Supply with biomass heat
Experiences from practice

Dr. Torsten Schmidt-Baum
November 4th 2016
CRES
Profitability of wood combustion dependencies

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

Fuel
- Water content
- Size
- Wood type
- Origin

Local conditions
- Storage facilities
- Delivery vehicles
- Technology
Time course of heat load (building with 2.200 full hours of operation)
Sorted annual load curve
Pellets or Woodchips?

- Hospitals, local heat network
- Schools, swimming halls, nursing facilities
- Town halls, administerial buildings > 50,000 inhabitants, schools
- Sport halls, smaller schools, building yard, hotels
- Town halls (up to 10,000 inhabitants), sport halls,
- Multi-family-house, Kindergarten
- 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)
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

**Graph:**
- X-axis: Boiler Capacity [kW]
- Y-axis: Investment in €
- The graph shows three lines with different slopes, indicating varying investment costs based on boiler capacity.
Investment in plant engineering as a function of the boiler capacity
Comparison of different plant concepts

<table>
<thead>
<tr>
<th>Year</th>
<th>Wood</th>
<th>Gas</th>
<th>Total</th>
<th>Wood Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>2.519.000</td>
<td>280.000</td>
<td>2.799.000</td>
<td>90%</td>
</tr>
<tr>
<td>2014</td>
<td>1.899.000</td>
<td>343.000</td>
<td>2.242.000</td>
<td>85%</td>
</tr>
<tr>
<td>2015</td>
<td>2.087.000</td>
<td>328.000</td>
<td>2.415.000</td>
<td>86%</td>
</tr>
<tr>
<td>Average</td>
<td>2.168.333</td>
<td>317.000</td>
<td>2.485.333</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Capital service</th>
<th>Maintenance</th>
<th>Fuel</th>
<th>Power supply</th>
<th>Staff</th>
<th>Chimney Sweeper</th>
<th>Cost per Year</th>
<th>Heat output [€ / kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>240.000 €</td>
<td>60.000 €</td>
<td>4.000 €</td>
<td>475 €</td>
<td>88.000 €</td>
<td>600 €</td>
<td>7.000 €</td>
<td>154.561 €</td>
<td>0.0650 €</td>
</tr>
<tr>
<td></td>
<td>60.000 €</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0622 €</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.846 €</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.846 €</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>149.120 €</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fuel costs [€/kWh]**

- Wood: 0.0406 €
- Gas: 0.0600 €
- Total: 0.0600 €
## Comparison of different plant concepts

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Cost per Year</th>
<th>Heat Output [€/kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>240,000 €</td>
<td>60,000 €</td>
</tr>
<tr>
<td>Capital service</td>
<td>19,384 €</td>
<td>4,846 €</td>
</tr>
<tr>
<td>Maintenance</td>
<td>4,000 €</td>
<td>475 €</td>
</tr>
<tr>
<td>Fuel</td>
<td>88,000 €</td>
<td>19,020 €</td>
</tr>
<tr>
<td>Power supply</td>
<td>600 €</td>
<td>- €</td>
</tr>
<tr>
<td>Staff</td>
<td>7,000 €</td>
<td>- €</td>
</tr>
<tr>
<td>Chimney sweeper</td>
<td>180 €</td>
<td>120 €</td>
</tr>
<tr>
<td>Cost per year</td>
<td>119,164 €</td>
<td>24,461 €</td>
</tr>
<tr>
<td>Heat output [€/kWh]</td>
<td>0,0550 €</td>
<td>0,0772 €</td>
</tr>
</tbody>
</table>

### Fuel costs

<table>
<thead>
<tr>
<th>Price [€/kWh]</th>
<th>Cost [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>0.0222 €</td>
</tr>
<tr>
<td>0.03</td>
<td>0.0322 €</td>
</tr>
<tr>
<td>0.04</td>
<td>0.0422 €</td>
</tr>
<tr>
<td>0.05</td>
<td>0.0522 €</td>
</tr>
<tr>
<td>0.06</td>
<td>0.0622 €</td>
</tr>
<tr>
<td>0.07</td>
<td>0.0722 €</td>
</tr>
<tr>
<td>0.08</td>
<td>0.0822 €</td>
</tr>
</tbody>
</table>

