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Energy

Planning and financing of Renewable Energy Projects

Heat and Power Generation from Renewable Energy Resources: Biomass, Biogas, Cogeneration Technologies
Vilnius, November 17th, 2009
Dirk Volkmann

www.german-renewable-energy.com

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content

- biogenic fuels
- technology of supply and preparation of fuels
- legal framework
- cost and economics
- finance
- set-up of a bio-energy project
- first project evaluation
- implementation of the project

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Energy

biogenic fuels

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resource base

- annual global primary production of biomass is approx. 220 billion to DS or 4,500 exajoules
- theoretically harvestable are 2,900 exajoules, of which 270 exajoules (equivalent to 2,300 GW) are considered technically available on a sustainable basis.
- the challenge is logistics: sustainable management, conversion and delivery to the market

1 exajoule is equivalent to 2.78 x 108 MWh

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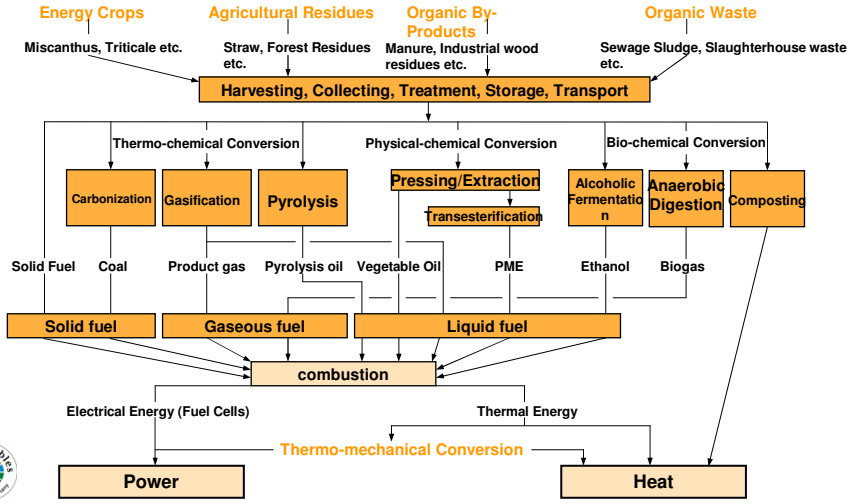
Biomass as a source of energy



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raw material for bio-energy

- biogenic solid fuels
  - pellets (wood)
  - wood chips
  - logs (wood)
  - industrial fuel (wood)
  - agricultural biomass (straw)
- gaseous fuels (biogas)
- liquid bio-energy sources (vegetable oil, RME, ethanol)




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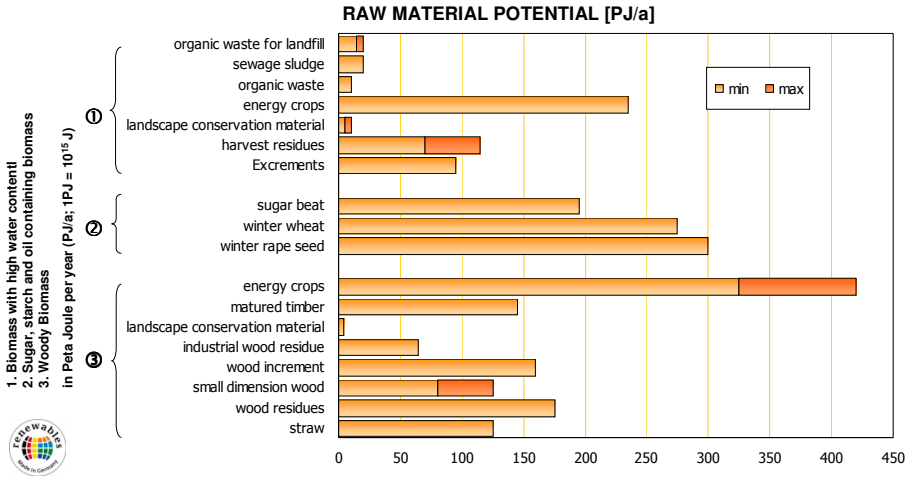
Technical potentials of biomass in Germany



