[Gaßner, Groth, Siederer & Coll.]

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Training Course on Geothermal Electricity

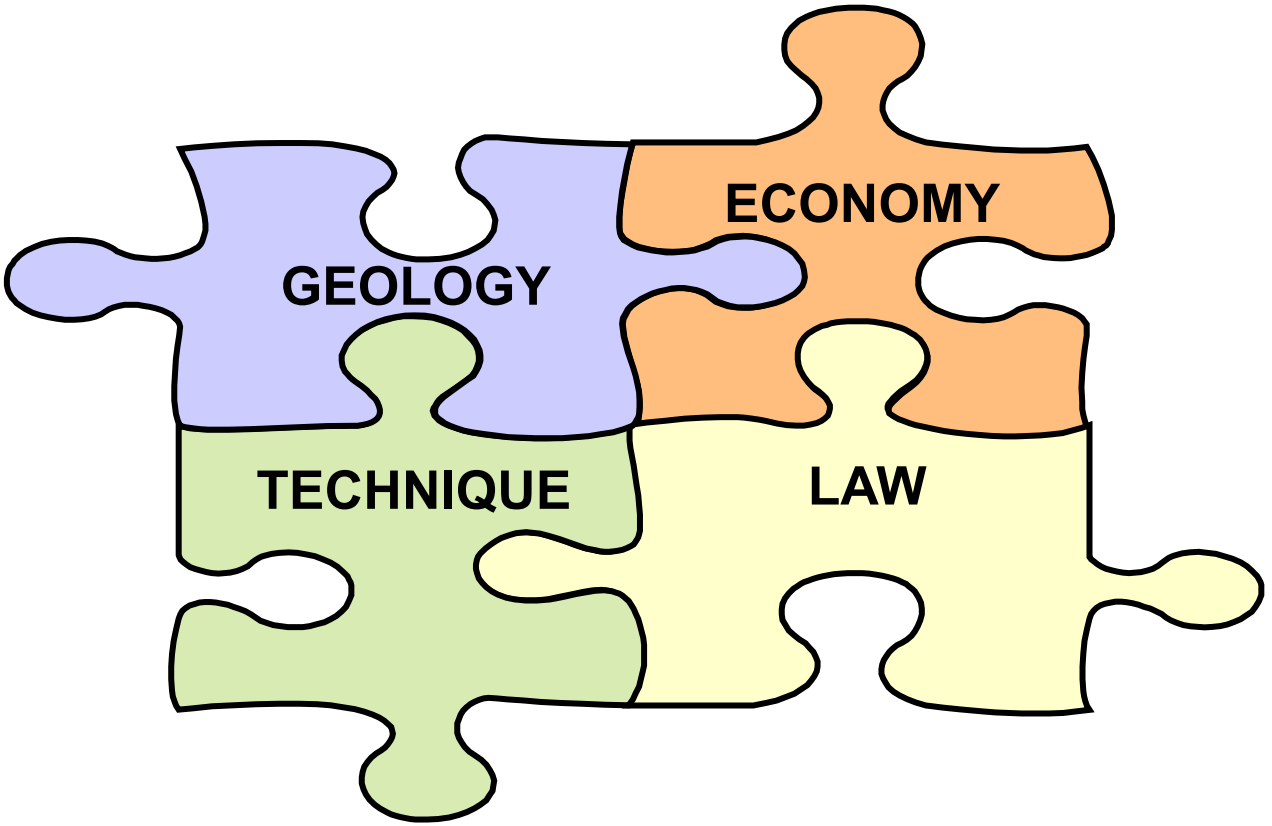
Legal and financial aspects

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. Successfull processing of a geothermal project



The challenge:

