



# CATOP 2000



## NEWEST MATHEMATICS APPLIED IN ENERGY INDUSTRY

Congress on Categorical Topological Methods

July 4 - 6, 2000

Fribourg, Switzerland





ad topic ...

## Congress on Categorical Topological Methods

July 4 - 6, 2000

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### TOPIC:

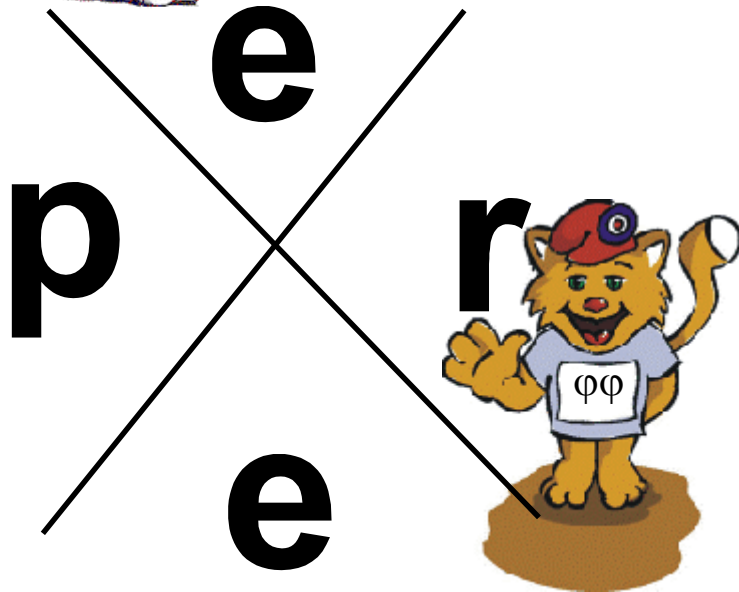
It is the aim of this conference to discuss categorical topological methods that are likely to be mathematically important in the next century. Furthermore, ...



agenda & ad „furthermore, ...“



- **K**itchen: cats and tops
- **l**ogic of topos
- **e**nergy
- **i**ndustry
- **s**ystems
- **l**ook for next century
- **i**nformation and forecasts



70<sup>th</sup> of Heinrich Kleisli

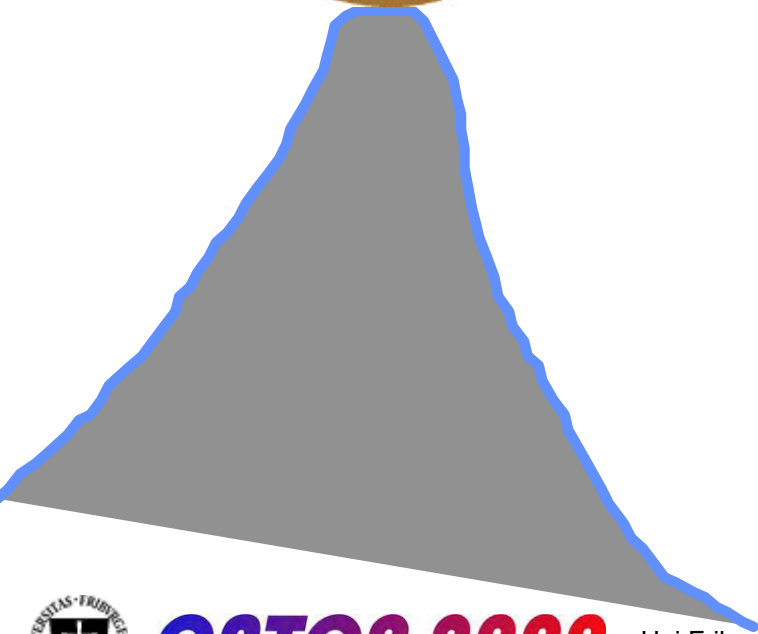
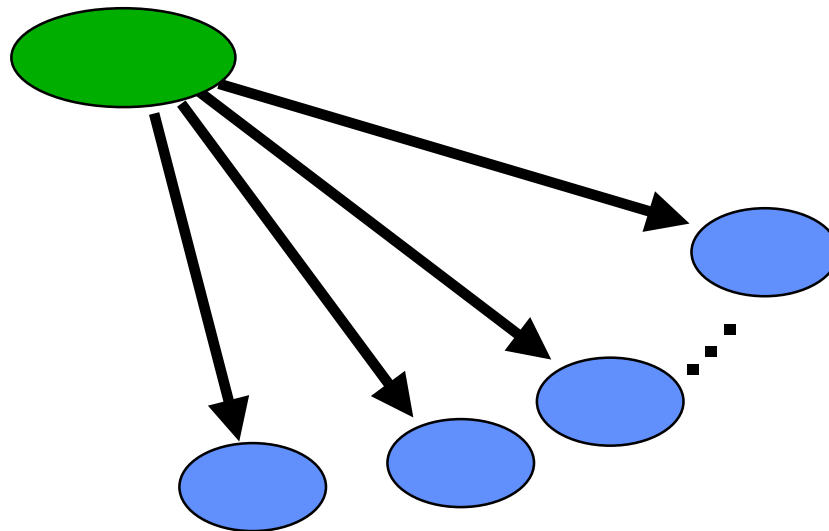


