



**[ Gaßner, Groth, Siederer & Coll. ]**

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# **Training Course on Geothermal Electricity**

**Legal and financial aspects**

Potsdam – April 15, 2013

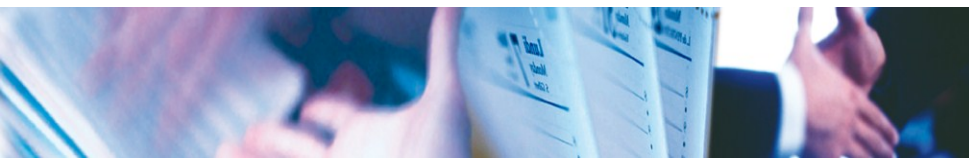




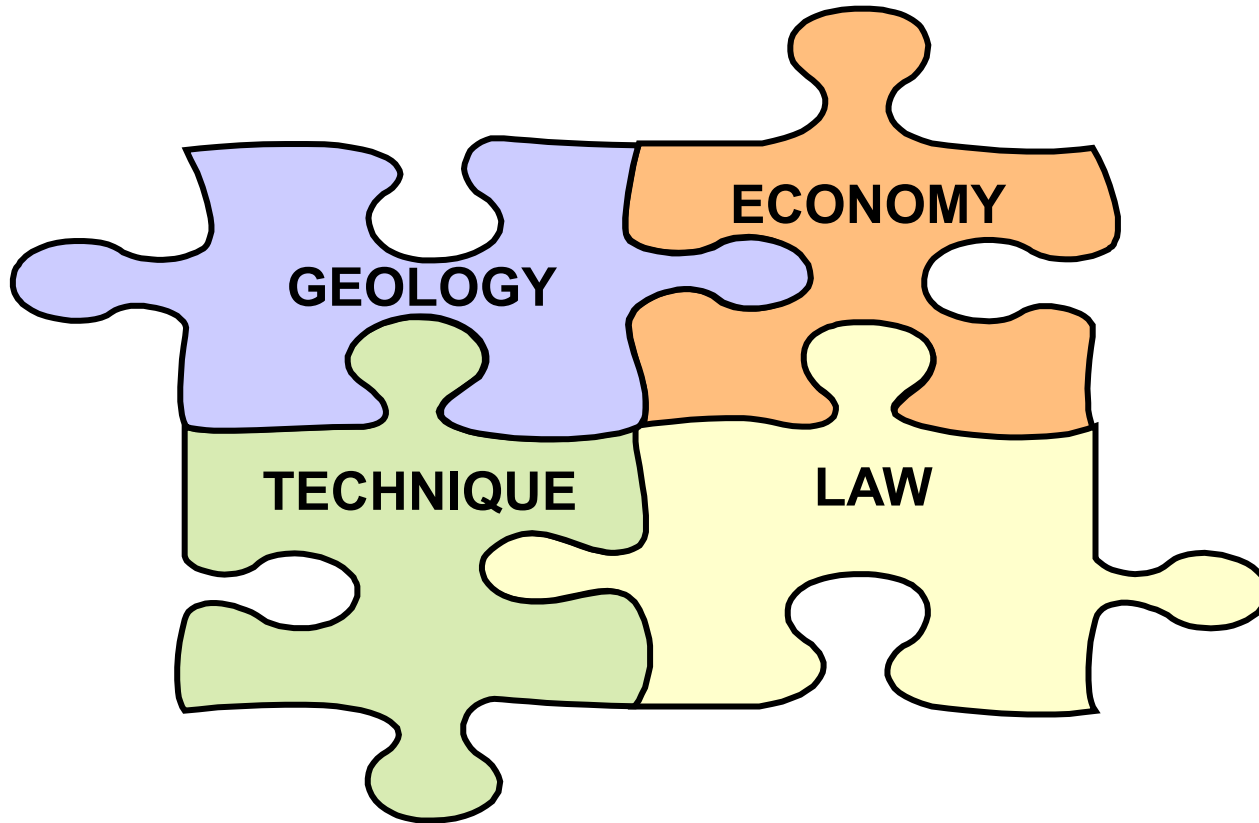
## The topics:

1. Processing of a geothermal project
2. Business environment for geothermal projects
3. Financing and their challenges
4. Economic analysis electricity generation
5. Project design – project optimization
6. Risks and their management
7. Summary geothermal power generation
8. About us





# 1. Successful processing of a geothermal project



## The challenge:

- to understand the total project
- to represent the interaction between individual disciplines
- to define the interfaces clearly
- ongoing and active exchange of information

➡ project evaluation / proposals for required activities



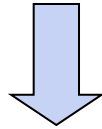
## Basical requirements

- choice of competent and experienced project partner
- careful and intensive preparation (ca. 2-3 years for planning and preparation)
- building of efficiently decision-making structures
- clearly definition of responsibilities
- creation of human capacities



## 2. Business environment for heat and electricity generation

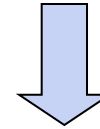
Geothermal **electricity** generation



feed-in tariff based on the  
Renewable Energy Sources Act (EEG)

