

Utilization of integrated numerical models to manage geothermal resources and district heating networks

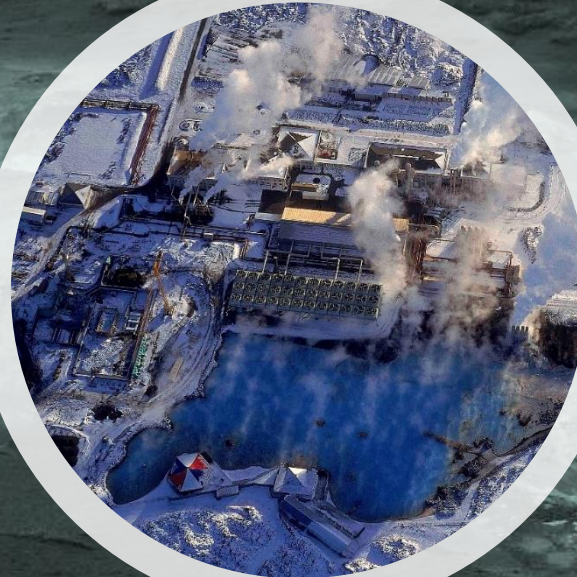
Sustainable District Energy Conference
October 23-25, 2019, Iceland

Ágúst Guðmundsson, Lárus Þorvaldsson, Eric M. Myer, Sveinn Óli Pálmarsson

Specialized consultancy regarding nearly all components of the physical environment:

- Geothermal reservoirs
- Groundwater aquifers
- Surface waters
- Atmosphere
- Urban environment

Our expertise lies in consultancy on various phases of a project life cycle with the aid of conceptual and computational models



Services and experience

Founded in 1982

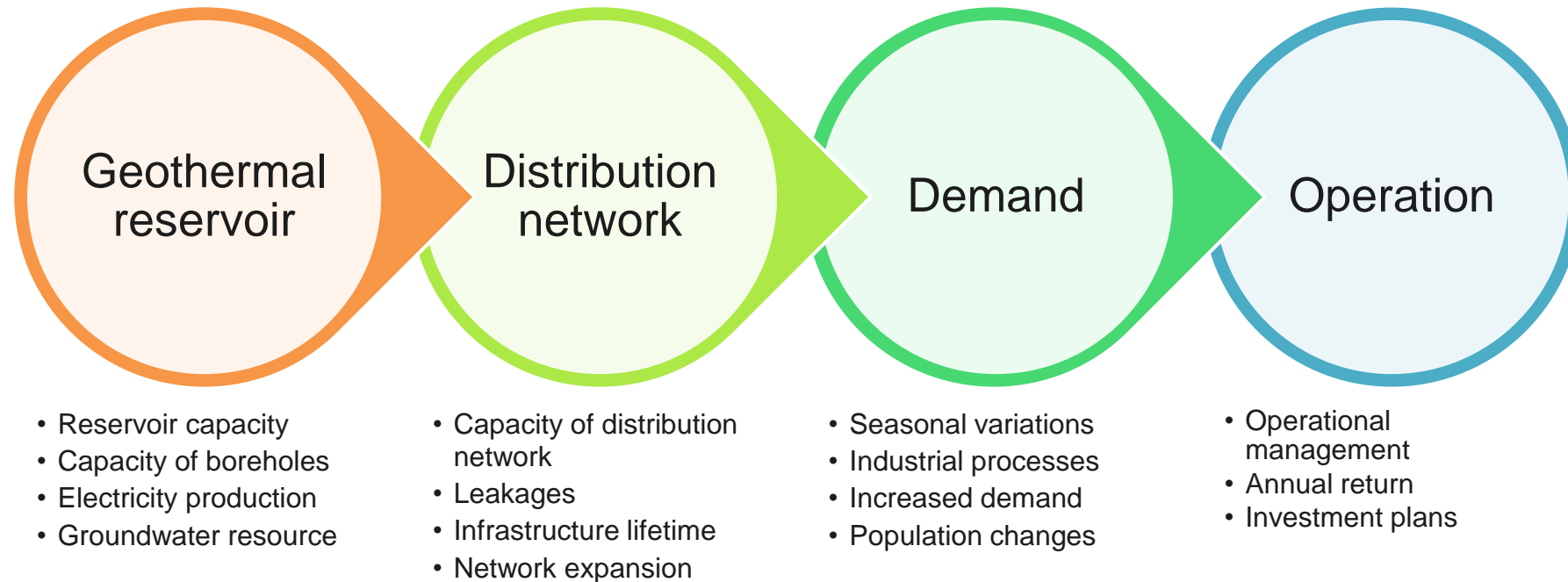
Nearly 40 years of experience on projects in Iceland and around the globe