**K: top cats - initial structures**



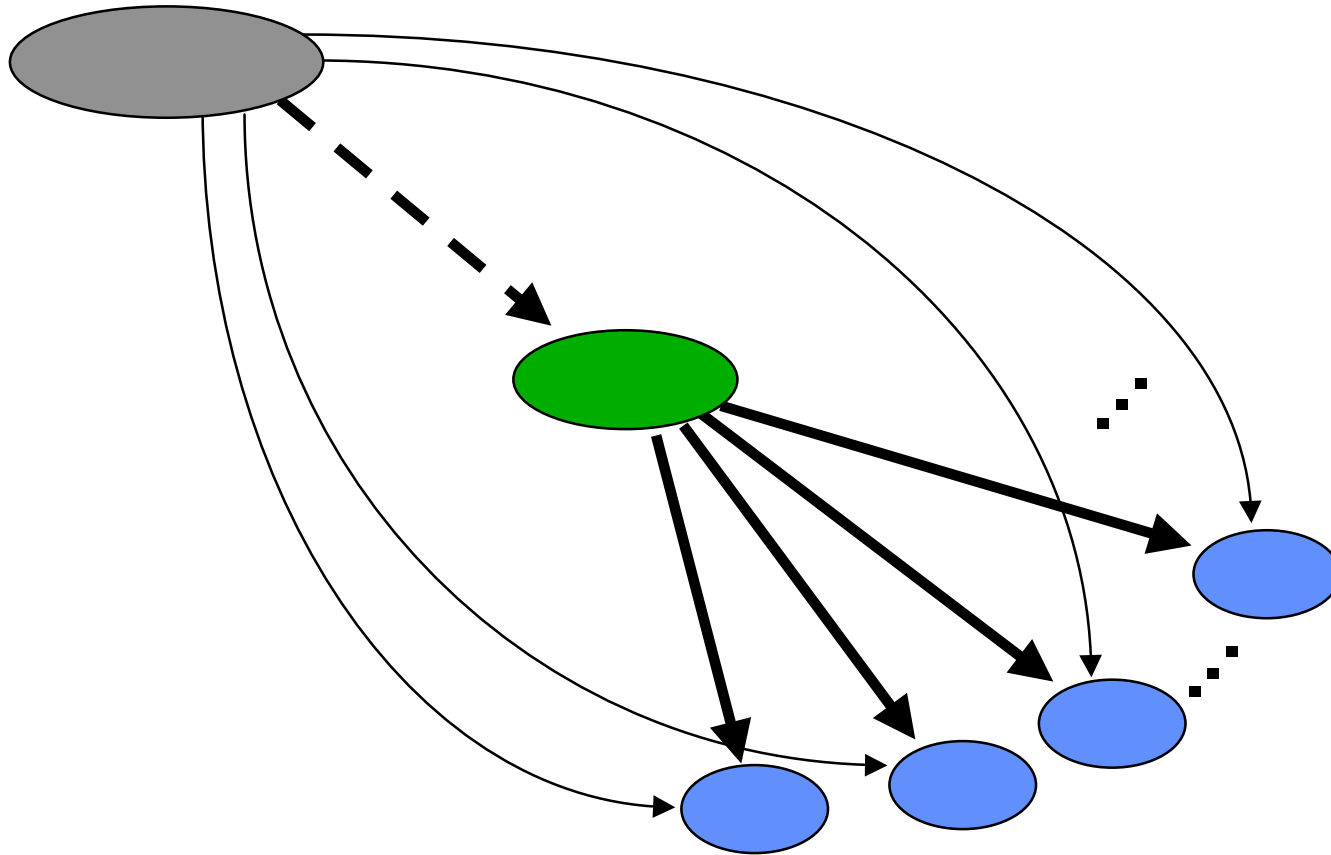
**Kant vs Newton**

...