fixed price per  
MWh – subsidized by all  
power customers

Geothermal **district heating**



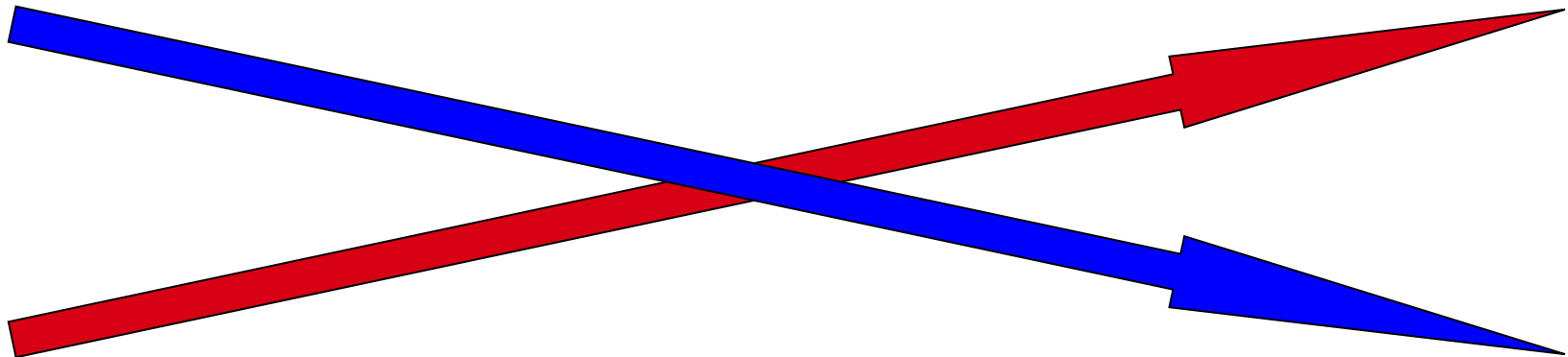
market heat-price

„marketable“ price  
competitive to traditional  
energies oil, gas, biomass etc.  
(almost) no subsidies



## Cashflow $\neq$ Cashflow

**typical development EBITDA electricity project**  
(revenues by feed-in tariff constant – expense increasing)



**typical development EBITDA district heating project**  
(expense increasing – revenues more increasing)



## Investment and financial need for geothermal projects

### „modular“ construction of projects

**exploration****1-3 Mio. €****wells****10-30 Mio. €****insurances****0,5-7 Mio. €****power plant (4-5 MW)****15-20 Mio. €****energy center****5-10 Mio. €****network****20-30 Mio. €**

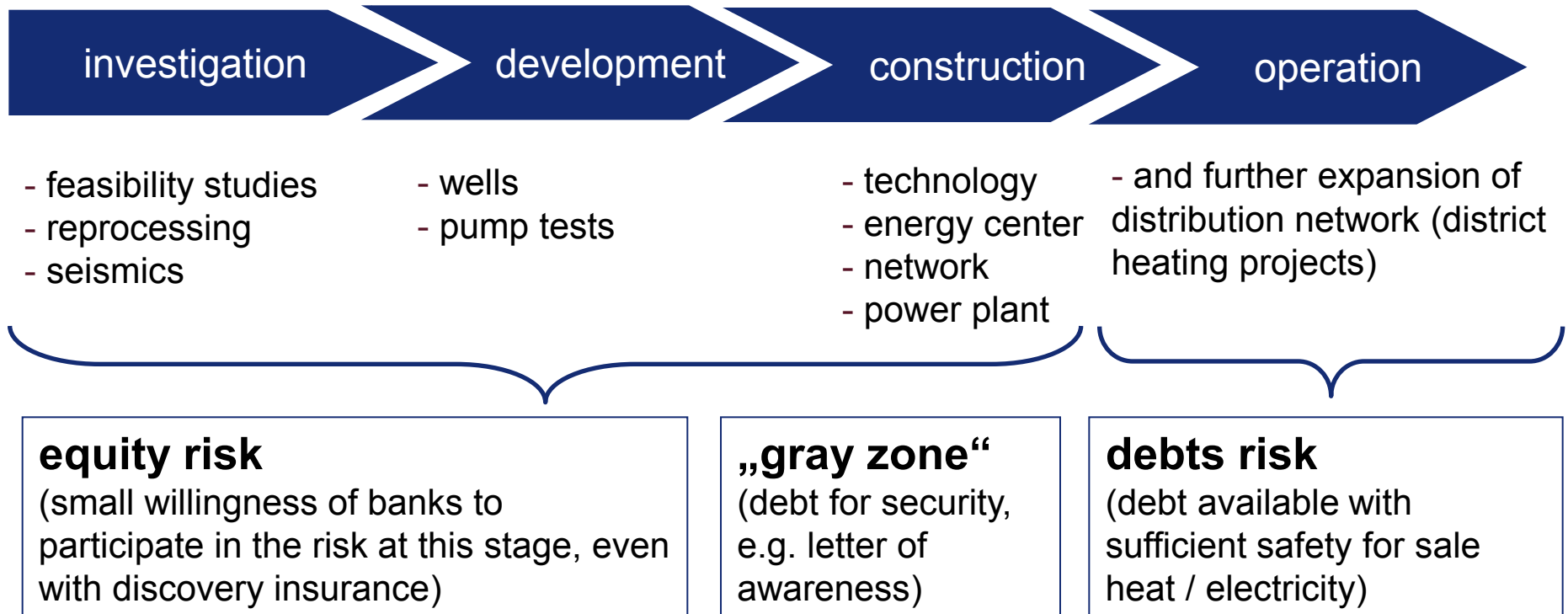
- typical project volume: 40 – 100 Mio. €
- depending on project type: electricity, district heating or combined project





### 3. Financing and their challenges

#### risk-based view of phases







## **(Economical) challenges of geothermal projects**

- significant investment
- higher levels of risk
- longer development time
- long-term expectation for the return



## Requirements of capital providers

- internal capital provider
  - risk-adequate return on equity  $> 10\%$ , usually 12 - 15% before taxes
- mezzanine capital provider
  - basic interest rate plus a success component
- external capital provider
  - secured ability to repay the capital (**cashflow!**)
  - risk-adequate interest on debt  $> 5\%$ , usually 6 - 7% (municipal 3 - 4%)
  - guarantees, covenants

➡ Capital costs (WACC)  $> 8\%$ , usually 8 - 10%

➡ Required amount of equity capital?



## Essential facts of the bank financing of geothermal projects

- risk of exploration: generally as risk of equity capital
- for the debt financing of the wells: banks want the most available hold-harmless agreement
- risk of drilling: corporate risk (or insurance)
- long-term experience on the power plan technology (or guarantees)
- when successful discovery the share of equity at least 30% of balance sheet
- term: 15-20 years (depending on the technical lifetime of the facility)
- debt service coverage ratio:  $>1,2$  (ratio between EBITDA and capital service)
- reserves, e.g. replacement pump
- integration of possible subsidies from national support



## Further „must haves“ for a project financing (from the banks' point of view)

- know-how:
  - renowned project partner (geology, technique, enonomy, operator ...)
  - project structure without interface risks
  - proven technology
- risk protection:
  - independent feasibility studies
  - receipt of all relevant permits
  - availability of substitute materials
  - feed-in tarif agreements, secure sales guarantee

➡ predictablity and guaranty of cashflow are crucial!