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

⇨ project evaluation / proposals for required activities

Basical requirements

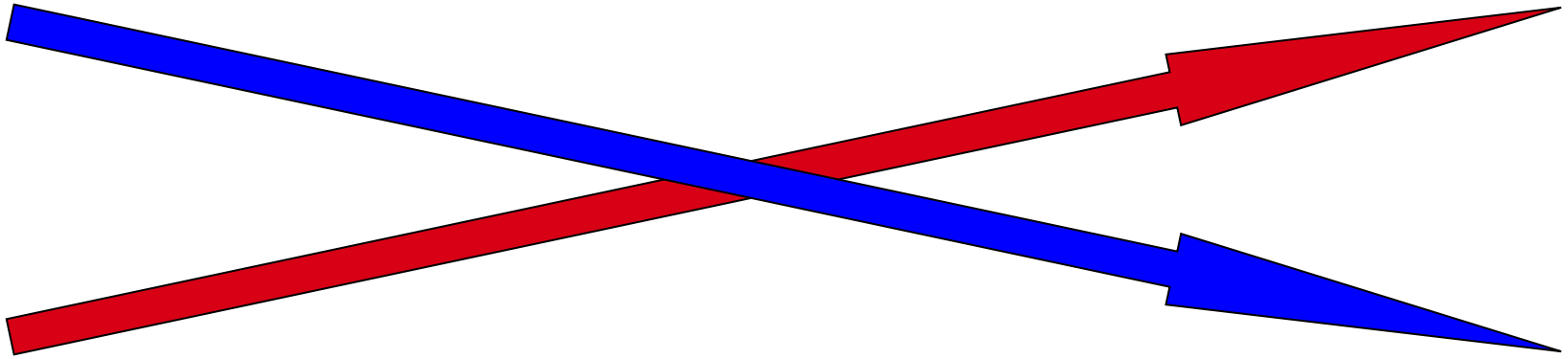
- choice of competent and experienced project partner
- careful and intensive preparation (ca. 2-3 years for planning and preparation)
- building of efficiently decision-making structures
- clearly definition of responsibilities
- creation of human capacities

2. Business environment for heat and electricity generation

Geothermal **electricity generation**	Geothermal **district heating**
feed-in tarif based on the Renewable Energy Sources Act (EEG)	market heat-price
fixed price per MWh – subsidized by all power customers	„marketable“ price competitive to traditional energies oil, gas, biomass etc. (almost) no subsidies

Cashflow ≠ Cashflow

typical development EBITDA electricity project
(revenues by feed-in tarif 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	wells	insurances
1-3 Mio. €	10-30 Mio. €	0,5-7 Mio. €

power plant (4-5 MW)	energy center	network
15-20 Mio. €	5-10 Mio. €	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

- feasibility studies
- reprocessing
- seismics

- wells
- pump tests

- technology
- energy center
- network
- power plant

- and further expansion of distribution network (district heating projects)

equity risk
(small willingness of banks to participate in the risk at this stage, even with discovery insurance)

„gray zone“
(debt for security, e.g. letter of awareness)

debts risk
(debt available with sufficient safety for sale heat / electricity)

(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 successfull 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!

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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_{th}	**21.000**
electricity generation nominal capacity in kW_{el}	**3.040**
degree of efficiency	14,75%