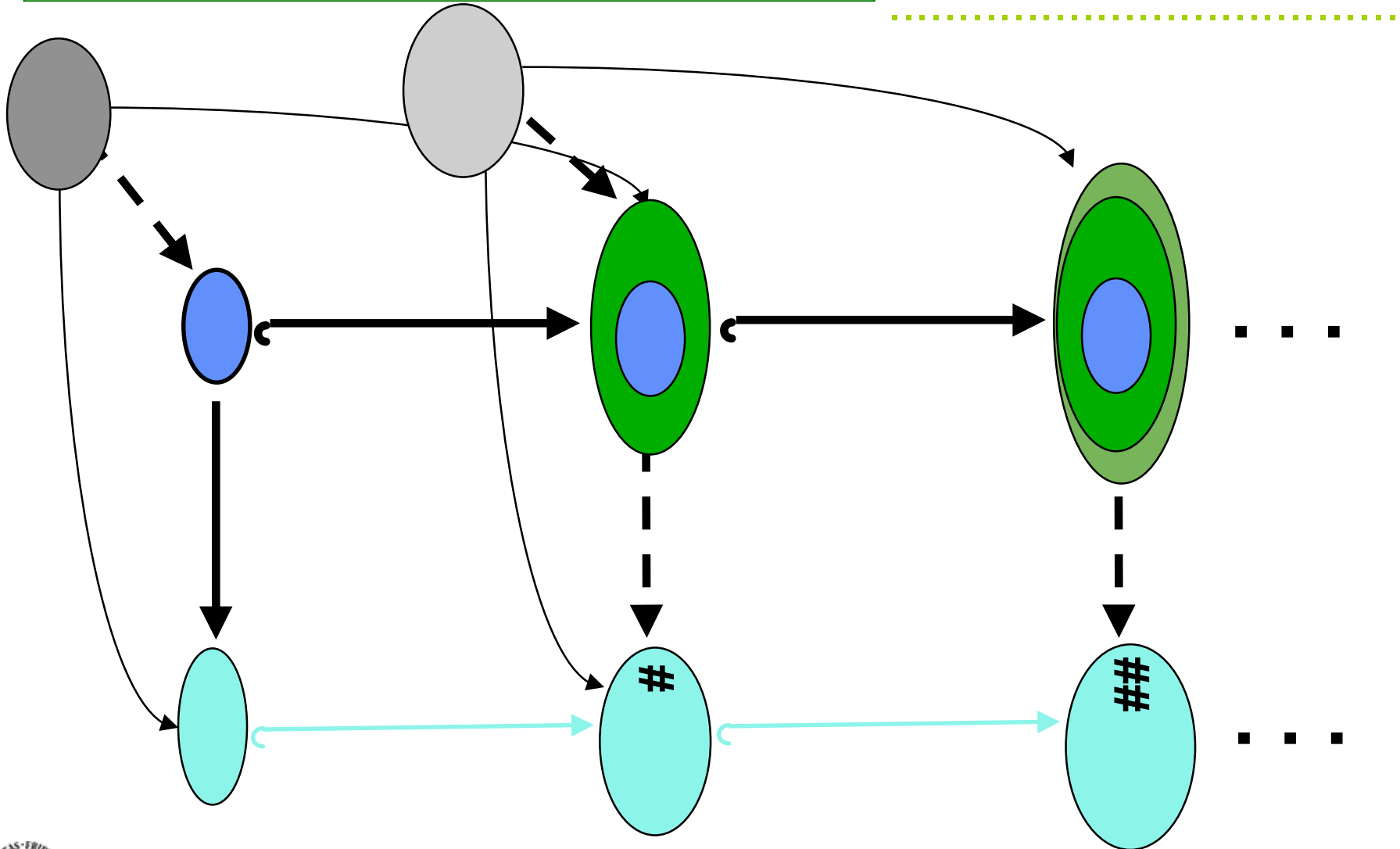


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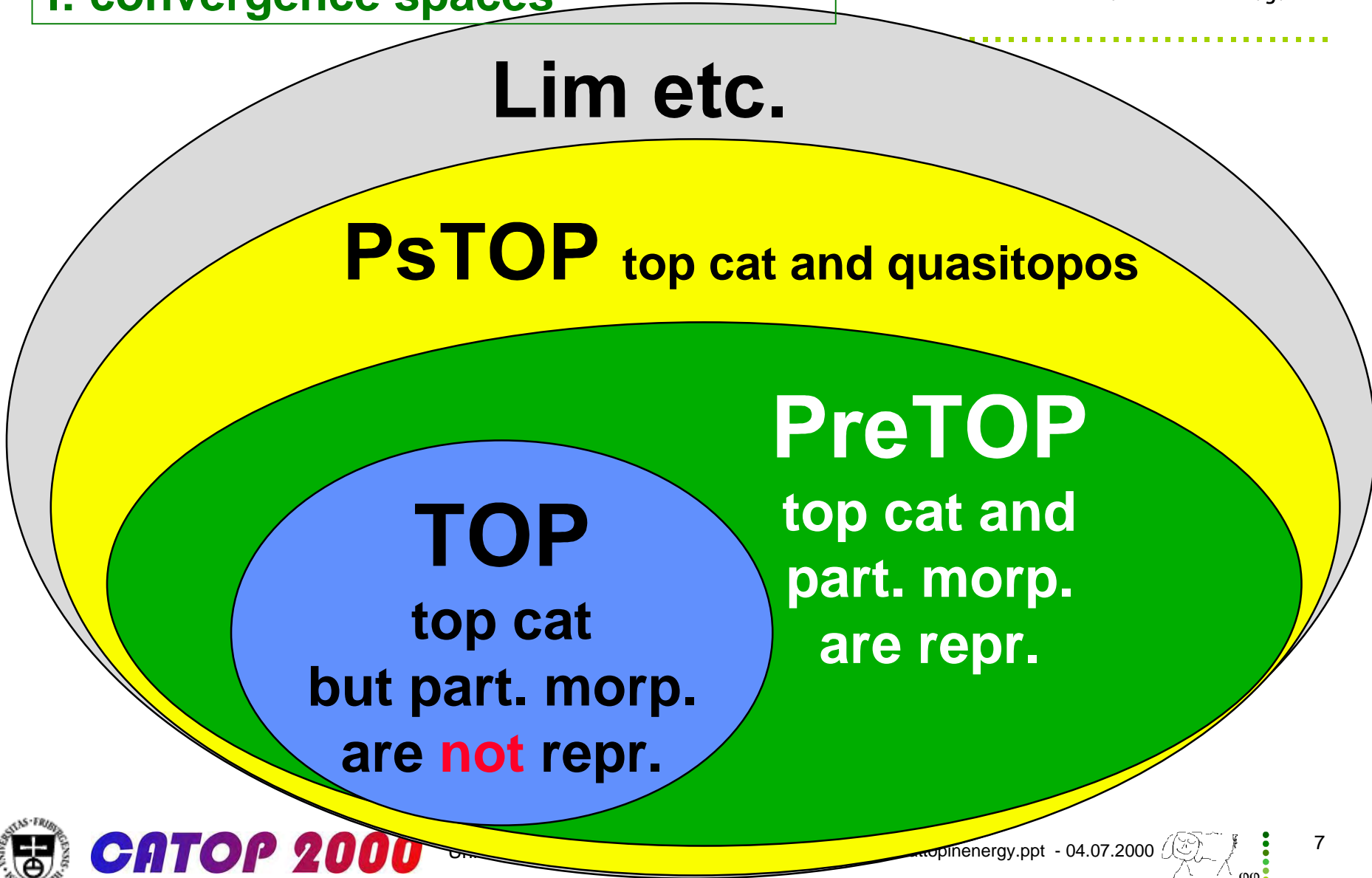


I: quasitopoi - partial morphisms





I: convergence spaces





I: viva PreTOP ...

in practice:

- look for non idempotent hull operators
- look for "partial knowledge"
- look for extensions

pretopologies have the "build in" iterative process, in particular needed, if no direct solutions are possible and/or known !!!