### Gas price

<table>
<thead>
<tr>
<th>Price [€/kWh]</th>
<th>Cost [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>55.148 €</td>
</tr>
<tr>
<td>0.03</td>
<td>80.001 €</td>
</tr>
<tr>
<td>0.04</td>
<td>104.854 €</td>
</tr>
<tr>
<td>0.05</td>
<td>129.708 €</td>
</tr>
<tr>
<td>0.06</td>
<td>154.561 €</td>
</tr>
<tr>
<td>0.07</td>
<td>179.414 €</td>
</tr>
<tr>
<td>0.08</td>
<td>204.258 €</td>
</tr>
</tbody>
</table>
Comparison of different plant concepts

Cost per year

- €
  - Holz
  - 0.02
  - 0.03
  - 0.04
  - 0.05
  - 0.06
  - 0.07
  - 0.08

250.000 €
200.000 €
150.000 €
100.000 €
50.000 €
Comparison of different plant concepts

Influence of fuel cost increase on the heat price
## Recommendation for heat supply contract

<table>
<thead>
<tr>
<th>Essential contract contents</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delivery obligations</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Purchase commitment</strong></td>
<td>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).</td>
</tr>
</tbody>
</table>
### Recommendations for heat supply contract

<table>
<thead>
<tr>
<th>Essential contract contents</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Duration</td>
<td>It is advisable to agree a term of <strong>at least 5 years</strong>. 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.</td>
</tr>
<tr>
<td>Remuneration arrangements</td>
<td>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.</td>
</tr>
<tr>
<td>Measurement of heat consumption</td>
<td>the heat supplier should normally use measuring devices to determine the consumption according to the legal requirements</td>
</tr>
<tr>
<td>Price change clause</td>
<td>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.</td>
</tr>
</tbody>
</table>
# Recommendations Design of heat price

<table>
<thead>
<tr>
<th>Essential contract contents</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic price</td>
<td>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.</td>
</tr>
<tr>
<td>Price per kWh</td>
<td>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.</td>
</tr>
<tr>
<td>Annual Price for the measurement of heat consumption</td>
<td>Determination according to the re-acquisition values of the heat quantity counters and the costs for their read-out.</td>
</tr>
</tbody>
</table>
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
ca. 2,7 m
ca. 4 m
ca. 3,0 m
400 kW
Erdgas
1 m
2,6 m
ca. 1,7 m
110 kW Pellet
1,0 m
1,5 m
Puffer 3.300 l
Verteiler

Wartungsfläche
Anlagenbeispiele 2
Anlagenbeispiele 3
Prinzipielle Darstellung der Wärmeerzeugung im Heizkessel verglichen mit der Wärme- und Stromerzeugung in einer KWK-Anlage
Kosten der Wärmebereitstellung

Kapitalgebundene Kosten
Umrechnung der Investition und Installation in jährliche Kosten

Geräte

Verbrauchsgebundene Kosten
Energie, Hilfsenergie

Energie

Betriebsgebundene Kosten
Wartung, Instandhaltung, Bedienung

Wartung
Wirtschaftlichkeitsvergleich
Schule mit Hallenbad; 620 kW, 220 kW Holz
Wärmelieferung im Contracting

Brennstofflager

Kesselanlage

Nahwärmenetz

Planung, Bau, Finanzierung,
Logistik, Betrieb, Wartung, Instandhaltung,
Notdienst, Messung, Abrechnung, Verwaltung

Contractor

Kunde
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%

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 ab 101 kW

Vorfeldberatung / OC bei konkreten Vorhaben von:
automatischen Holzfeuerungsanlagen (HHS, Pellets) & Nahwärmennetzen 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 thereby determines the rights and obligations of the heat supplier and the customer.
# Recommendations for biomass delivery contract