Clients from the energy sector, public utilities, private industry and government

Diverse team of specialists with wide range of academic backgrounds within the physical and environmental sciences, engineering and computer programming



Geothermal district heating networks



Problems can arise with increasing demand

- The geothermal resource
 - Pressure decline
 - Temperature decline
 - Limitations on borehole capacity
- The distribution network
 - Pressure fluctuations
 - Reduced deliverability of thermal energy
- These issues can lead to more problems and higher costs for the utility and the consumer

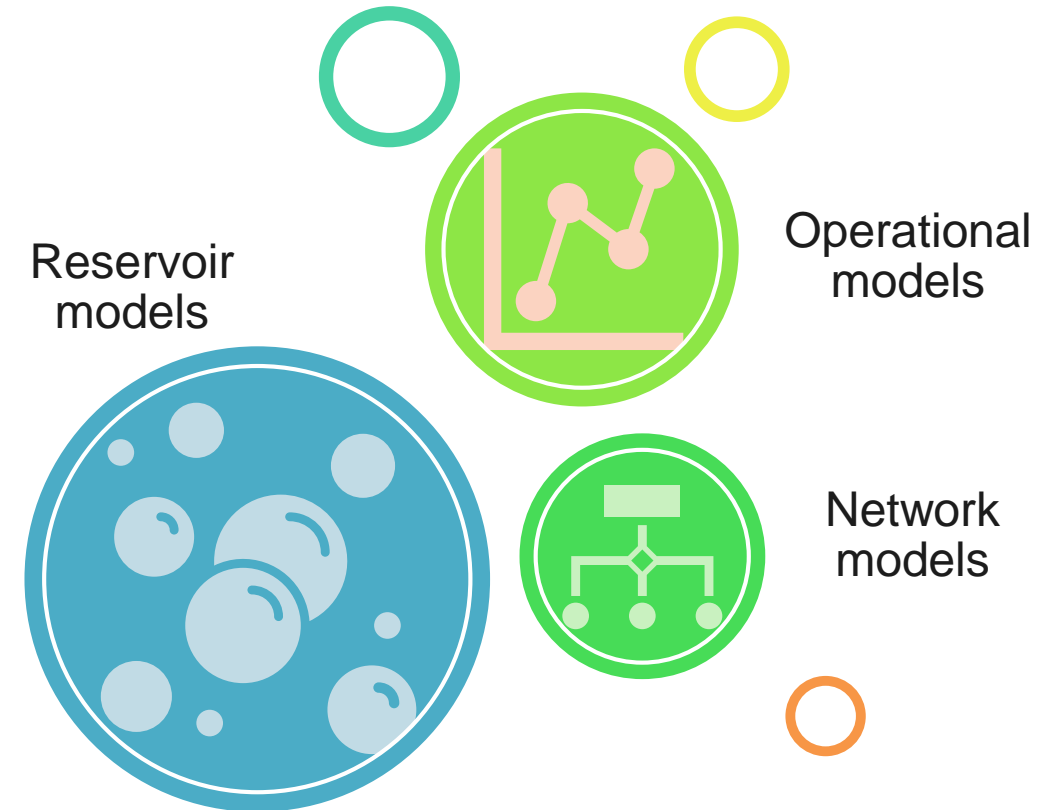


The perfect network



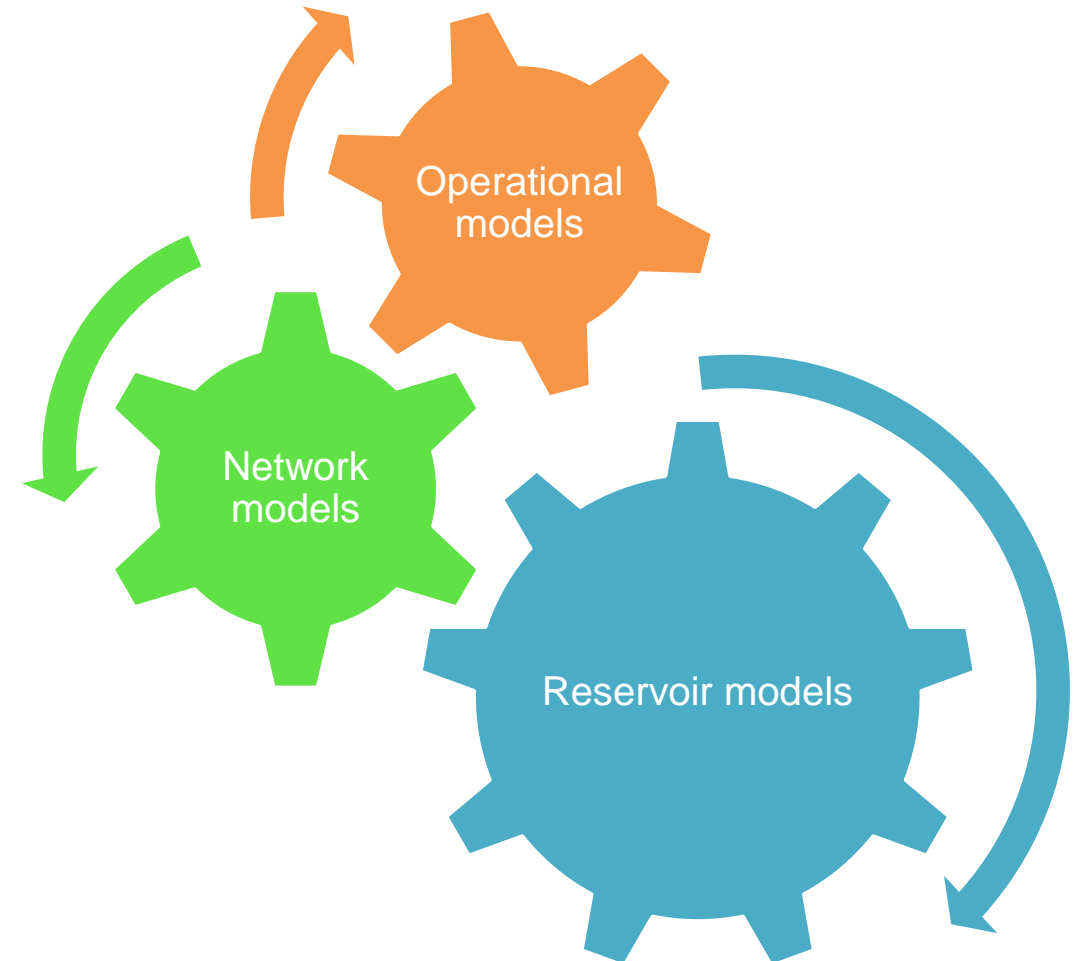
Integrated numerical models

- Multiple models have been developed for a variety of specific processes
- These models simulate each process very well but are sometimes limited from an operational perspective
- Integrating different numerical models can provide a holistic view of the system
- Combining the models can help answer a wider variety of questions that field and utility operators might have