Investment overview

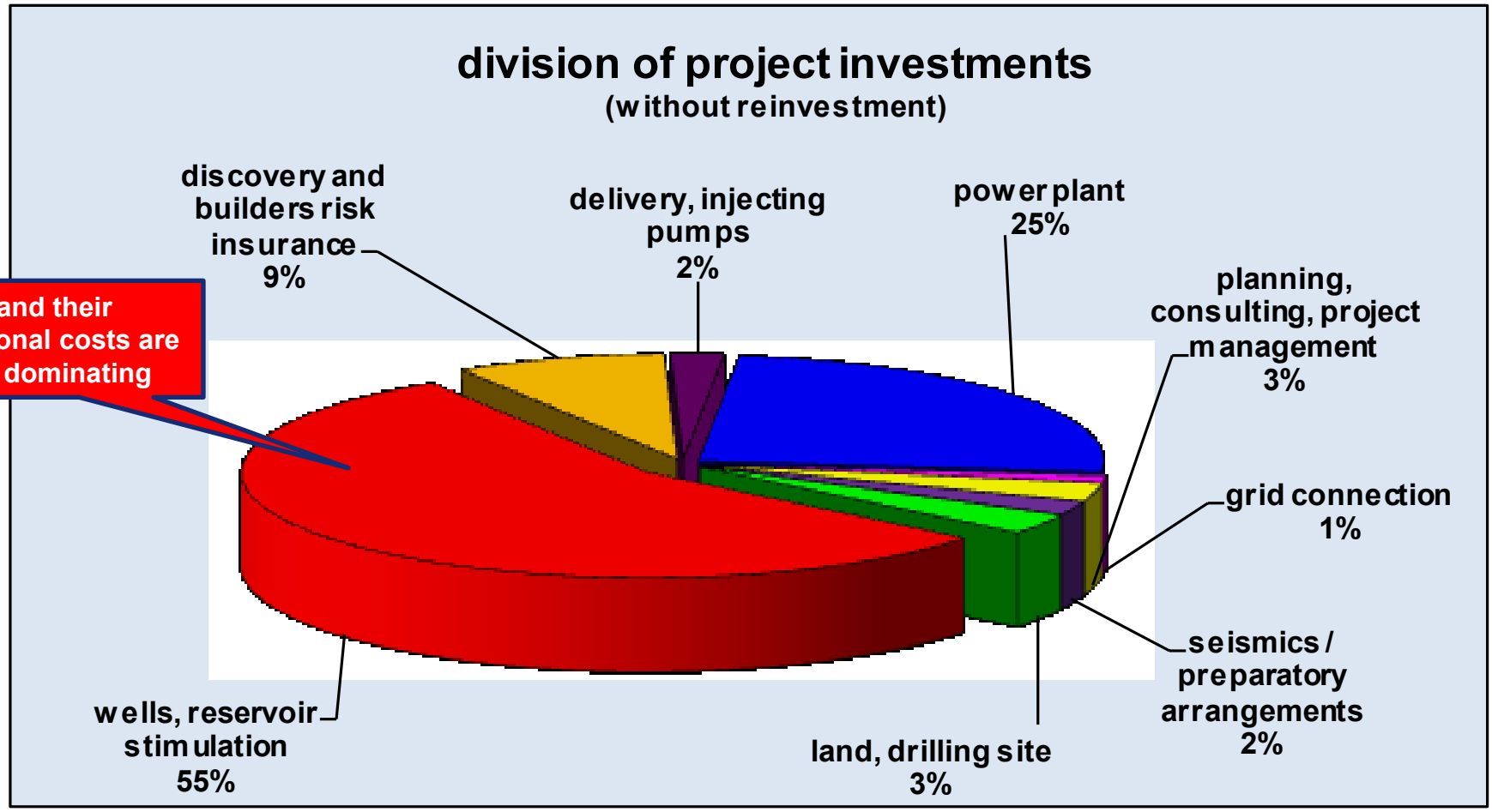
	year 1	year 2	year 3	year 4	
seismics / preparatory arrangements	1.000.000	0	0	0	
land, drilling site	0	1.500.000	0		
wells, reservoir stimulation	0	0	26.800.000	0	
discovery and builders risk insurance	0	0	4.060.000		
delivery, injecting pumps	0	0	0	1.020.000	
power plant	0	0	0	12.170.000	
grid connection	0	0	0	500.000	
planning, consulting, project management	0	450.000	450.000	450.000	
SUM	1.000.000	1.950.000	31.310.000	14.140.000	**48.400.000**