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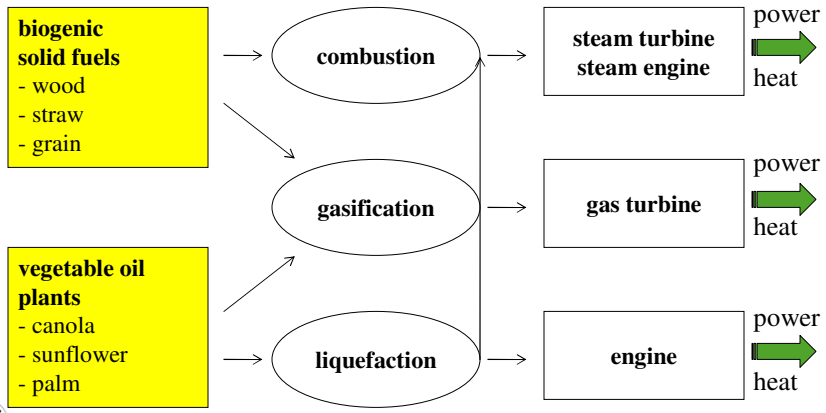
utilization of biomass in CHP plants



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size of biomass combustion technologies

process	technology
Pellet combustor 10 .... 50 kW (Pellets)	Boiler plant with 10 to 50 kW thermal output for exclusive production of heat or to power a sterling motor (only with wood pellets) fuel: wood pellets, straw pellets
Small size combustor 10 kW .... 1 MW (wood, straw)	Boiler plant with 10 to 1,000 kW thermal output for exclusive production of heat fuel: clean non-polluted wood, straw
Heating station 0,5 .... 5 MW (wood, stoker, grate)	Boiler plant with 50 to 5,000 kW thermal output for exclusive production of heat or to power ORC / Kalina-power processes fuel: clean non-polluted wood, straw
Power plants 10 .... 20 MW (wood, grate, steam turbine)	Boiler plant with combined steam power process (steam turbine) for power production or coupled/uncoupled power and heat production fuel: clean unpolluted wood, scrap lumber, straw, residues
Co-firing in large coal power plants 5 .... 200 MW (wood)	Facilities for storage, processing and combustion of solid biomass in existing coal or gas fired power plants. thermal output of co-firing 5 to 200 MW fuel: clean unpolluted wood, scrap lumber, straw, residues

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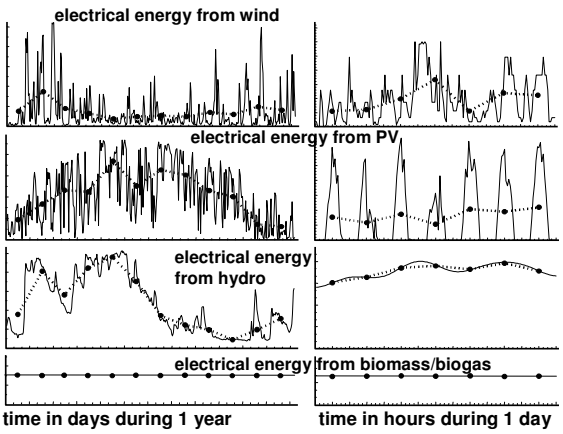
system comparison with other RE



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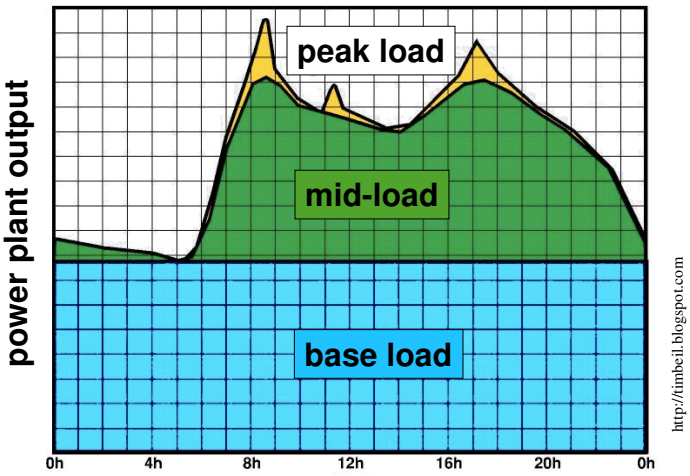
load distribution



http://timbeil.blogspot.com

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the German power grid

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technology of supply and preparation of fuels