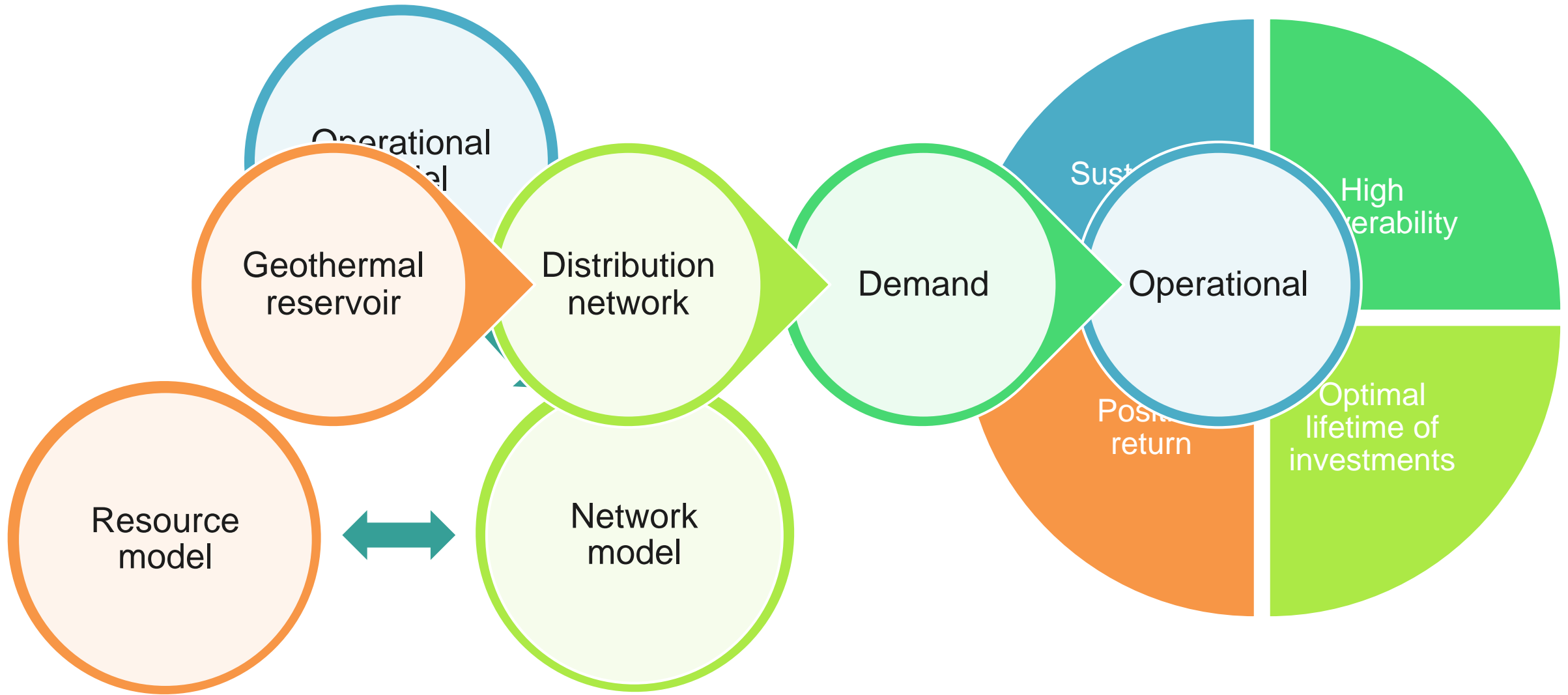


Benefits of integrated numerical models

- Resource oriented production planning
- Return assessment from investments
- Sustainable development of resource
- Improved overview and knowledge of the system from a single viewpoint
- Analysis of complex causal relationships