## 4. Economic analysis electricity generation

### „Simulation" of an EGS electricity project in Germany

Project features	
geothermal gradient in °C/100m	2
flow rate in l/s	50
delivery temperature in °C	165
temperature after power plant process in °C	60
number of wells	2
drilling depth per well in m	5.500
geothermal nominal capacity in kW <sub>th</sub>	<b>21.000</b>
electricity generation nominal capacity in kW <sub>el</sub>	<b>3.040</b>
degree of efficiency	14,75%



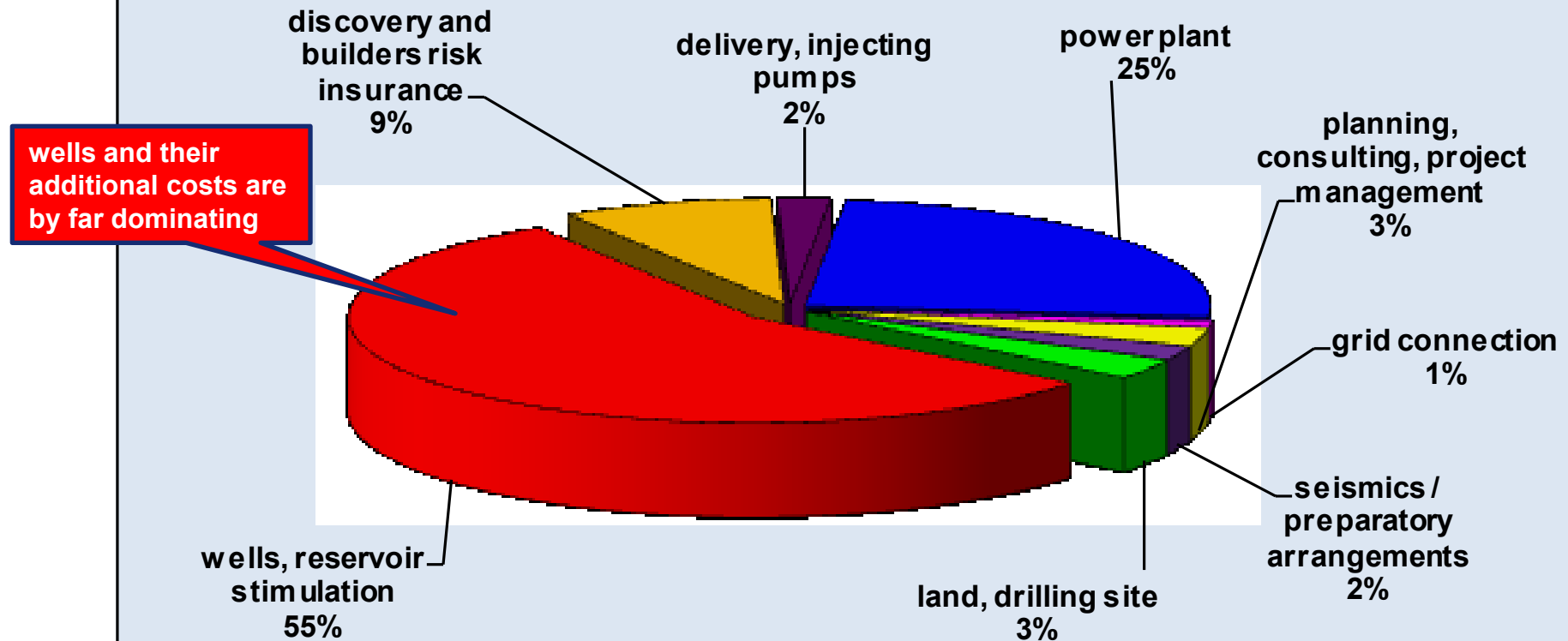
## Investment overview

	year 1	year 2	year 3	year 4	
seismics / preparatory arrangements	1.000.000	0	0	0	=> ca. 2 Mio. € / 1.000 m MD (wells >5.000 m TVD and 6 1/8" diameter at total depth including stimulation measures and contingencies)
land, drilling site	0	1.500.000	0	0	
wells, reservoir stimulation	0	0	26.800.000	0	constructors all risk insurance including lost in hole for both wells, discovery insurance for one well
discovery and builders risk insurance	0	0	4.060.000	0	
delivery, injecting pumps	0	0	0	1.020.000	
power plant	0	0	0	12.170.000	
grid connection	0	0	0	500.000	
planning, consulting, project management	0	450.000	450.000	450.000	
<b>SUM</b>	<b>1.000.000</b>	<b>1.950.000</b>	<b>31.310.000</b>	<b>14.140.000</b>	<b>48.400.000</b>

plus reinvestment of ca. 12 Mio. € for pumps and power plant field (if it is considered reasonable)