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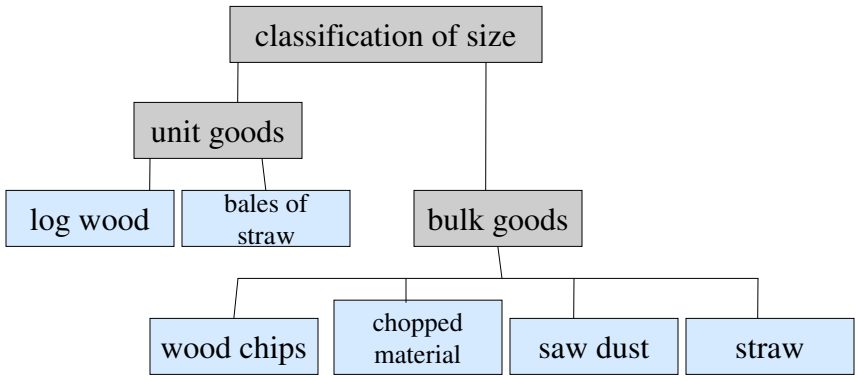
treatment, storage and transport



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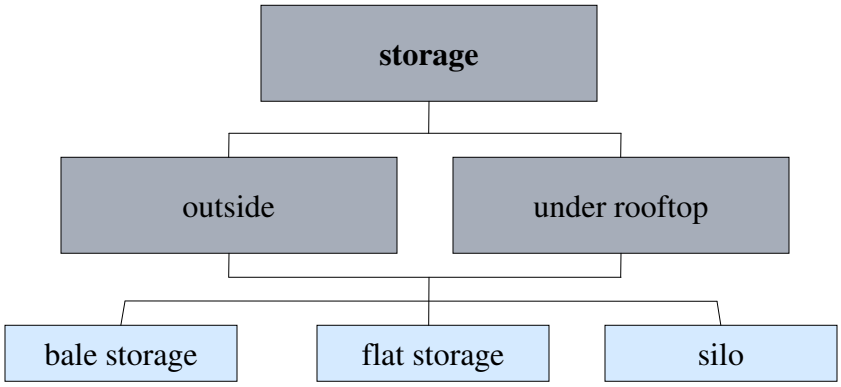
treatment, storage and transport



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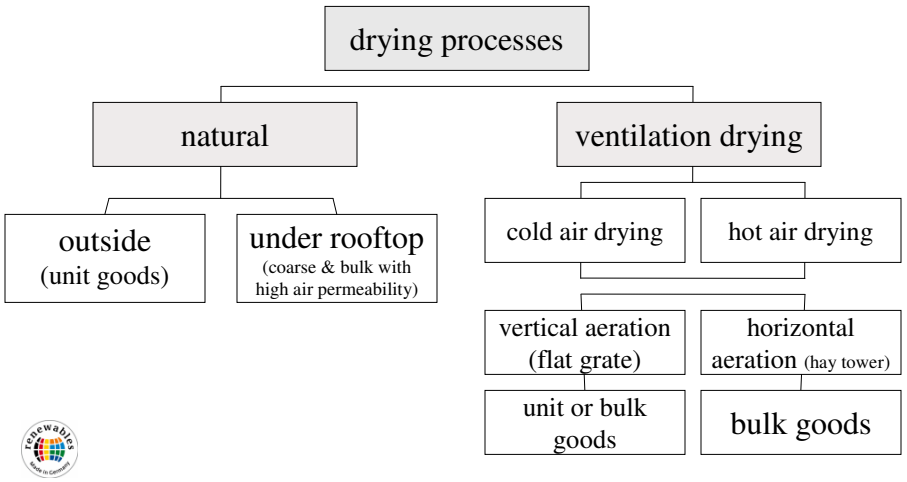
treatment, storage and transport