=> ca. 2 Mio. € / 1.000 m MD

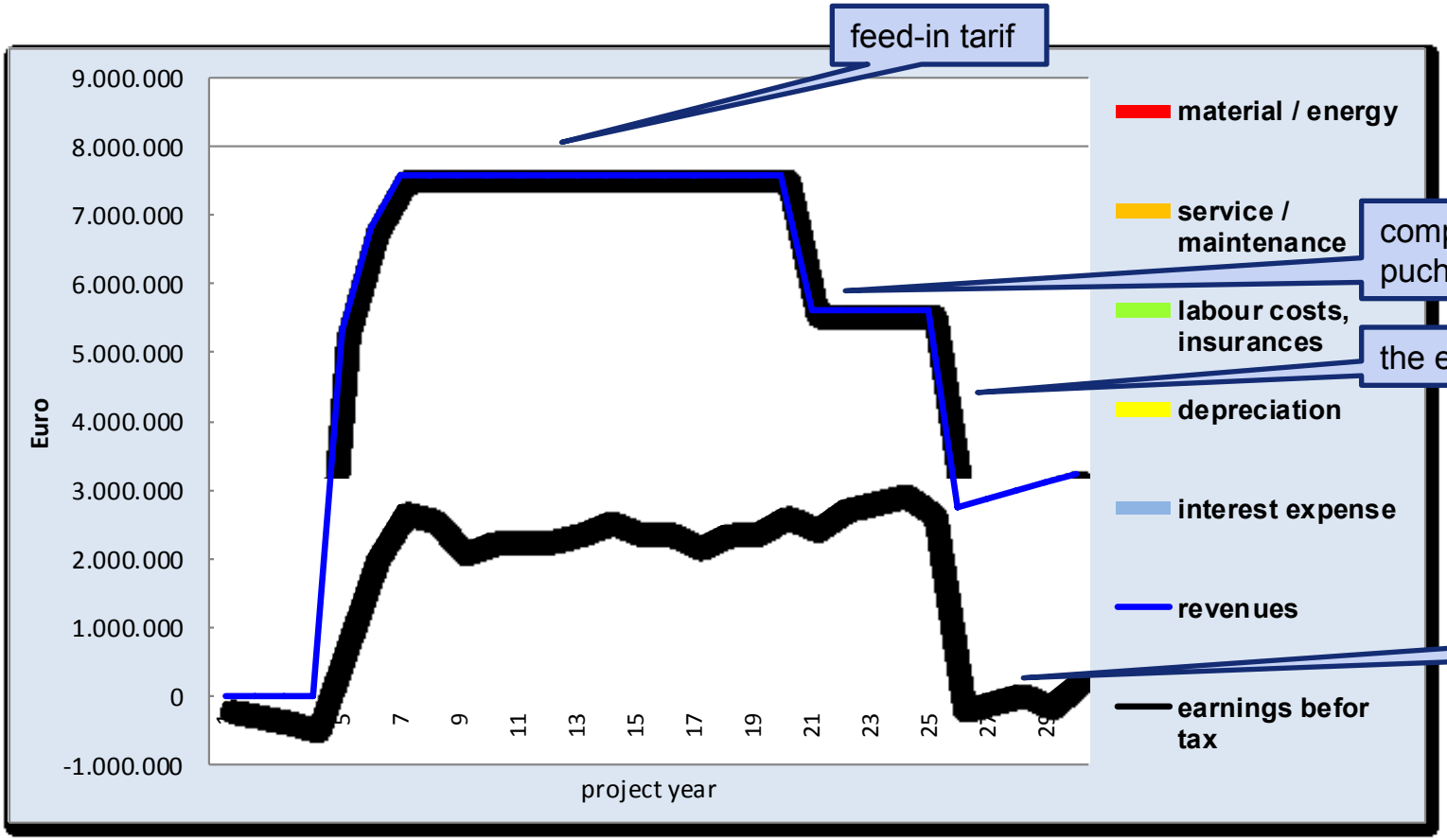
(wells >5.000 m TVD and 6 1/8“ diameter at total depth including stimulation measures and contingencies)

constructors all risk insurance including lost in hole for both wells, discovery insurance for one well

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


division of project investments
(without reinvestment)
discovery and builders risk insurance 9%
delivery, injecting pumps 2%
power plant 25%
planning, consulting, project management 3%
grid connection 1%
seismics / preparatory arrangements 2%
land, drilling site 3%
wells, reservoir stimulation 55%
wells and their additional costs are by far dominating

Expenses and income



Finance (simplified)

- resource of needs
  - investment 48,4 Mio. €
  - negative cashflow 2,5 Mio. €
- resource of founds
  - equity 34,1 Mio. €
  - debts 16,8 Mio. €