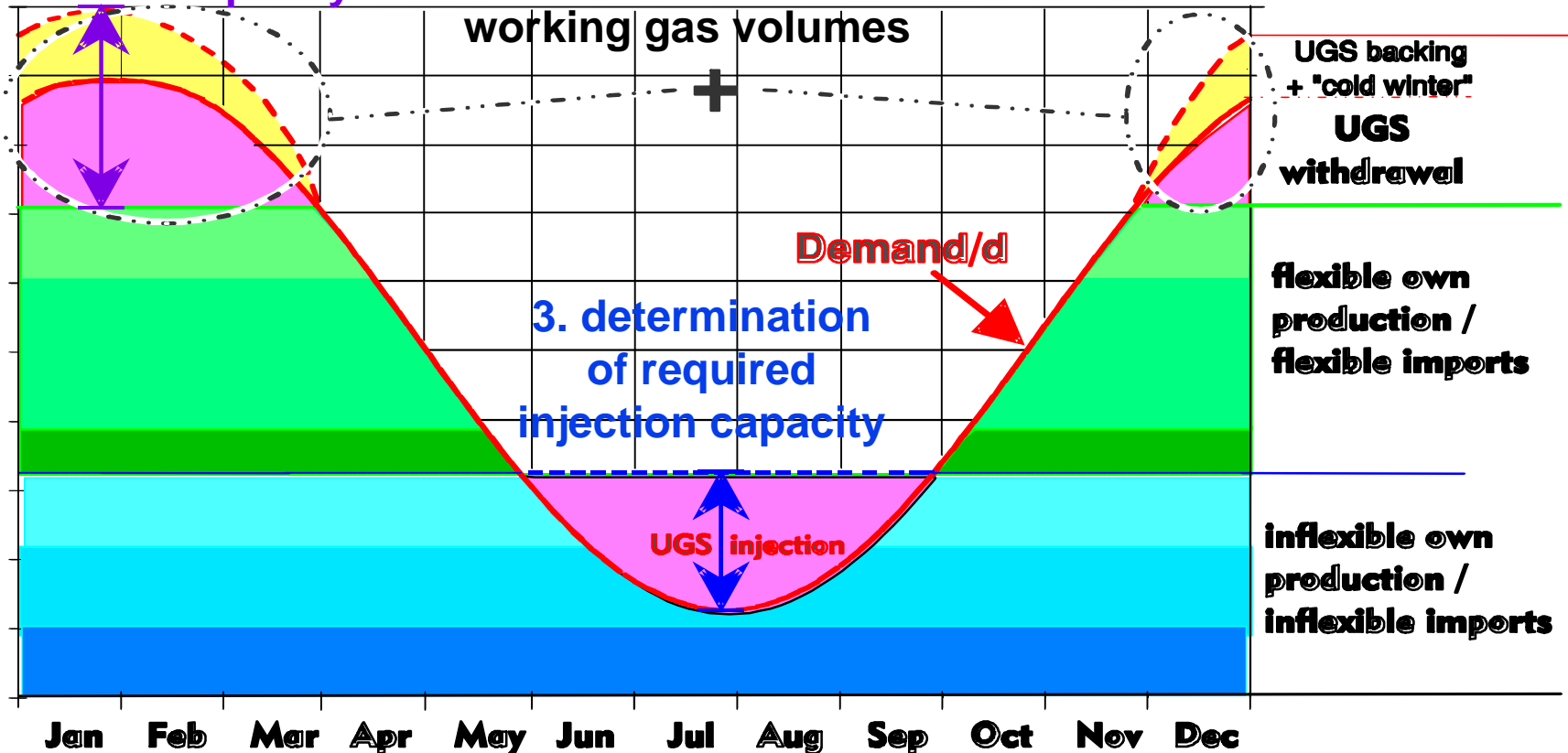


## e: load balancing

2. determination of required withdrawal capacity

1. determination of required working gas volumes

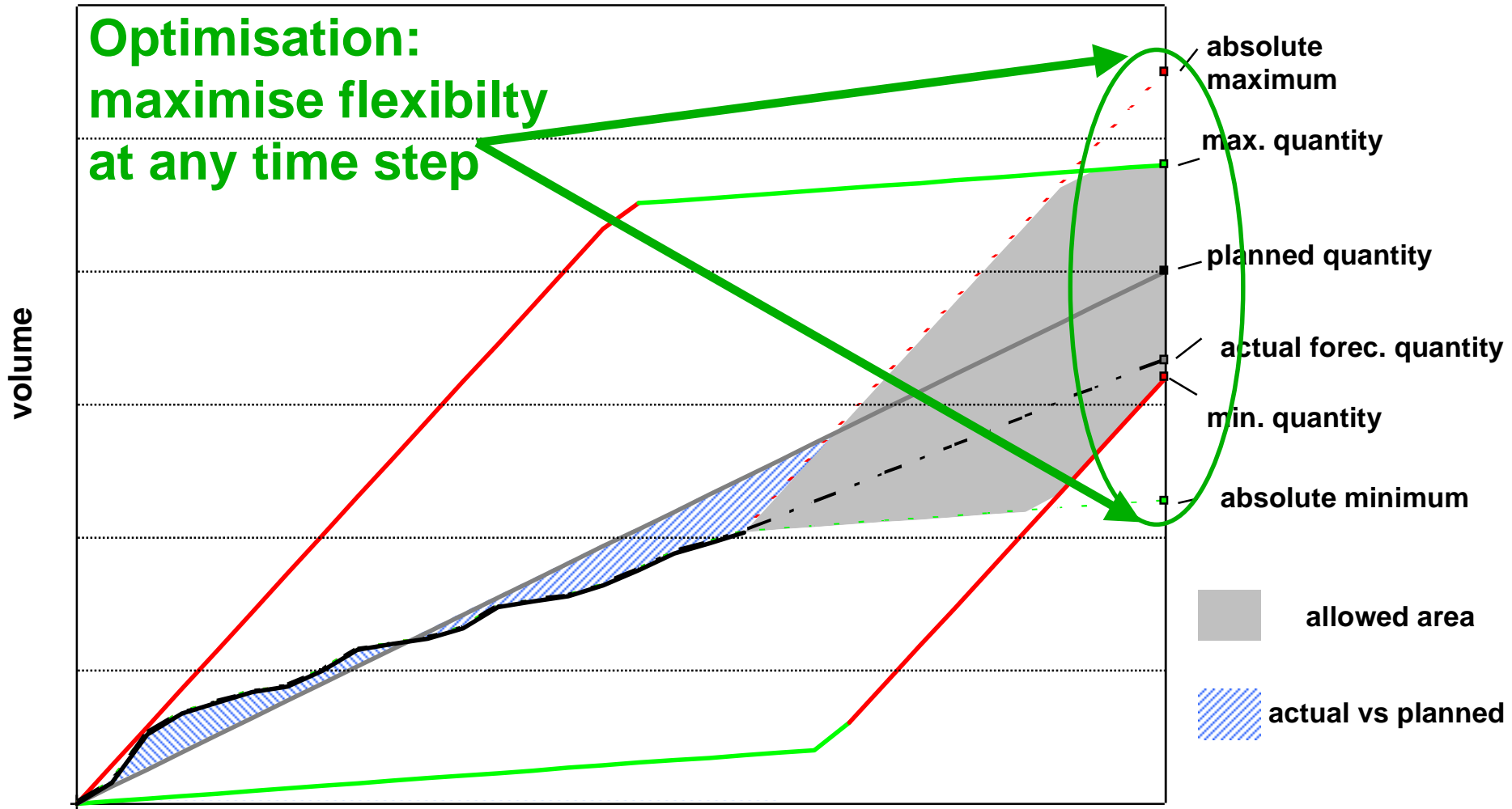
3. determination of required injection capacity