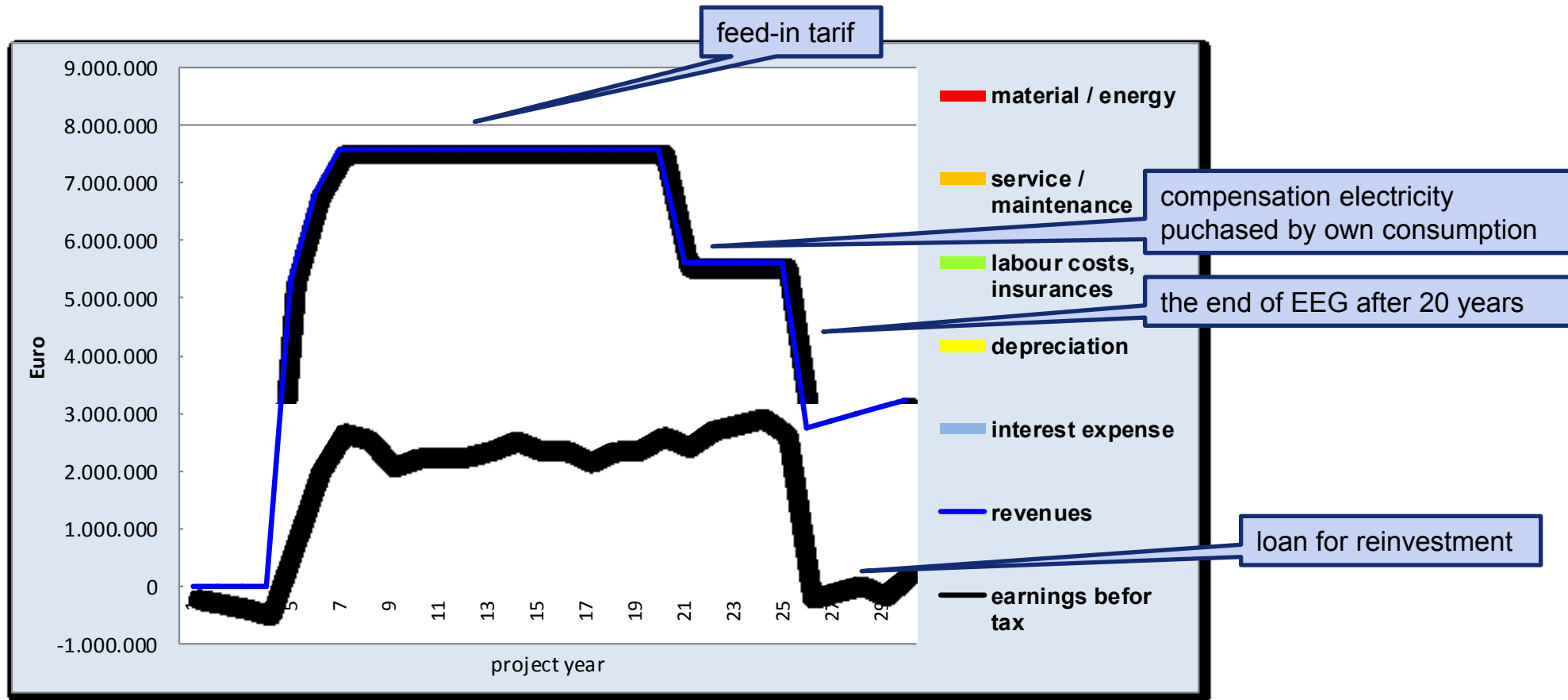
## division of project investments (without reinvestment)







## Expenses and income





## Finance (simplified)

- resource of needs
  - investment
  - negative cashflow

48,4 Mio. €

2,5 Mio. €

- resource of funds
  - equity
  - debts

34,1 Mio. €

16,8 Mio. €

The „classical“ financing in the construction phase:

→ equity for exploration and wells

In the operation phase:

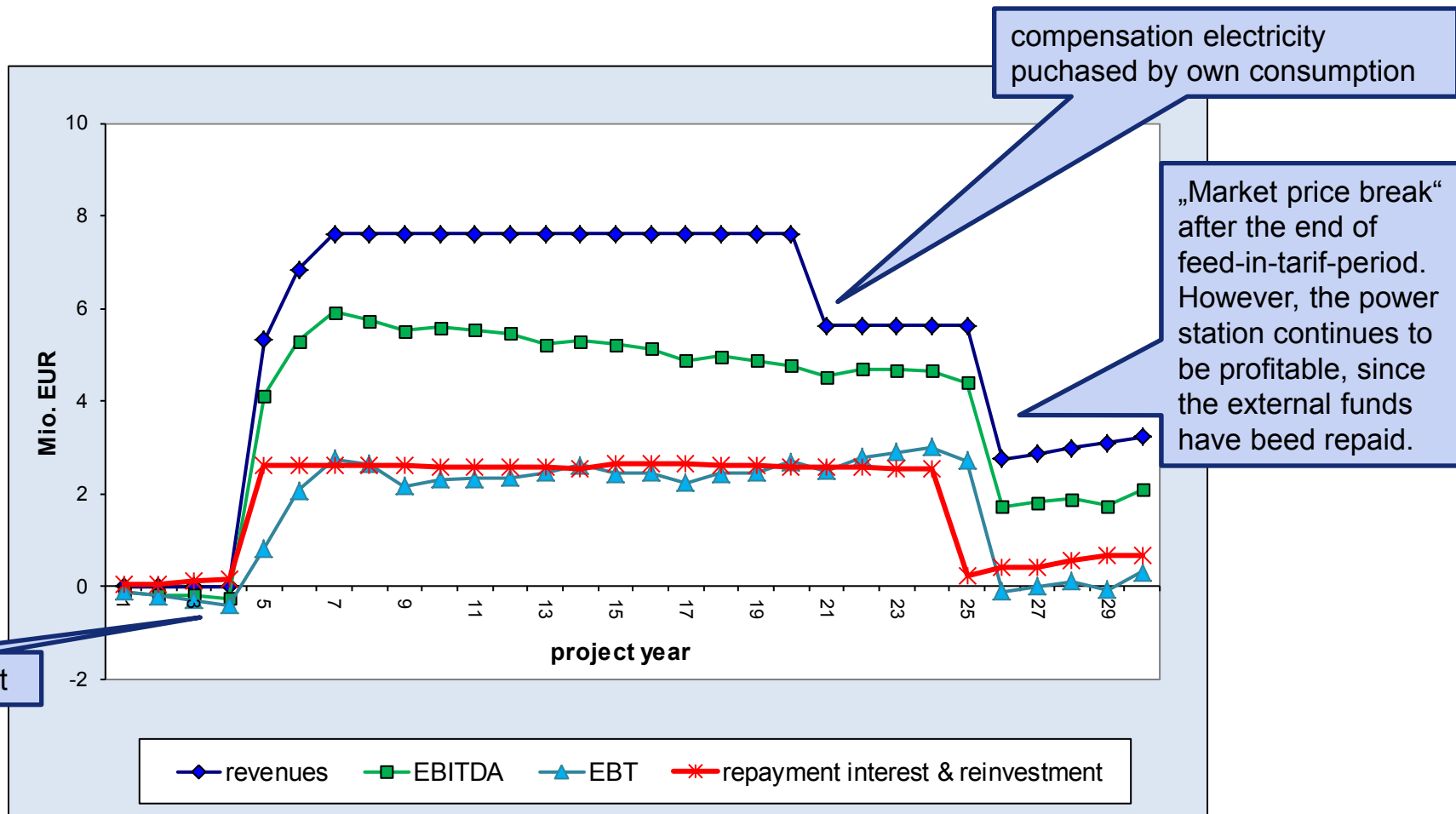
→ debt exchange based on the total project (here: 40%)

