered exclusively from one supplier**, since otherwise a clear assignment is getting difficult.

Recommendations for biomass delivery contract

Ash disposal

For the sake of simplicity the customers often indenture the supplier to dispose the ashes. However this is not necessarily the least expensive solution. Because the disposal of ash is not the core activity of the supplier and the delivery vehicles cannot be used for the removal of ash, **the ash disposal by specialized companies is commonly more cost effective.**

But it is difficult to make a blanket statement, because there are **differences in starting conditions in the EU-countries.** For example in Denmark commissioning of a company that takes care of the ashes will increase the costs due to high labour costs and taxes. So it is recommended to consider alternatives.

Recommendations for biomass delivery contract

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Recommendations for biomass delivery contract

Model Contracts

- specific contractual terms are discussed in detail and examples of good practice are shown.
- Where possible, formulation aids are added, too. But - due to the specific conditions of each heating plant **- in any case a legal aid should be consulted to elaborate the biomass supply contract**.
- To provide quick access to the information needed, this chapter contains 3 sections. Each is focused on one of the various solid biomass fuels – woodchips, pellets, straw.
- Preliminary for each fuel general information of trade and measurement as well as quality requirements are given.