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legal framework

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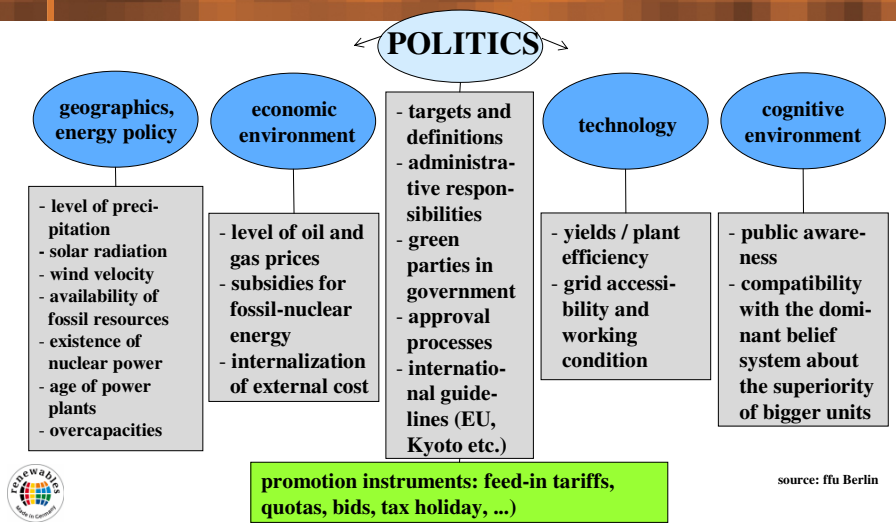
factors which influence the utilization of Renewables



source: ffu Berlin

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various instruments to promote the expansion of the energy infrastructure – the European example

- liberation of the regulation
- grid development plan (infrastructure for the coming 10 years)
- financial subsidies
  - guidelines about trans European power grids (TEN-E-guidelines)
  - European energy program for economic recovery (EEPR)
  - national economic recovery programs
  - loans of the European Investment Bank

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various instruments to promote the expansion of the energy infrastructure – the European example

- in addition autonomous national procedures
  - obligation of the grid operator for the expansion of the grid in favor of Renewable Energy, § 9 EEG
  - liability for damages in case of culpable delay or omission of the expansion of the grid, § 10 EEG

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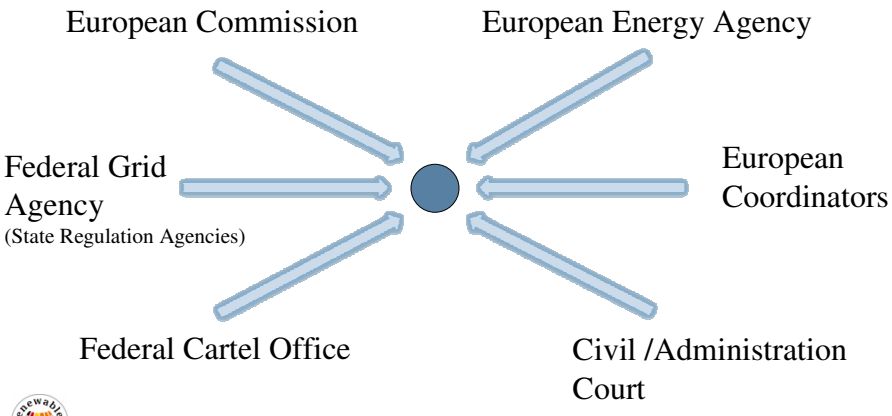
multitude of stakeholders – the European example



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cost and economics

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economic requirements

- the plant has to flexible for the production of power and heat
- the plant has to produce power with the highest degree of efficiency, as payments for power are better than for heat
- as biomass storage is limited due to the low energy density, the plant should be capable to process different type of fuel

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structure of revenues & expenditures for biomass plants

CAPEX - net investment cost - extra expenses for planning, approvals and expertise - prepaid tax / VAT - interest during construction - miscellaneous **OPEX** - fuel cost - cost of O & M - cost of insurance and tax - employment cost - cost of materials & supplies	**revenues** -earnings from sale of power and heat - grants, bonuses, subsidies, and the like **promotion and incentive programs** - feed-in tariffs

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retail purchase prices for used timber in Germany