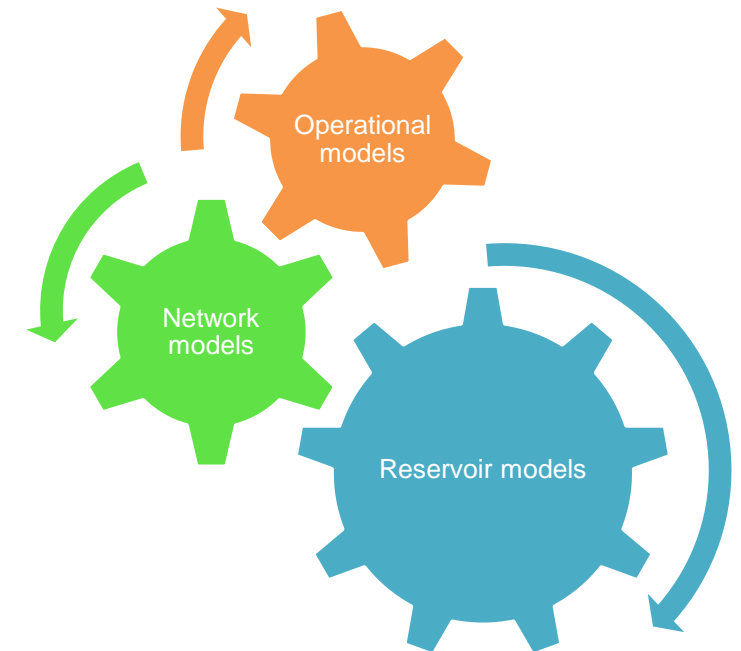


Integrated view of geothermal networks

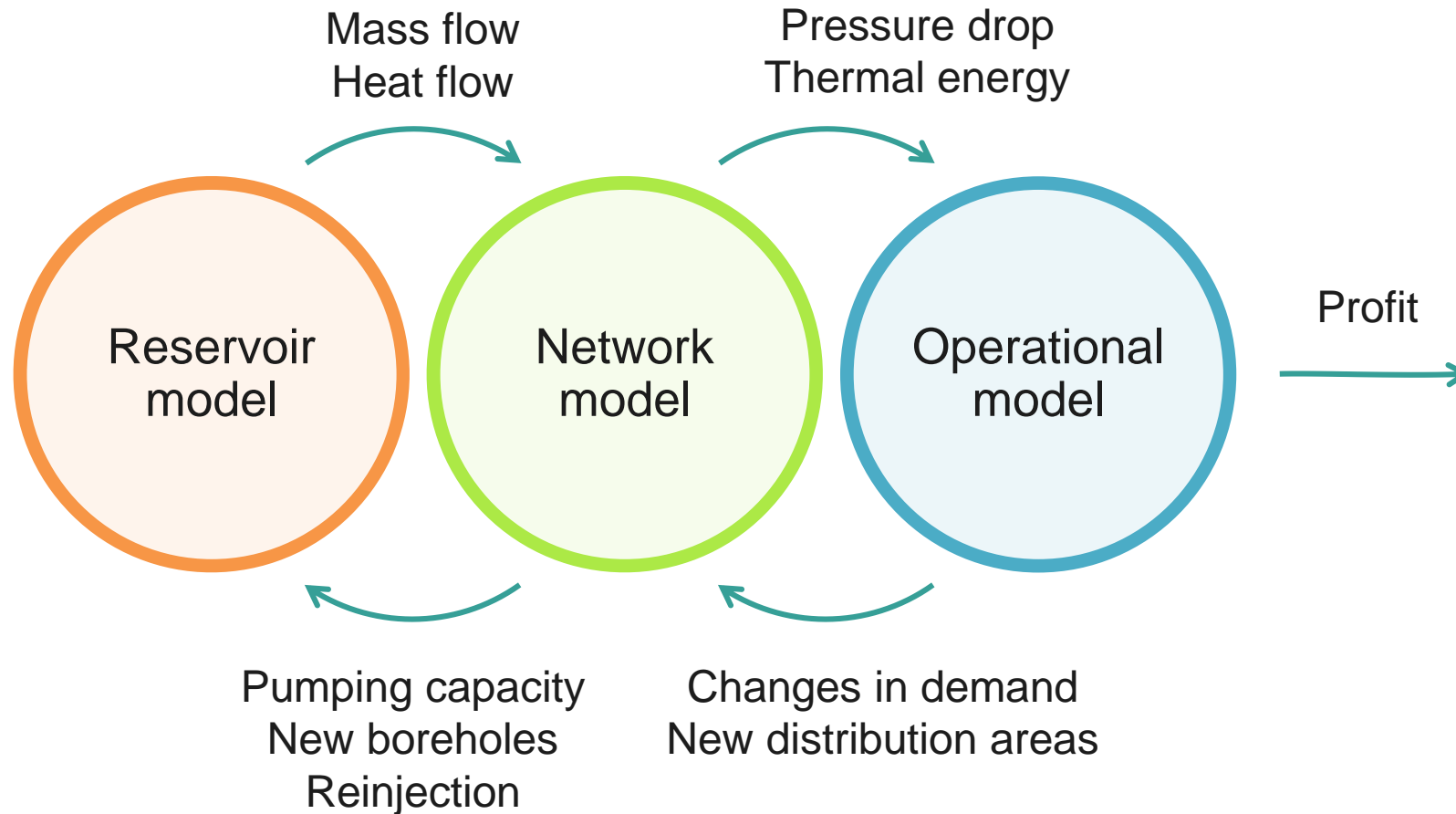


Examples of applications

- Design of resource utilization plan with regards to profitability, sustainability and urban development
- Optimization of resource utilization with the characteristics of the available resources in mind
- Refurbishments and growth of distribution networks focusing on sustainability, lifetime of investments and profitability
- Making decisions on the pricing of thermal energy based on the need for capital investment and the limits of the resource (e.g. long run marginal cost pricing).