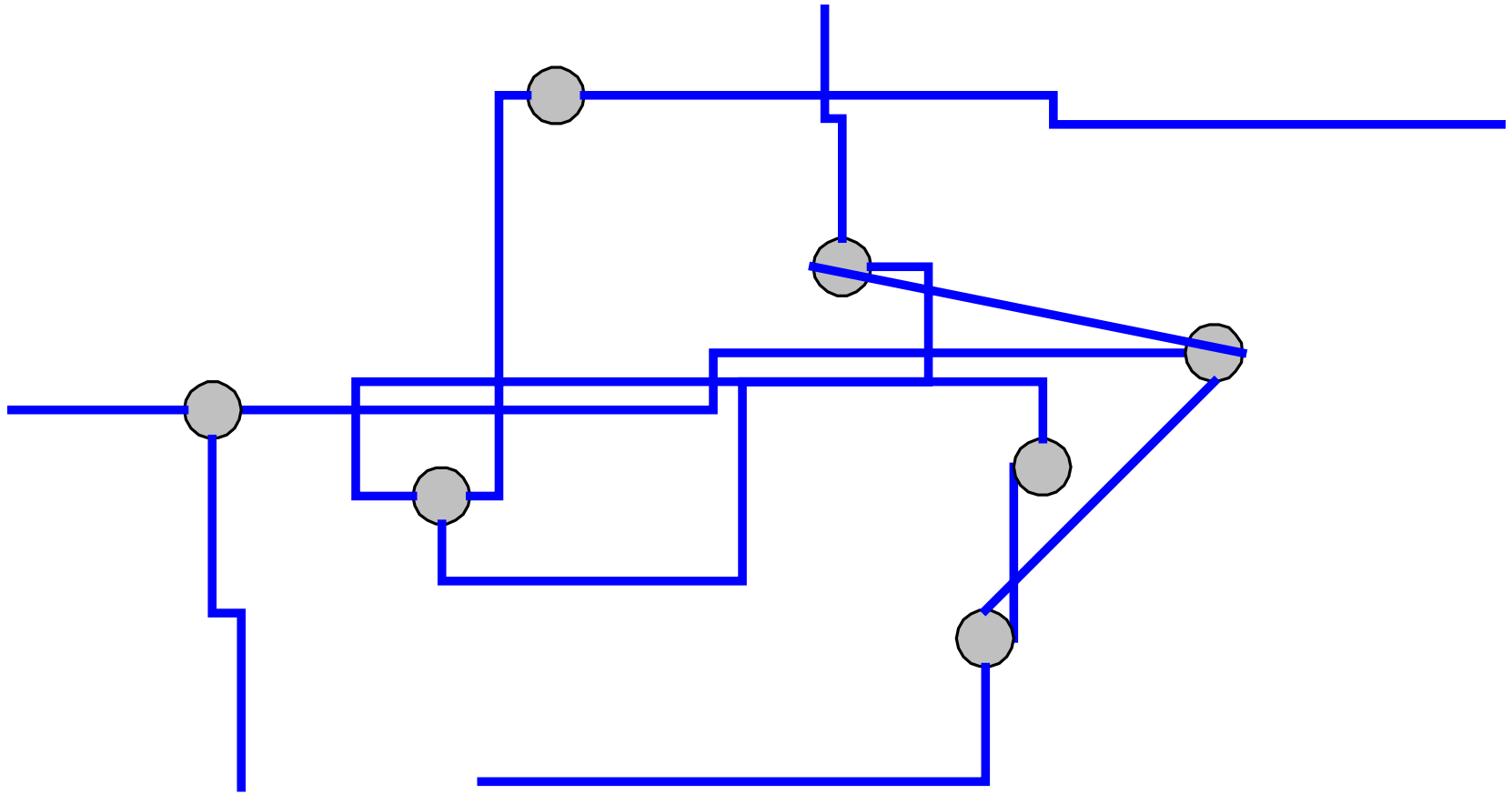


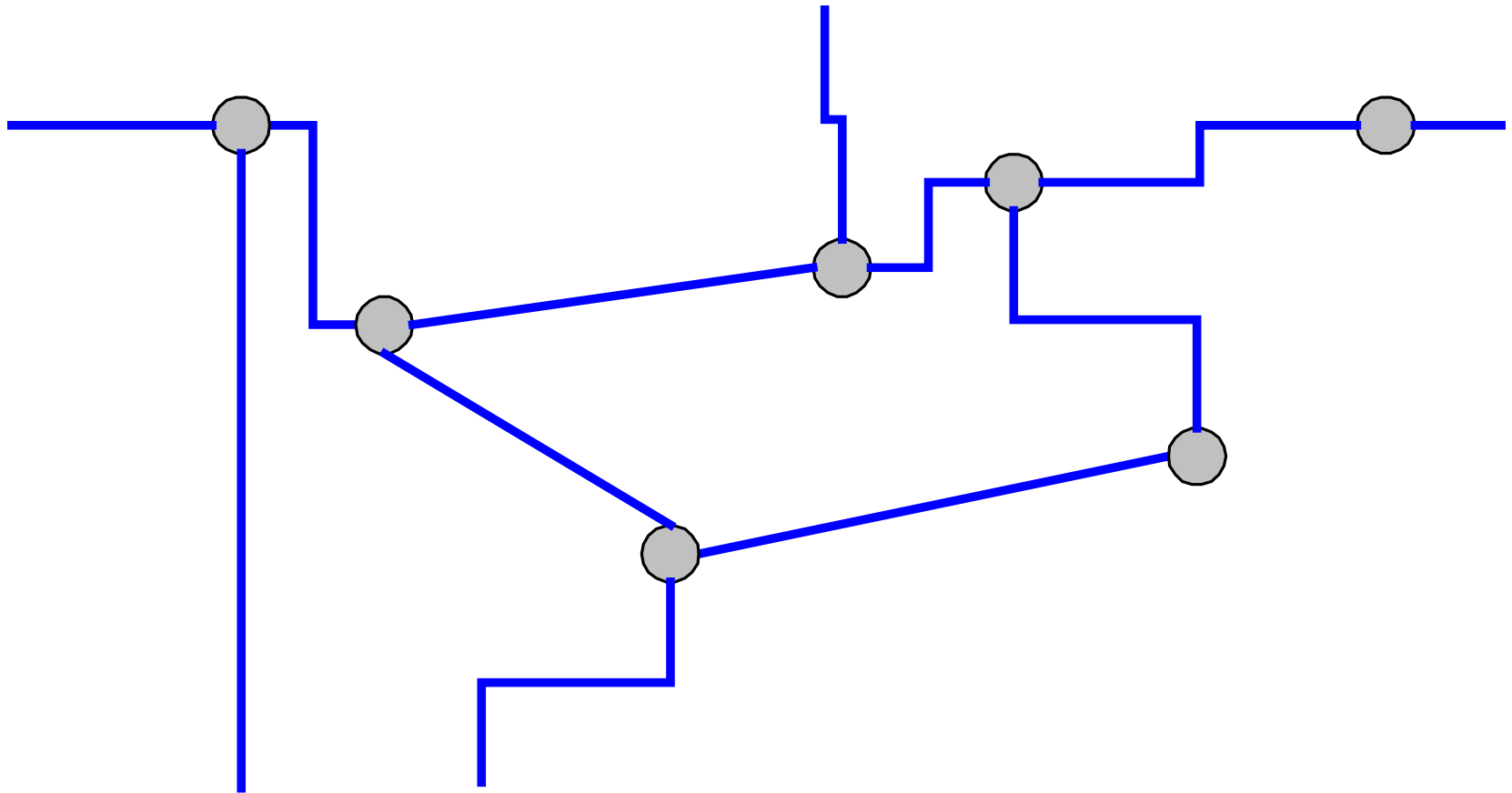


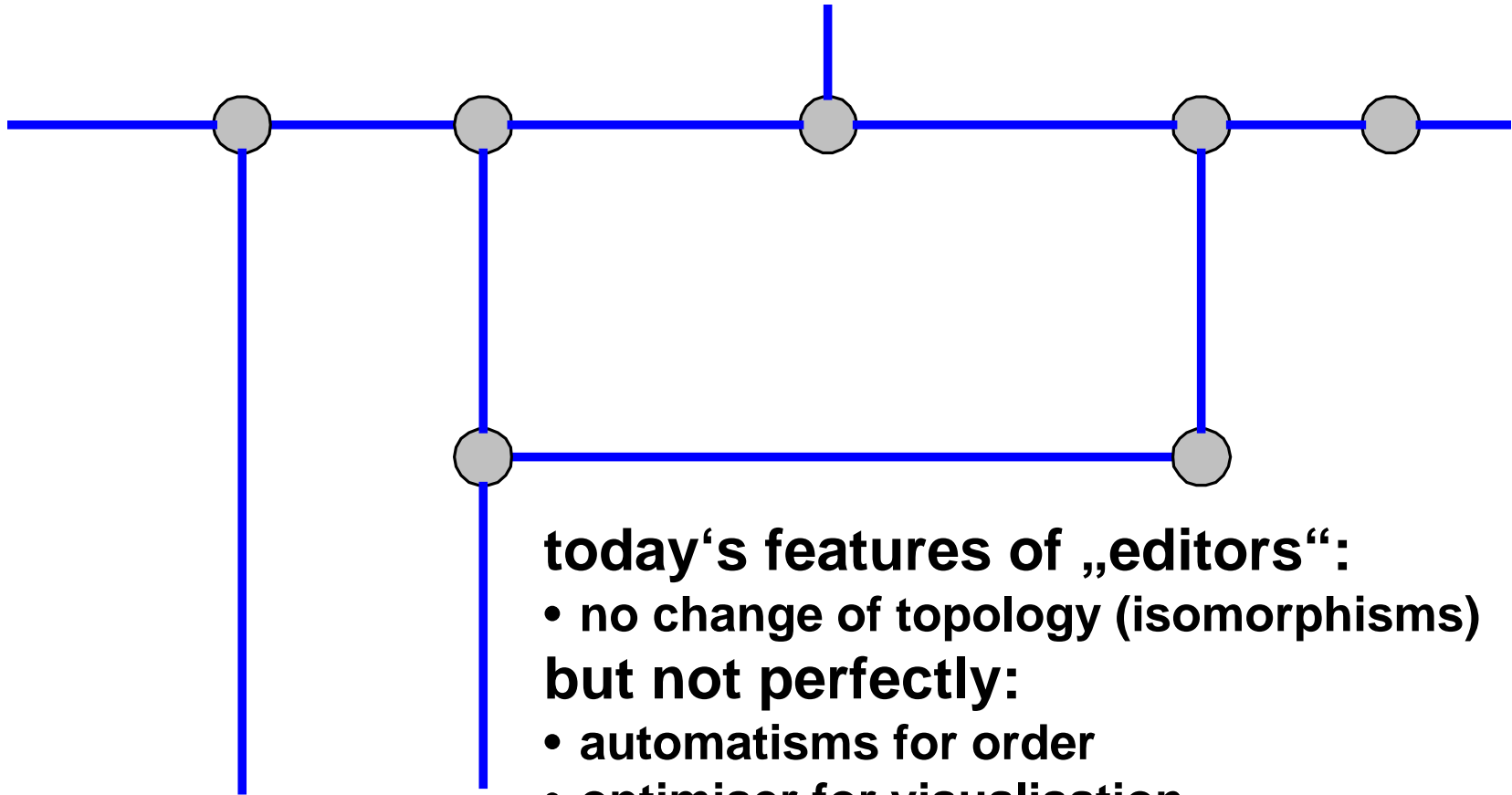
## e: side constraints

**Optimisation:  
maximise flexibility  
at any time step**