July 2009 prices in €/to

	July 09	April 09	January 09	July 08
untreated used wood, abs. clean, wood chips (0-150 mm)	24 - 36	24 - 34	24 - 36	22 - 29
untreated used wood, abs. clean, wood chips (0-300 mm)	10 -24	10 - 22	13 - 25	8 - 20
treated used wood wood chips (0 – 150 mm)	10 - 33	10 - 32	9 - 30	6 - 19
treated used wood fractured (0 – 300 mm)	-8 - 17	-8 - 15	-8 - 12	-10 - 8
contaminated used wood wood chips (0 – 150 mm)	10 - 33	10 - 32	-2 - 30	-6 - 19
contaminated used wood fractured (0 – 300 mm)	-20 - 17	-20 - 15	-20 - 15	-20 - 8

source: EUWID 16/2009

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biomass direct combustion financial summary

performance	direct fired	co-fired
duty cycle	base load	base load
typical capacity factor	60 - 90	60 - 85
economics		
project cost (US$M/MWe)	1.5 – 3.5	0.3 – 0.5
fixed O&M (US$k/MW biomass/y	70 - 90	5 - 15
variable O&M (US$/MWh biomass)	10 - 15	1 - 3
levelized cost (US$/MWhe	70 - 120	5 - 30
commercial status		
estimated time to commercial	now	regulatory driven

source: Tiptree Investments Ltd.

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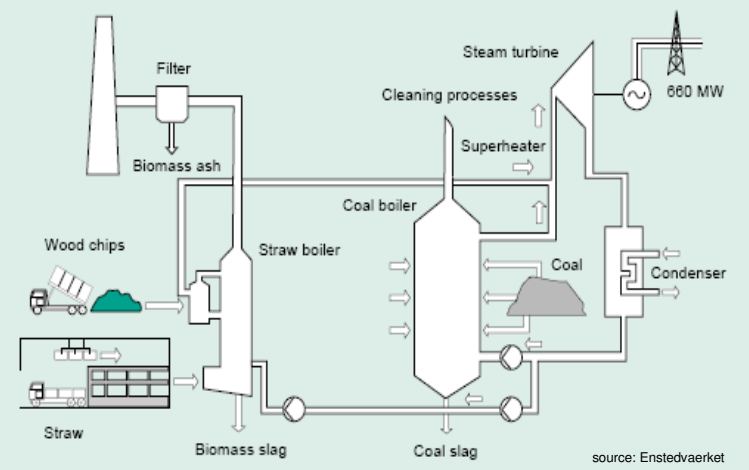
biomass fired boiler in a coal CHP power plant



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finance

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sources of finance

- equity
- debt capital
- from local and international banks
  (ADB, WB, KfW etc.)
- emission certificates
  - CDM / JI
  - Gold Standard
  - VER+

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set-up of a bio-energy project

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borderlines for the energetic utilization of biomass fuel

- main criteria
  - the specific characteristics of the bio fuel to be utilized
  - the specific properties with regard to the energy demand

  and
  - the best available technology for the energy production from solid biomass

    the selection of the combustion system depends, as the size of the plant, on the type of fuel (chips, chopped material, pellets or bales) available

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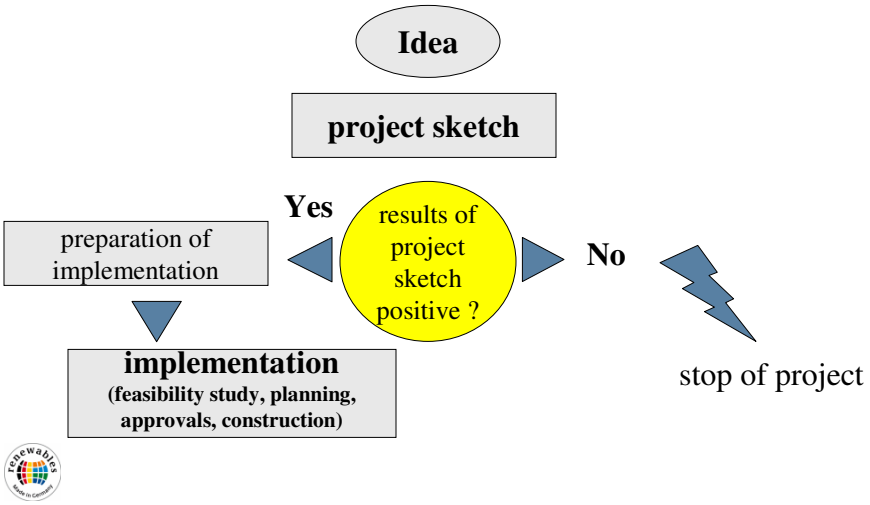
from idea to implementation