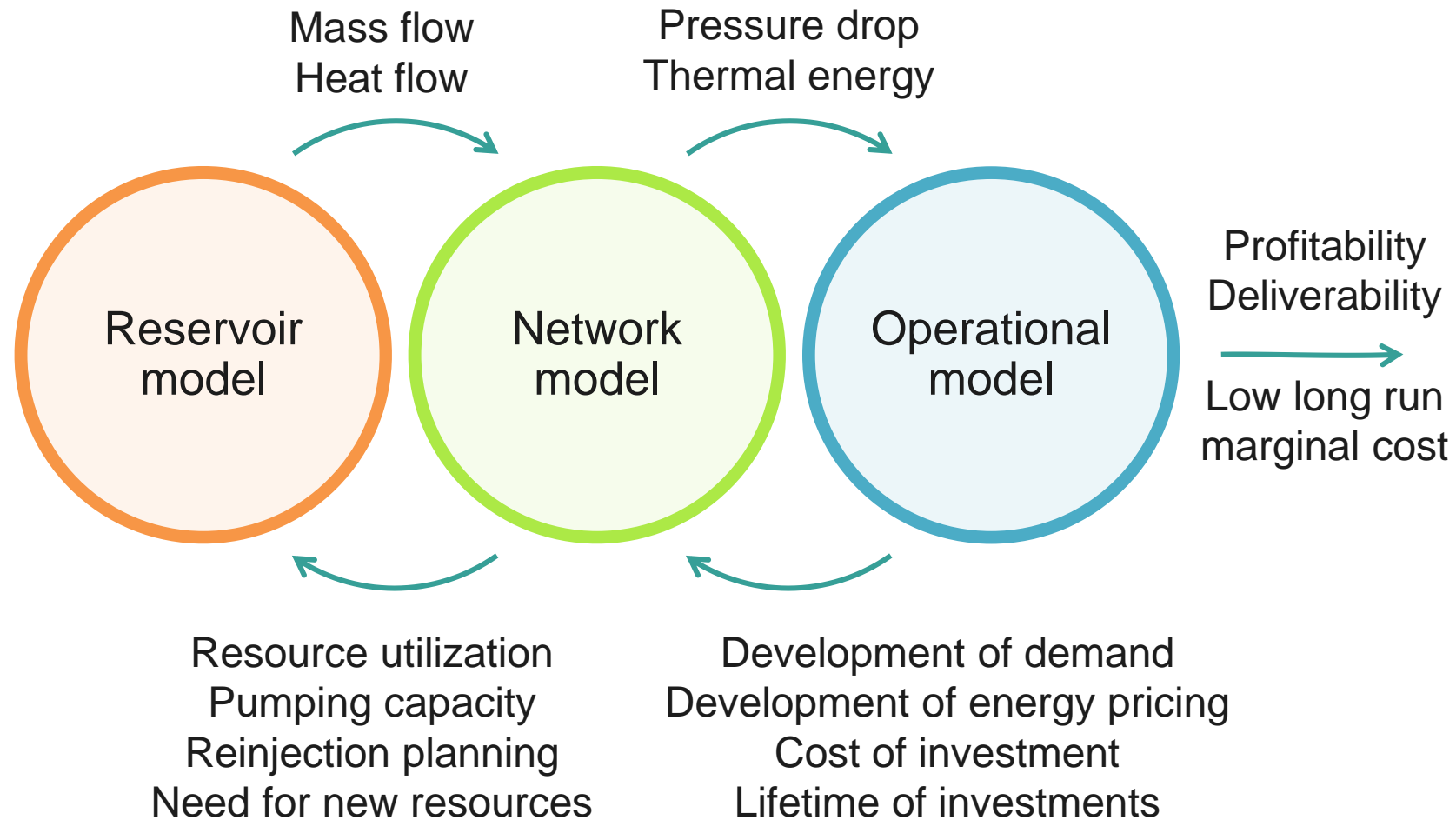
Integrated geothermal district heating network