**today's features of „editors“:**

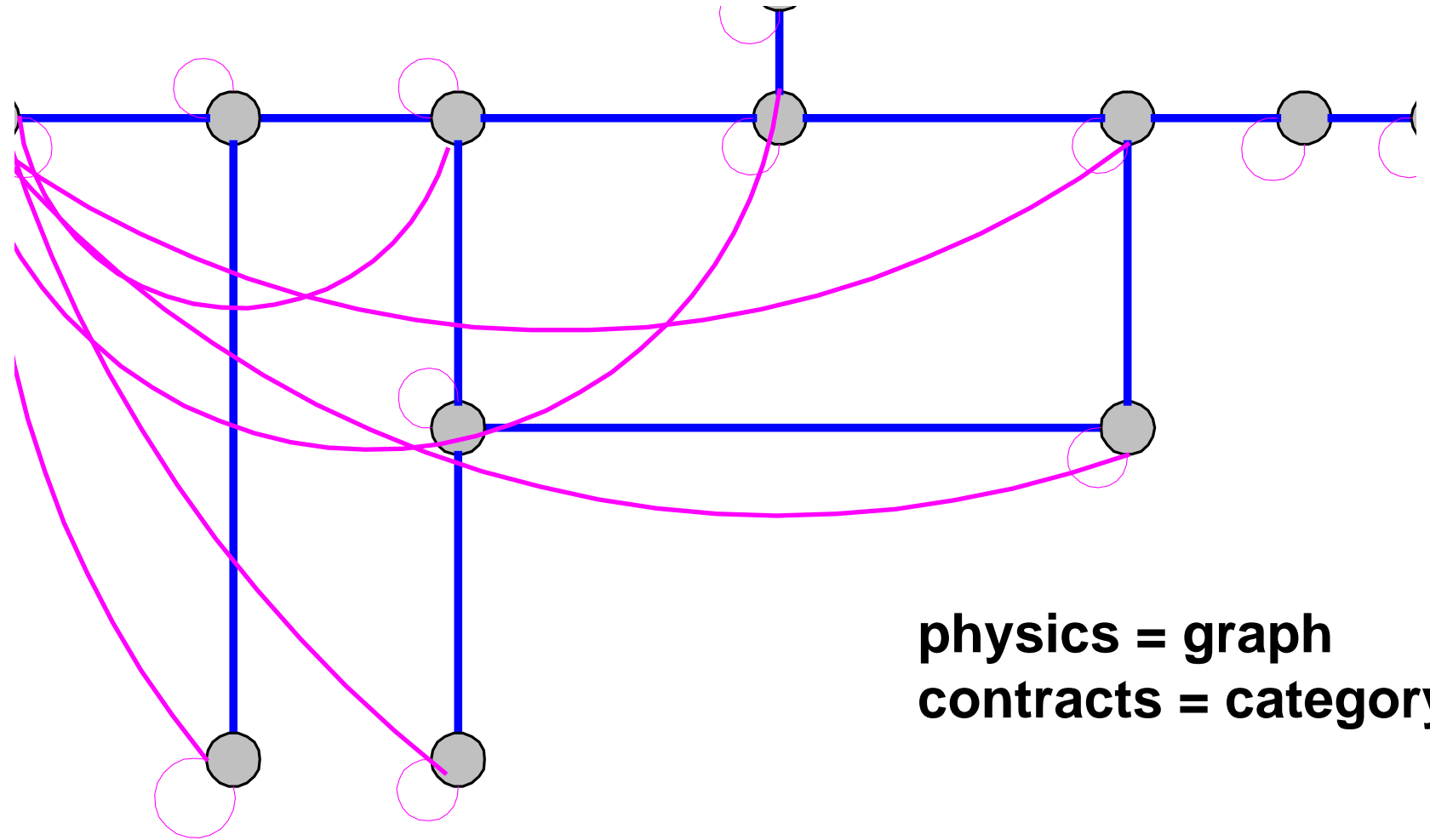
- no change of topology (isomorphisms)

**but not perfectly:**

- automatisms for order
- optimiser for visualisation

**but definitely not:**

- limits and colimits ...