➡ without subsidies, as country-dependent

➡ detailed questions (e.g. the type of dividends) requiring coordination



## Project profitability





## Explanation

- break-even-point (BEP: the first positive return before taxes)
  - the electricity project achieves the BEP nearly by the start of operation
- electricity sales
  - initially assumed lower operating hours of the power plant (reserve), then continuous under the feed-in tariff (max. 300 € / MWh)
  - payment for supply to the grid remains constant over 21 years, after this period the sales depend on market value
  - once the sales fall below the electricity purchase price, the geothermal electricity is used itself
- earnings from the (remaining) heat sales are at this point not included, since here the potential vary from site to site



- EBITDA (earnings before interest, taxes, depreciation, amortisation)
  - the interest expense drops steadily while increasing electricity costs will cause a contrary trend
    - the declining curve is typical of electricity projects
  - important parameter for bank financing
    - EBITDA should always be significantly higher than the payment burden for debt repayment and interest

➡ debt service coverage ratio: → ca. 2,0

➡ the project is financially sound



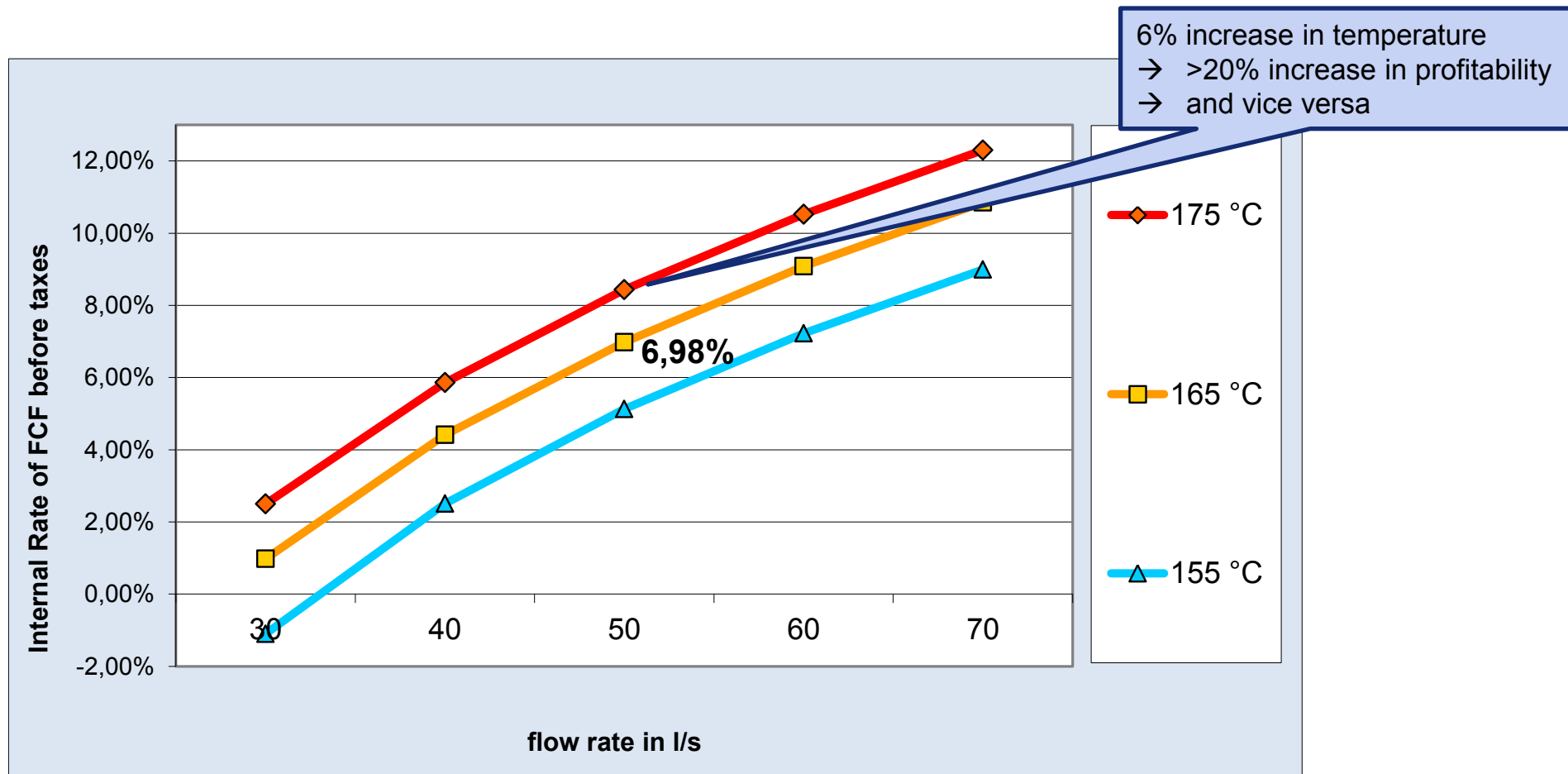
## Rate on return at electricity projects → ca. 6 - 10 %

- depending on:
  - geology and costs for development
  - consideration of process heat
  - capacity utilisation
  - used technology