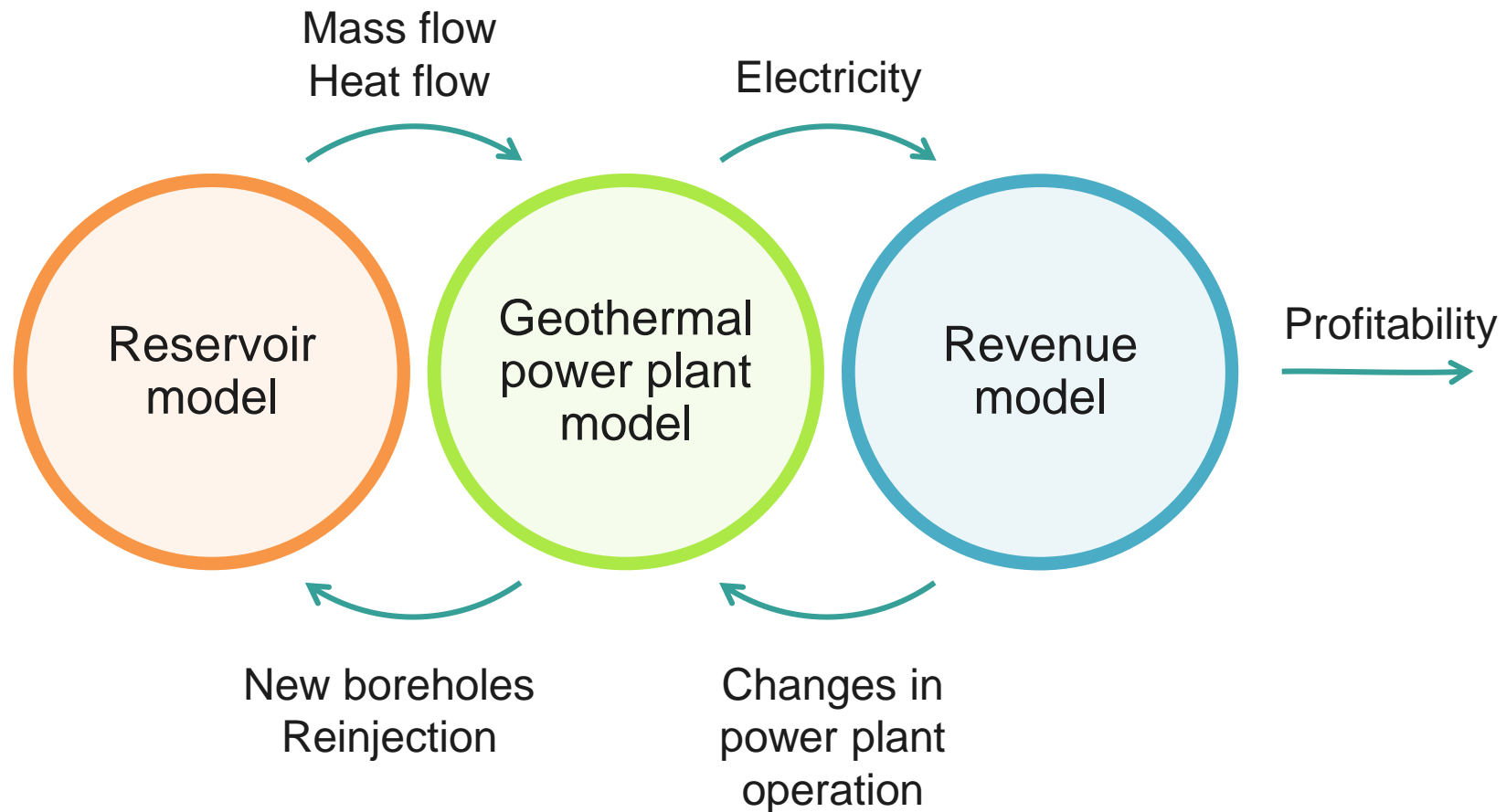
Opportunity for optimization?

- Various parameters can be used as objective functions to optimize different components of the system
 - ✓ Profitability of projects
 - ✓ Sustainable use of resource
 - ✓ Lifetime of investments
 - ✓ Deliverability to customers