**physics = graph**  
**contracts = category**

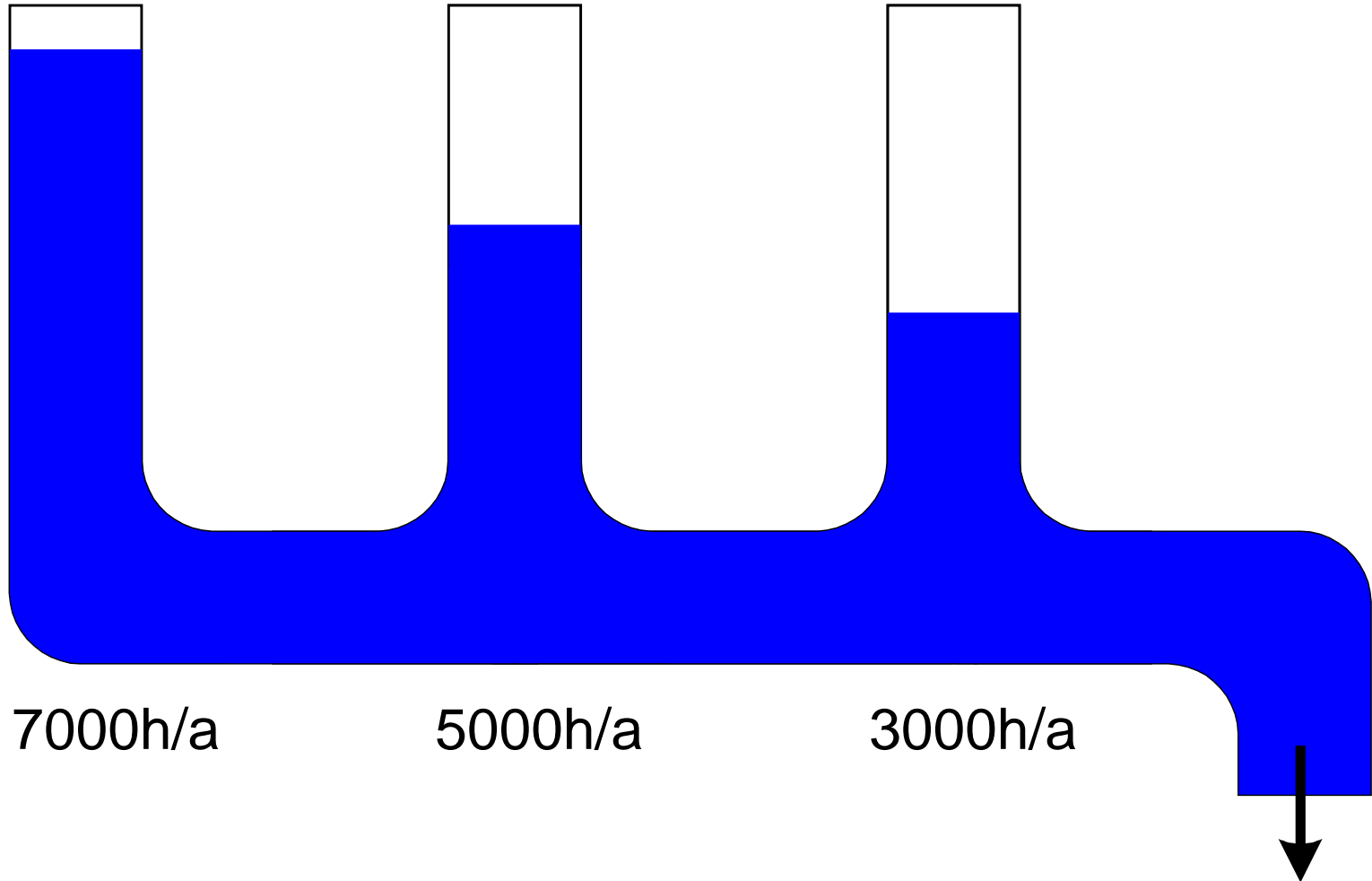


## I: applications of bin packing

- ✌ wired circuit boards
- ✌ space technology
- ✌ logistics (“decide as late as possible ...”)
- ✌ balancing of energy grids
- ✌ pattern recognition
- ✌ ...