➔ **the financing is ensured as long as the weighted capital costs from equity and borrowed capital lie below the project percentage**



## Profitability and geology – geology is crucial

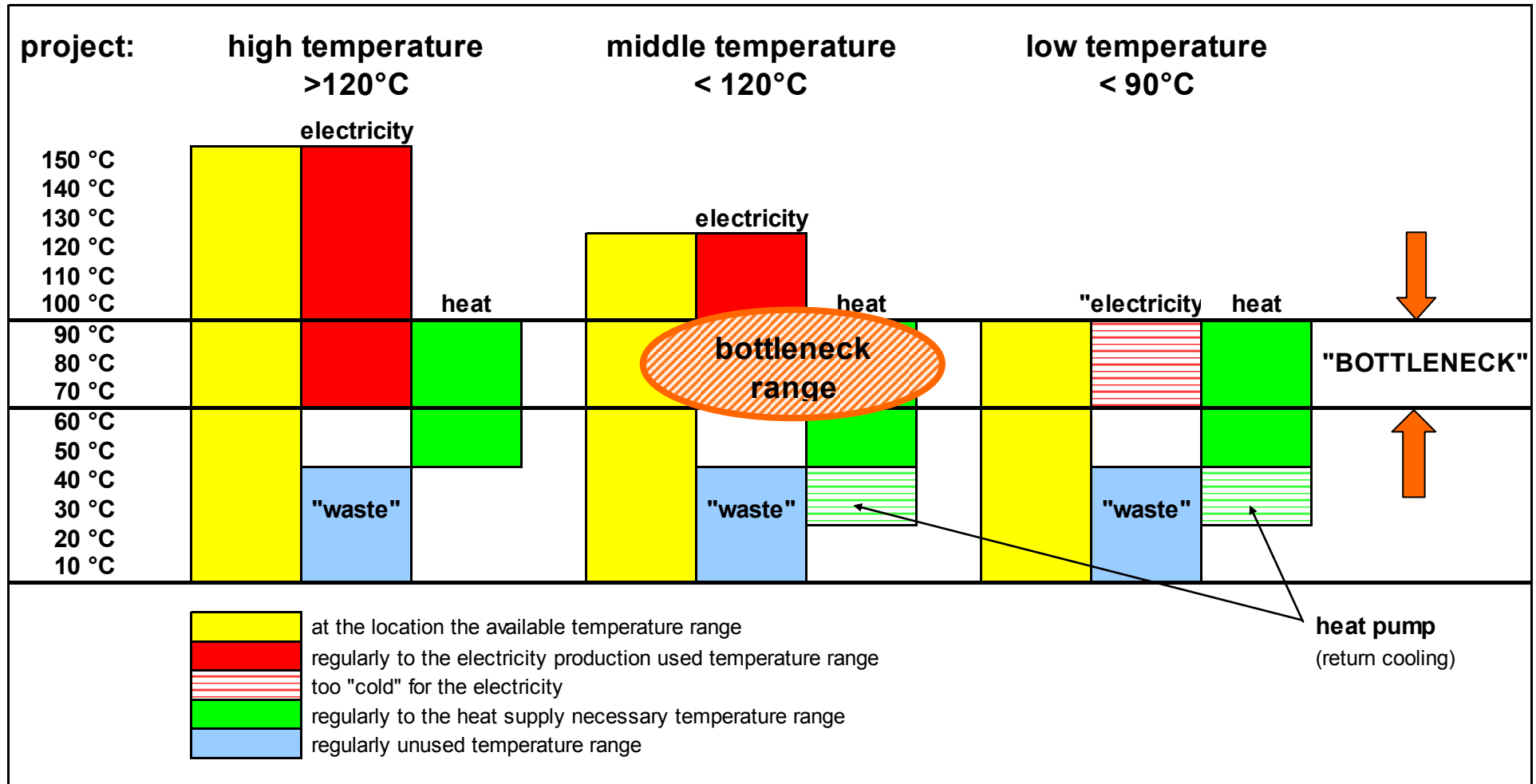






## 5. Project design – project optimization

	ELECTRICITY PROJECT	DISTRICT HEAT PROJECT
break-even point	fast, with operation of power plant	longer „dry spell“
majour investment	in the operation-stage (1-4 years)	in the operation-stage and network-stage
financing	predictable	more difficult to predict
distribution	guarantee for purchase and feed-in	competition
sales	constant, simply predictable by fixed feed-in tarif rates	price is market dependent
material	rising (price increase)	strong rising with expanded network
risk	discovery	discovery and distribution/sales





- District heating project

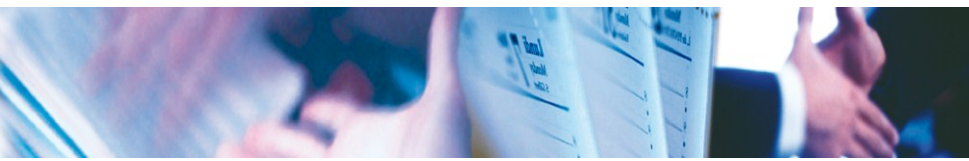
- peak load covering by additional energy source
- integration of a medium load component
- improved efficiency of the geothermal source by cooling the return flow via heat pump
- refinement of the medium load (second medium load component) etc.