<table>
<thead>
<tr>
<th>Essential contract contents</th>
<th>Details</th>
</tr>
</thead>
</table>
| **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.*
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 account, for example, that some are only suitable for basic load, others for base and peak load.
• The problem of availability (e.g., irradiation-dependent power in solar thermal energy) is also to be explained, or suitable solutions (e.g., memories) are to be presented.
• Furthermore, technically possible and economically reasonable interfaces for the energy distribution have to be defined (essentially the feed temperature and return temperature).
• Planning of heat distribution systems
• The planning of the heat distribution system requires, in the first step, the establishment of the preliminary network structure, which is based on local requirements.
• Depending on the selected operating temperatures, a suitable pipe / laying system or a combination of different systems can be selected (if necessary, case separation) and the local heating network can be dimensioned. In this connection, the pipeline construction has to be coordinated with the other development measures (sewage, roads, etc.) and building production.
• Customer connection / home stations
• Depending on the possible operating temperatures / pressures (domestic installation, hot water production), the most cost-effective variants have to be selected and dimensioned for the customer connection or the house stations. Here, too, a case differentiation should be made depending on possible operating temperatures.
• Optimization of the overall system
• The optimization of the overall system as an iterative process is usually based on a pre-selection of the heat generator based on the local specifications. In this context, not only economic but also political factors (subsidies, pilot projects, image gain, etc.) are often the focus. Unfortunately, in some cases the technological wisdom solution and the economic sense are not sufficiently balanced.
• Not the maximum environmental pollution at any cost, but the low-cost environmental protection will lead to a sustainable expansion of environmentally compatible local and district heating.
• A key objective is the system optimization, in which the operating temperatures in the area of the heat distribution network and the house stations determine the costs and the system design (flexible plastic medium pipes, direct integration of the house stations) within the framework of the technical requirements through heat generation.
• The degrees of freedom in the operating pressures are, inter alia, due to topographical conditions and network expansion.
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 (“economically desirable”) and opponents (“unnecessary, deterrent enforcement”). Taking account of advantages and disadvantages, a viable decision has to be taken, taking into account the local possibilities and taking advantage of room for maneuver.

A market-strategic decision is the apportionment of the investment costs for connection, provision and consumption costs. In addition to the house connection costs (house connection), the costs of the grid production can be transferred as a building cost subsidy up to 70% according to § 9 AVBFernwärmeV to the connection. This can lead to a cost of investment for the customer, which is equivalent to a decentralized single furnace. Alternatively, part of the costs can be charged as a monthly connection or provision fee or as a partial operating cost, in order to offer the customer an attractive offer and to achieve the highest possible degree of connection.

The choice of the operator and the financing decisively influences the feasibility of the projected procedure (operating / financing models).
• 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 $t_{\text{Norm}}$ and the frequency of the various outside temperatures which are associated with the standard heat demand can be taken either from known regulators ([DIN4710]) or from weather services. The linear relationship between the external temperature and the heat demand is shown graphically (Figure).

In addition to the known value pair (standard outside temperature / standard heat demand), a heating limit temperature $t_{\text{HGr}}$ of 15°C is set for the construction, from which no room heat is removed. With this functional dependence and the temperature distributions mentioned above, the corresponding annual duration curves can be constructed by assigning a heat demand value to each outside temperature. With the data of [DIN4710] the following average annual temperature distribution is obtained for the city of Essen: see picture on the left.

In the case of a supply object with a standard heat demand of 500 kW and with the aid of the standard outside temperature (according to DIN 4701 for food $10^\degree\text{C}$), the following yearly duration curve is obtained: Figure 2.5: Duration of the heat demand for the heating system for some hours per year. In Fig. 2.5 slightly higher than the standard heat demand. However, this is of secondary importance for the design of the heat generator. In addition to the external temperature-dependent heat requirement, a basic load share (depending on the object) has to be added (in the case of residential buildings by the use of hot water, in commercial or industrial buildings, use-dependent basic loads). With the hourly mean values given in DIN 4710 for the various months, characteristic daytime curves could be determined in the same way. However, since these values are mean values over all days of a month and thus individual peak values are strongly attenuated, a different calculation should not be based on the DIN values but on other sources.
• 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 temperature and the heat requirement, a sufficiently exact year-duration line can be constructed. The picture shows the heat-year duration line for a residential settlement. The pronounced peak load and the basic load are clearly visible. The annual consumption corresponds to the area under the permanent line. Characteristic for residential settlements is the almost constant hot water demand and the ambient temperature-dependent room heat demand. Typical full hours of use of the connection values are 1500 h/annum or 1700 h/annum (with service water).
• financing 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

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

<table>
<thead>
<tr>
<th>Essential contract contents</th>
<th>Details</th>
</tr>
</thead>
</table>
| **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 |
| **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**

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.

- **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.
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.