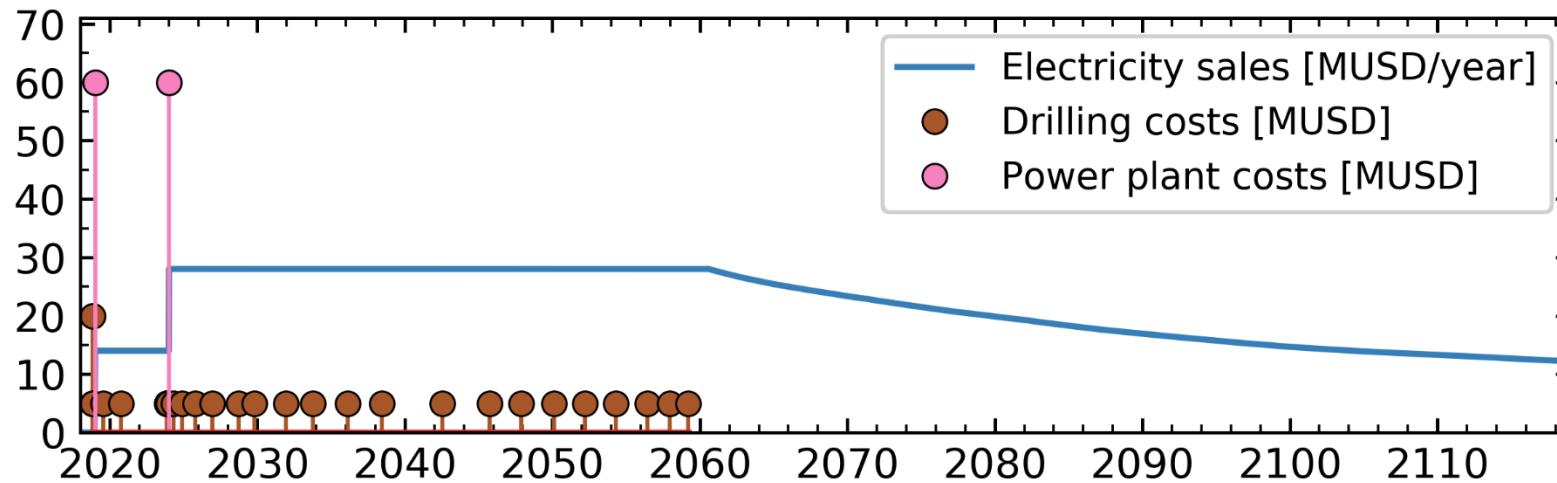
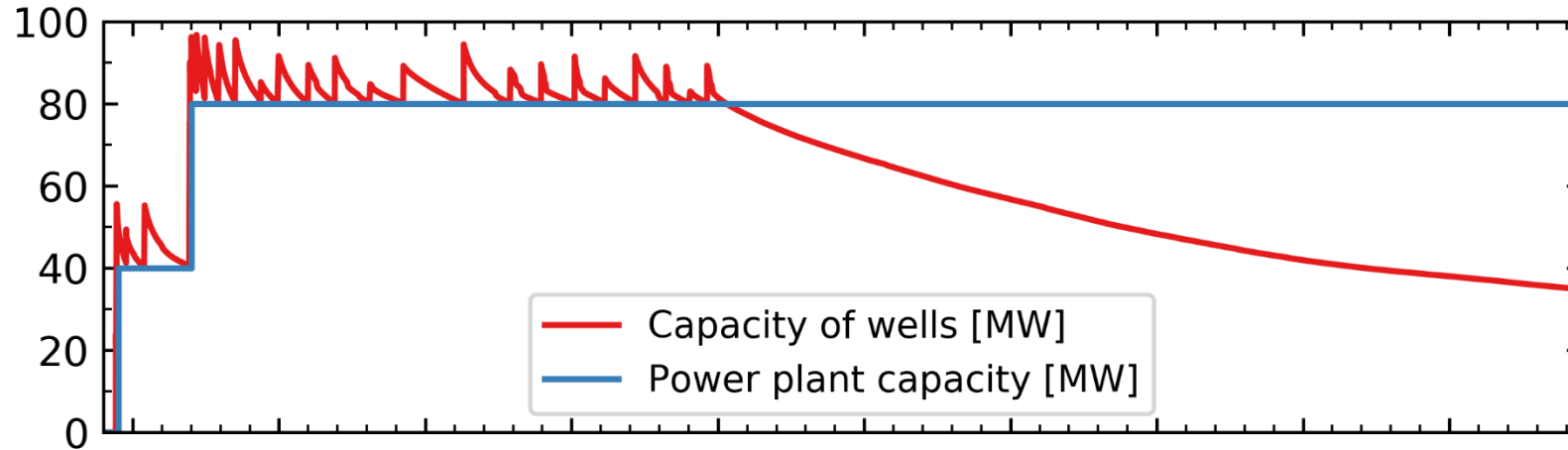
Optimizing a district heating network



Geothermal resource utilization for electricity production



Geothermal resource utilization for electricity production



Summary

- Geothermal district networks consists of various features which are affected by each other
- Various problems may arise in conjunction with network expansion
- Integrated numerical models can be used as a tool in the management of geothermal district heating networks aiming towards:
 - Sustainable use of resources
 - High deliverability of thermal energy to customers
 - Prolonging life time of investments
 - Positive return
- The use of integrated models provides the opportunity for optimization



Thank you!