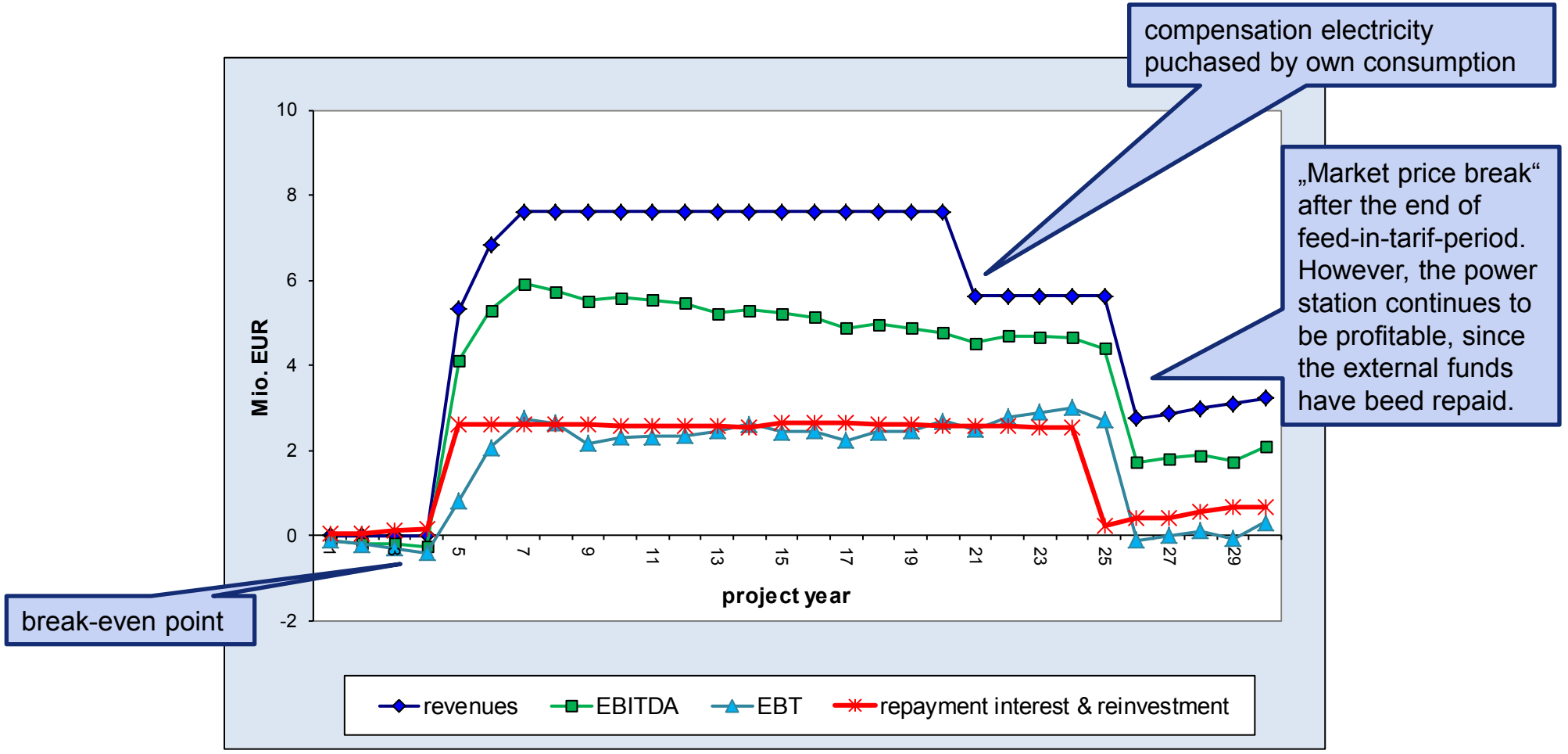
The „classical“ financing in the construction phase:
→ equity for exploration and wells

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 tarif (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 potantial vary from site to site

- EBITDA (earnings before interest, taxes, depreciation, amortisation)
  - the interest expense drops steadity 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