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content of a project sketch

technical aspects (technical rough concept)	economical aspects (economic estimate)	non-technical/non-economical aspects
definition of project conditions/limitations	rough estimate of the capital requirement	preliminary appraisal of project partners
identification of biomass quantities	rough estimate of the plant feasibility	assessment of duties to obtain permits
rough concept for the biomass supply chain	evaluation of possible subsidies	valuation of acceptance
technical plant requirements		preparation of next steps to implementation

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relevant environmental permits in Germany

effective output	relevant directive	Oxygen Vol.%	CO (g/Nm³)	total C (mg/Nm³)	No_x (mg/Nm³)	dust (mg/Nm³)
emission values for the combustion of untreated wood						
15 – 50 kW	1. BImSchV	13	4			150
50 – 150 kW	1. BImSchV	13	2			150
150 – 500 kW	1. BImSchV	13	1			150
500 – 1000 kW	1. BImSchV	13	0,5			150
1 – 5 MW	TA Luft	11	0,25	50	500	150
5 – 50 MW	TA Luft	11	0,25	50	500	50
emission values for the combustion of straw and similar plant material						
15 – 100 kW	1. BImSchV	13	4			150
100 kW–5MW	TA Luft	11	0,25	50	500	150
5 – 50 MW	TA Luft	11	0,25	50	500	50

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first project evaluation

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necessary steps for the technical concept

definition of project conditions / limitations	plant site data of energy consumer, including heat requirements
identification of available biomass quantities	biomass quantities average radius during one year time curve of supply fuel characteristics
rough concept for the biomass supply chain	type of delivery kind of long term storage kind of necessary treatment

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necessary steps for the technical concept

rough plant concept	number, type and size of plant(s) for the production of heat, power and/or cooling energy type of combustion technology type of power production flue gas cleaning design and operating parameters data of main components
civil concept	necessary floor area construction volume

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necessary steps for the technical concept

concept of heat distribution	length of main heat trench diameter of heat trench number of transfer stations
concept of power to the grid	feed-in access point to the grid and level of voltage agreement with the grid operator about the technical requirements for power feed-in

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implementation of the project

renewables Made in Germany

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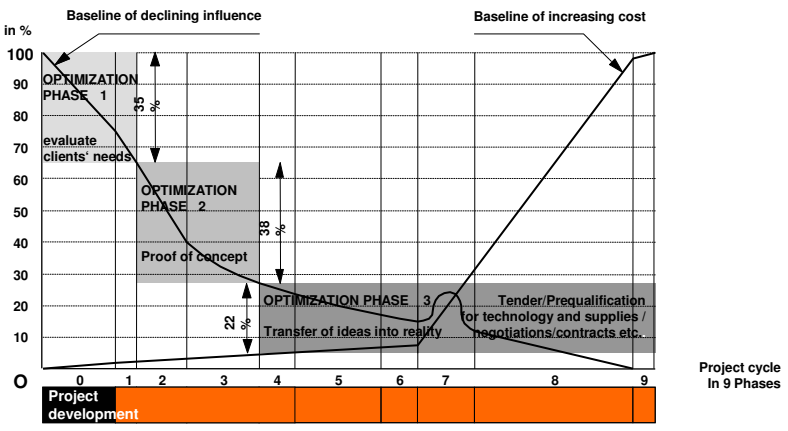
Ways of influencing a project during the execution

The better you plan in the beginning the less you pay during execution !



renewables Made in Germany

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PROJECT Example

Owner:	**Stadtwerke Leipzig GmbH**
Project:	**Biomass power plant Wittenberg-Piesteritz**
Capacity:	**1. 160.000 t/year fresh wood**
	2. 20 MW_{el} + 10 MW_{th}
	electrical efficiency 37 %
	total efficiency 50 %
Construction:	**2006 – 2009**

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The Challenge

- In the future all single options for the utilization of renewable energy have to be coordinated to a much higher extent AND have to be integrated a lot better into the existing energy system
- In Europe - and the rest of the world – trade in renewable energy will grow tremendously; for this reason all necessary measures have to be taken (introduction of standards).
- German companies and contractors have cutting-edge technology in some areas; this competitive edge needs to be further strengthened.
- PLUS: cost for the production of renewable energy has to be reduced further, also through upgrade in technology.

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