➡ capital costs instead of „fuel costs“

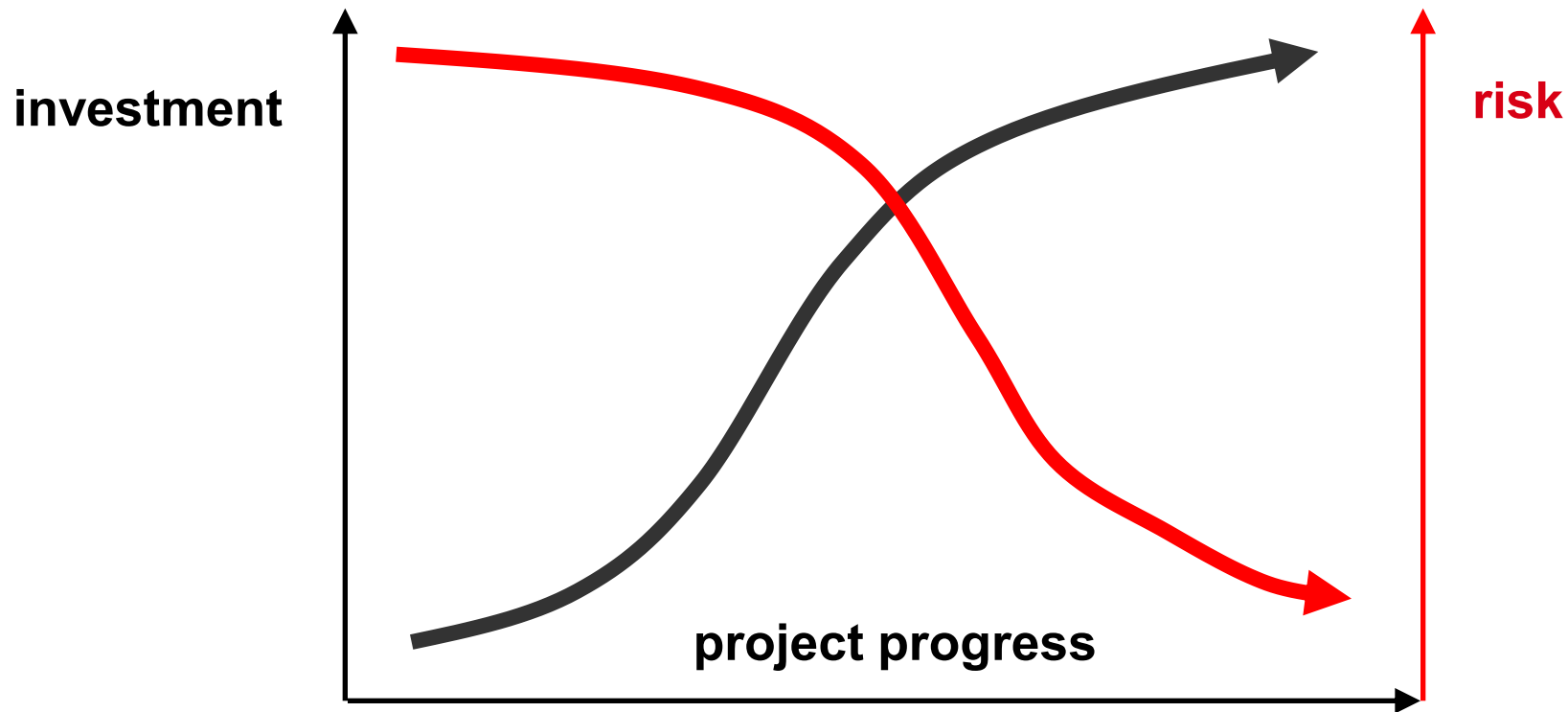
➡ maximum use of the most capital-intensive geothermal energy as base load



- Combined heat and power projects
  - heat-focused vs. power-focused  
(geothermal heating vs. amortization of the power station)
  - parallel vs. serial use of thermal water
  - regime change after power station amortization etc.
  - hybrid forms (heating the residual temperature of power plant for the heat use)
- The bottleneck situation is only partly solvable  
(especially with temperatures  $< 140^{\circ}\text{C}$ )
  - when no / less energy for heating is needed (day / night, summer / winter),  
the power station efficiency is approximately 30% below average!
  - „electricity in the summer and heat in the winter“ is a simplified concept