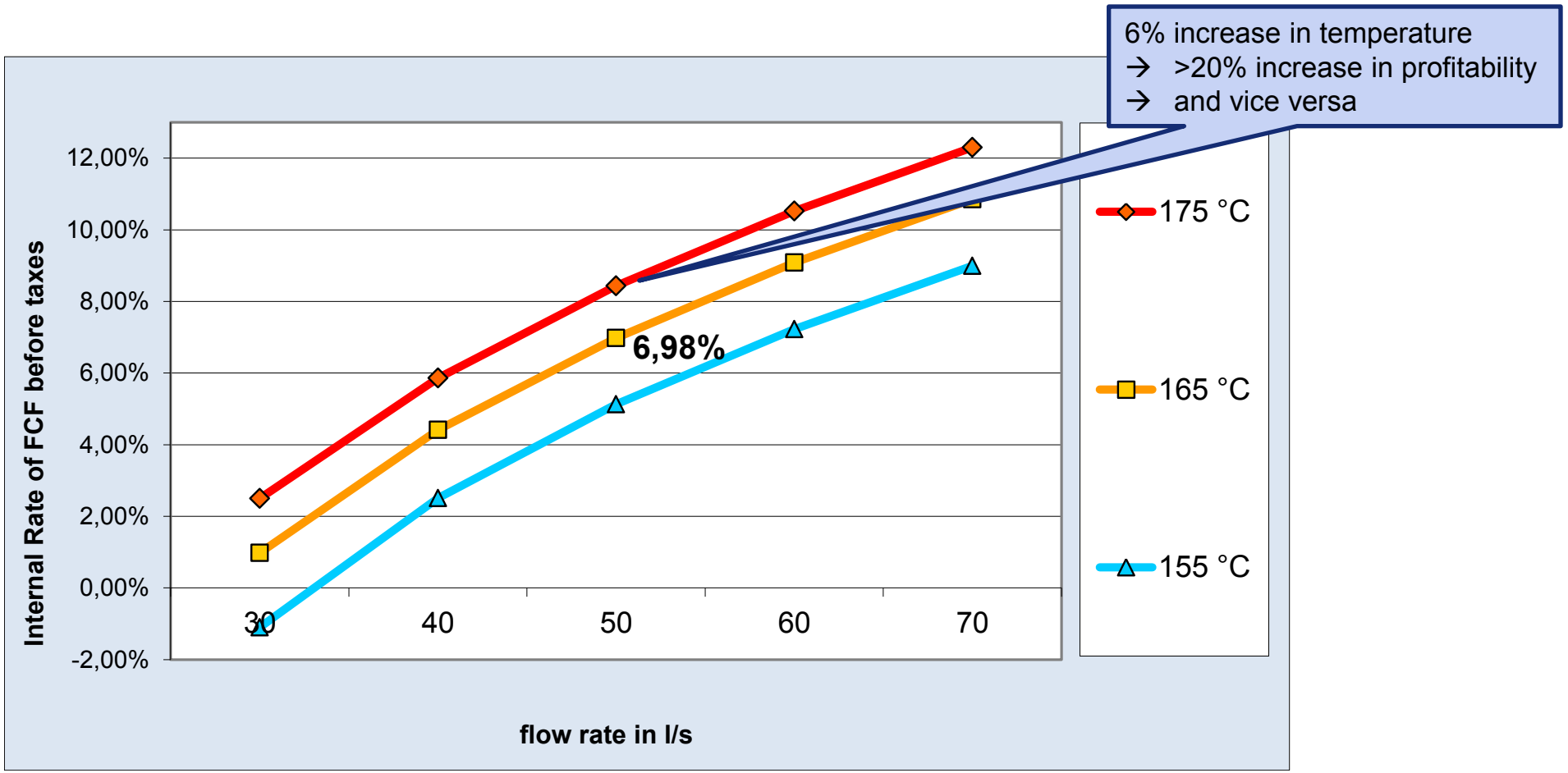
⇨ the project is financially sound

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



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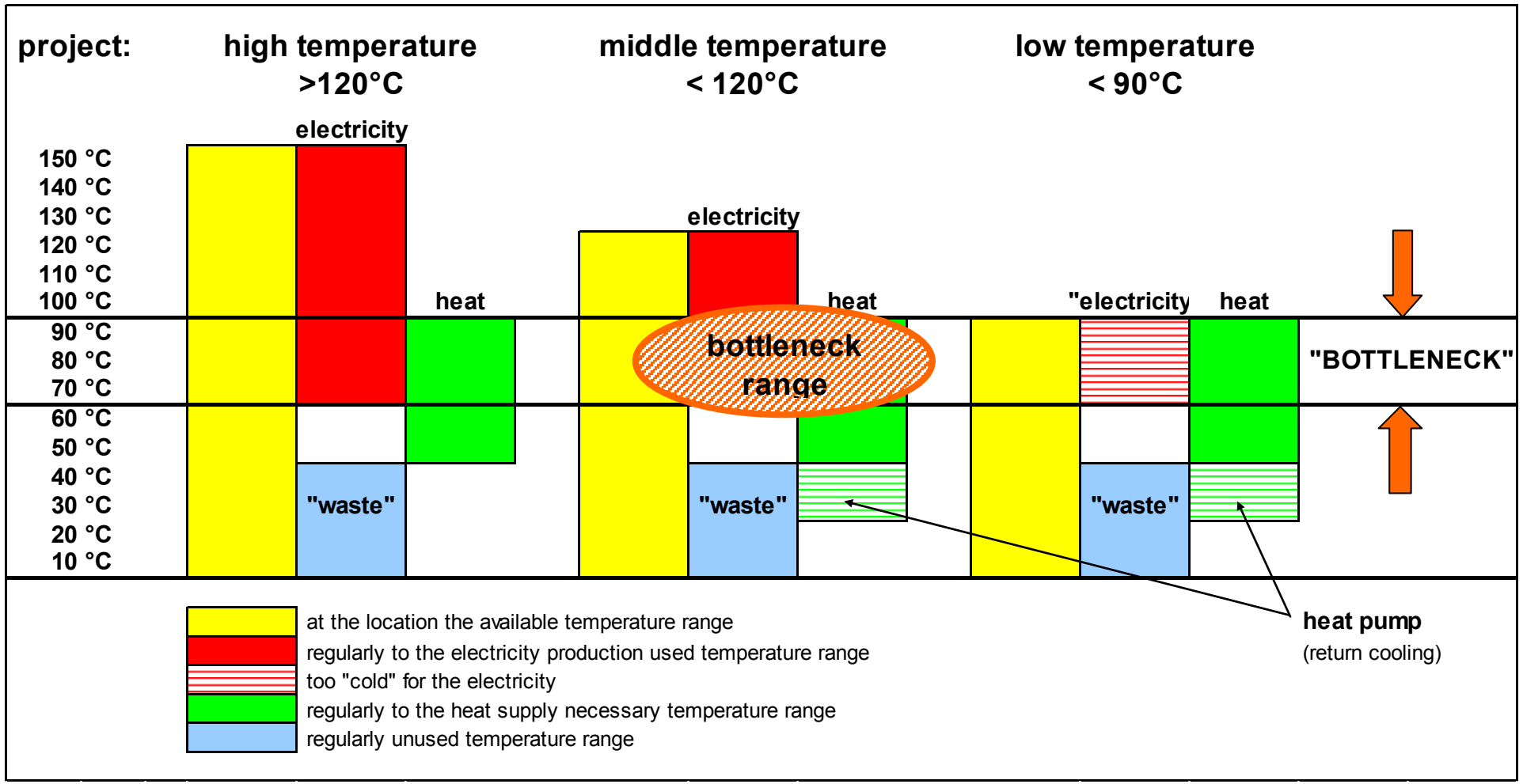
5. Project design – project optimization

	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


project:
high temperature >120°C
middle temperature < 120°C
low temperature < 90°C
150 °C
140 °C
130 °C
120 °C
110 °C
100 °C
90 °C
80 °C
70 °C
60 °C
50 °C
40 °C
30 °C
20 °C
10 °C
electricity
heat
"waste"
electricity
heat
bottleneck range
"waste"
"electricity
heat
"waste"
"BOTTLENECK"
heat pump
(return cooling)
at the location the available temperature range
regularly to the electricity production used temperature range
too "cold" for the electricity
regularly to the heat supply necessary temperature range
regularly unused temperature range

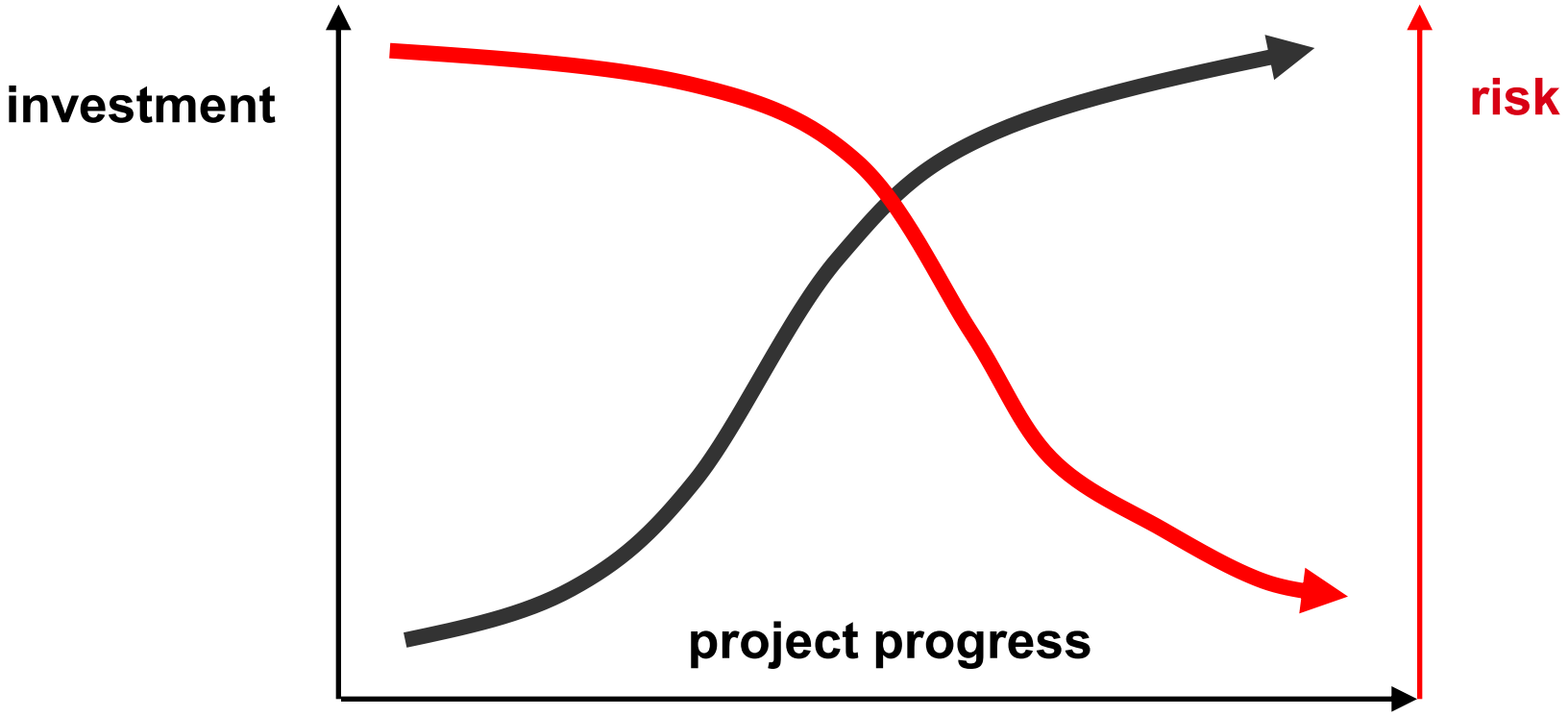
- District heating project
  - peak load covering by additional energy source
  - integration of a medium load component
  - improved efficiency of the geothermal source by cooling the return flow via heat pump
  - refinement of the medium load (second medium load component) etc.

⇨ capital costs instead of „fuel costs“

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

- Combined heat an power projects
  - heat-focused vs. power-focused
    (geothermal heating vs. amotization 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°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

- temperature
- flow rate

geology

- investment
- financial costs

investment/ finance

- plant availability

technique

heating project

power project

- sales volume
- connection density
- (starting) heat price

marketing

- price development

competition

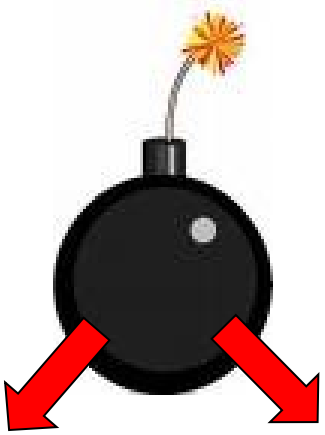
heating project

The right risk strategy

risk PREVENTION

risk REDUCTION

risk TRANSFER



risk ACCEPTANCE

Risk management options

	RISKS	PROTECTION
GEOLOGY TECHNIQUE	- „failed“ discovery - „partially“ discovery	- feasibility studies, reprocessing, seismics - discovery insurance
	- drill target is not reachable	- quality of drilling company - drilling contract - drilling insurance
	- facility / operation	- quality of planning - know-how of operator - manufacturer warranties - storage (pump)
ECONOMY MARKETING	- investment budget / financing - price development of alternative energies - distribution / sales	- businessplan, current update - financial flexibility (reserves) - contract design

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 potantial

⇨ necessary: agreement of insurance coverage

⇨ helpful: supporting throught experienced broker

7. Summary geothermal power generation

- The guarantee for a successfull development of a geothermal project is not sure, but
- achievable by observing the following essential rules:
  - a good preperation 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)
- geothermal project Aschheim/Feldkirchen/Kirchheim (heat) – in realization (www.afk-geothermie.de)
- geothermal project Unterföhring (heat) – in realization (www.geovol.de)
- geothermal project Mauerstetten/Kaufbeuren (electricity/heat) – switched to research EGS
- geothermal project Garching (heat) – in realization (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)
- geothermal project Dublin (heat) – in planning (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 Estlania – feasibility studies (Eestimaa Rohelised)

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We thank you for your attention

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