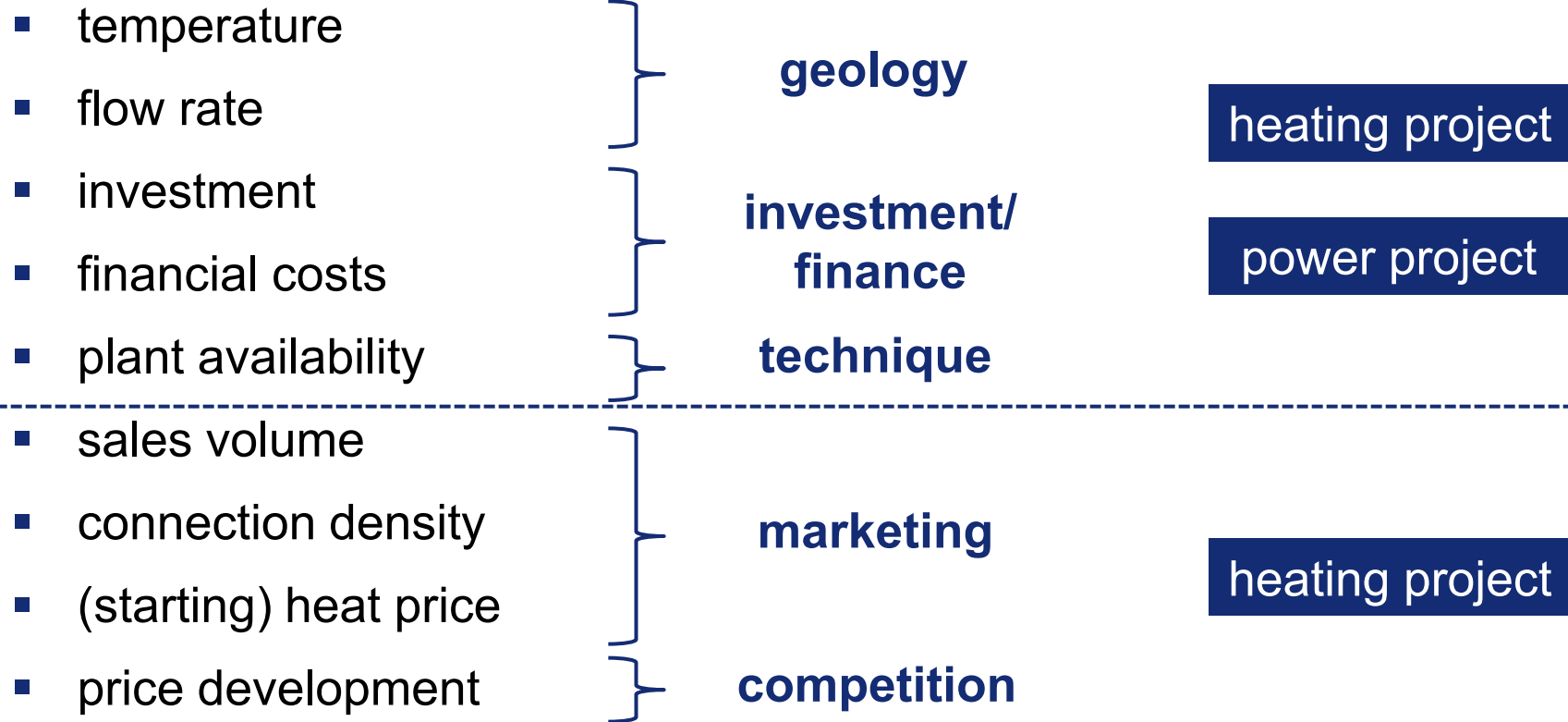
## 6. Risks and their management



➡ Much of the investment falls into the high-risk phase!



## Crucial parameters for the success





## The right risk strategy

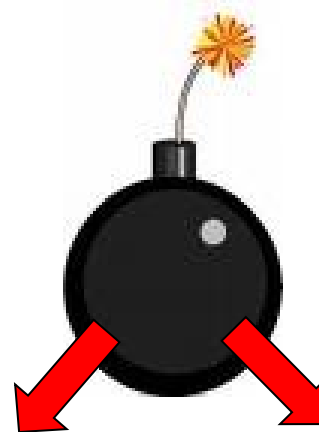
**risk  
PREVENTION**



**risk  
REDUCTION**



**risk  
TRANSFER**



**risk  
ACCEPTANCE**







## Risk management options

	RISKS	PROTECTION
GEOLOGY       TECHNIQUE	<ul style="list-style-type: none"> <li>- „failed“ discovery</li> <li>- „partially“ discovery</li> </ul>	<ul style="list-style-type: none"> <li>- feasibility studies, reprocessing, seismics</li> <li>- discovery insurance</li> </ul>
	<ul style="list-style-type: none"> <li>- drill target is not reachable</li> </ul>	<ul style="list-style-type: none"> <li>- quality of drilling company</li> <li>- drilling contract</li> <li>- drilling insurance</li> </ul>
	<ul style="list-style-type: none"> <li>- facility / operation</li> </ul>	<ul style="list-style-type: none"> <li>- quality of planning</li> <li>- know-how of operator</li> <li>- manufacturer warranties</li> <li>- storage (pump)</li> </ul>
ECONOMY  MARKETING	<ul style="list-style-type: none"> <li>- investment budget / financing</li> <li>- price development of alternative energies</li> <li>- distribution / sales</li> </ul>	<ul style="list-style-type: none"> <li>- businessplan, current update</li> <li>- financial flexibility (reserves)</li> <li>- contract design</li> </ul>



## Insurance coverage for the deep geothermal project

- business liability insurance
  - inkl. mining regulations
- constructors all risk insurance
  - damage-related costs for lost in hole of equipments, by-pass etc.
  - damage-related giving up of the borehole
- discovery insurance
  - coverage of the thermal capacity / energy potential

➡ necessary: agreement of insurance coverage

➡ helpful: supporting through experienced broker



## 7. Summary geothermal power generation

- The guarantee for a successful development of a geothermal project is not sure, but
- achievable by observing the following essential rules:
  - a good preparation in the phase of the start
  - careful planning of drilling, technique, financing
  - risk hedging
- Geothermal power projects are critically dependent on access to financing under attractive conditions



## 8. About us

- Gaßner, Groth, Siederer & Coll. [GGSC] are the leading German business & legal consultants for deep geothermal projects with multiple project references in district heating and electricity production as well as project due diligence.
- The [GGSC] business consultants are specialized in planning, financial modelling and risk management of renewable energy projects. The [GGSC] lawyers are experts in all corresponding legal aspects.
- Together with our specialised network partners we offer our guidance during the deep geothermal energy project and advise on all operational and economic questions – from the idea to its implementation.



## Project references

### National

- geothermal project Pullach (heat) – in realization ([www.iep-pullach.de](http://www.iep-pullach.de))
- geothermal project Aschheim/Feldkirchen/Kirchheim (heat) – in realization ([www.afk-geothermie.de](http://www.afk-geothermie.de))
- geothermal project Unterföhring (heat) – in realization ([www.geovol.de](http://www.geovol.de))
- geothermal project Mauerstetten/Kaufbeuren (electricity/heat) – switched to research EGS
- geothermal project Garching (heat) – in realization ([www.ewg-garching.de](http://www.ewg-garching.de))
- geothermal project Waldkraiburg (heat) – in realization
- geothermal project Ismaning (heat) – in realization
- geothermal project Holzkirchen (electricity/heat) – in realization
- geothermal project Taufkirchen/Oberhaching (electricity/heat) – in realization
- geothermal project Geretsried (electricity/heat) – in realization
- geothermal project Vaterstetten/Grasbrunn/Zorneding (heat) – in planning
- geothermal project Puchheim (heat) – in planning
- geothermal project Munster (electricity/heat) – in planning
- geothermal project Wunstorf (electricity/heat) – in planning
- various Due Diligences of geothermal projects for MVV AG, RWE Innogy GmbH, Axpo AG and further more ...

### International

- geothermal project Manchester (heat) – in planning ([www.gtenergy.net](http://www.gtenergy.net))
- geothermal project Dublin (heat) – in planning ([www.gtenergy.net](http://www.gtenergy.net))
- geothermal project Assal, Djibouti (electricity) – in planning (REI/Weltbank)
- East African Geothermal Initiative (electricity) – in planning (KfW with East African countries)
- Geothermal use in Estlandia – feasibility studies (Eestimaa Rohelised)



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**We thank you for your attention**

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