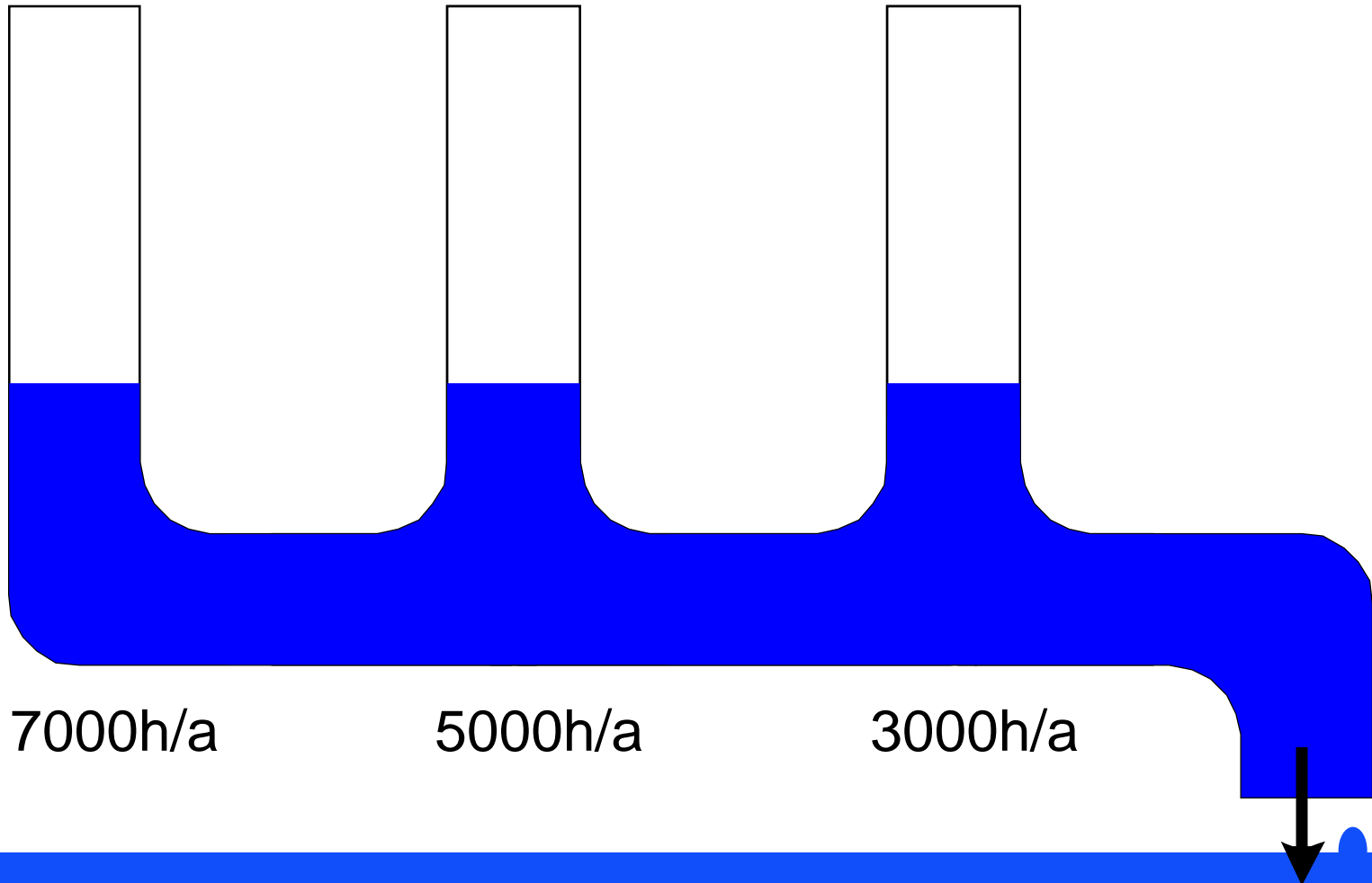
I: communicating tubes = bin packing





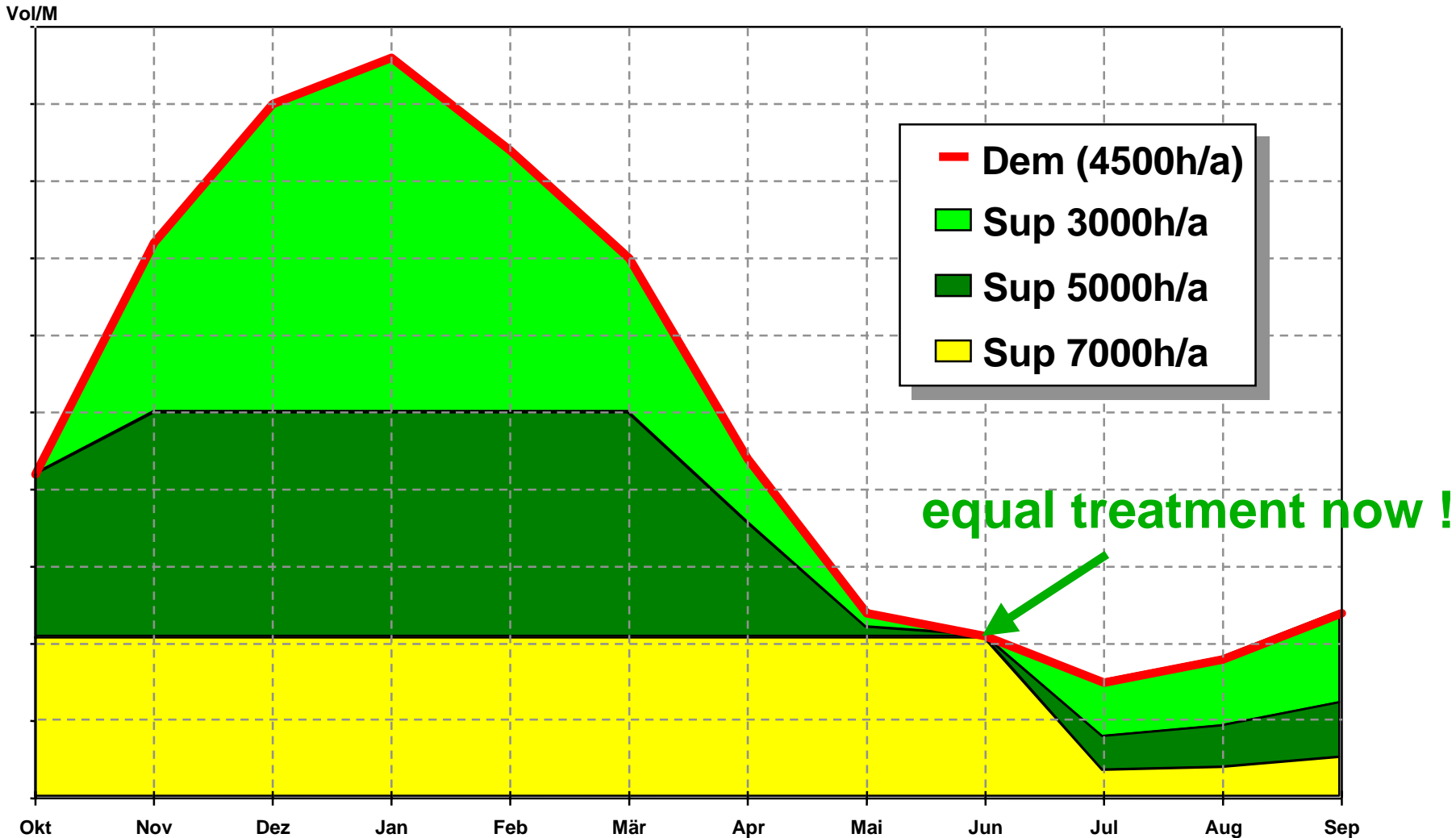
## Newest Mathematics Applied in Energy Industry

I: communicating tubes = bin packing





## I: demand/supply balancing

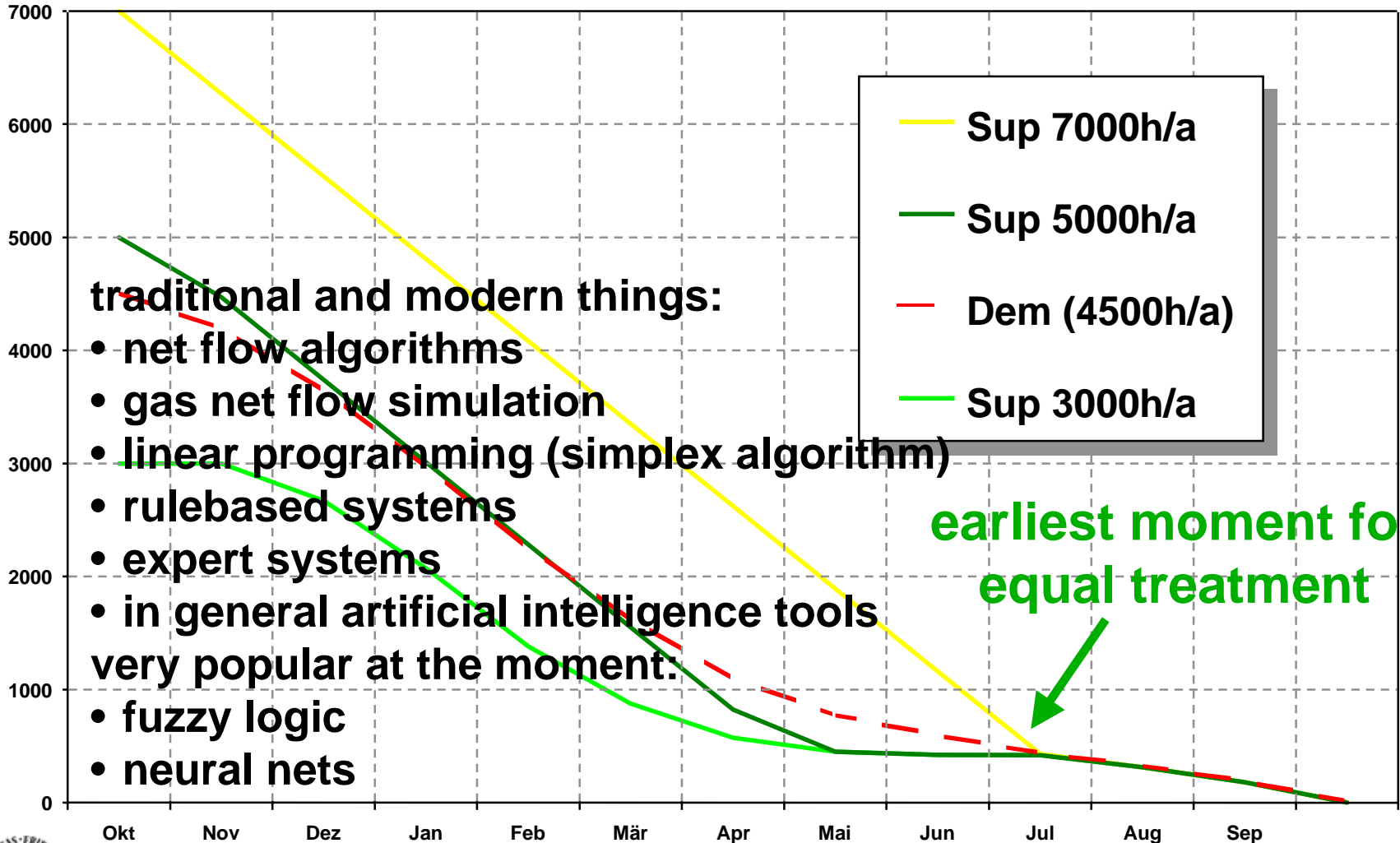




# Newest Mathematics Applied in Energy Industry

**I: equal treatment as soon as possible**

Rest Bh (Monatsbeginn)



**traditional and modern things:**

- net flow algorithms
- gas net flow simulation
- linear programming (simplex algorithm)
- rulebased systems
- expert systems
- in general artificial intelligence tools very popular at the moment:
- fuzzy logic
- neural nets

**earliest moment for equal treatment**

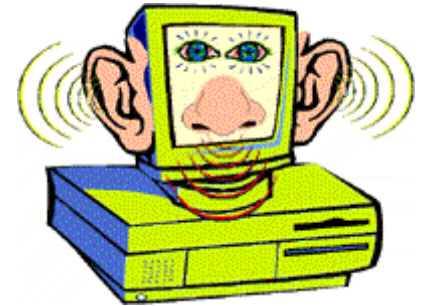


# Human Interface Supervision System

## Seeing



- External influences due to unauthorised persons/ fire/storm damage
- Formation of ice on parts of plants (leaks)
- Accumulations of liquids



## Smelling



- Detection of small leaks
- Detection of the key substances benzene and hydrogen sulphide
- Separation of plant-specific smells from external smells (e.g. sour gas/liquid manure)

## Hearing

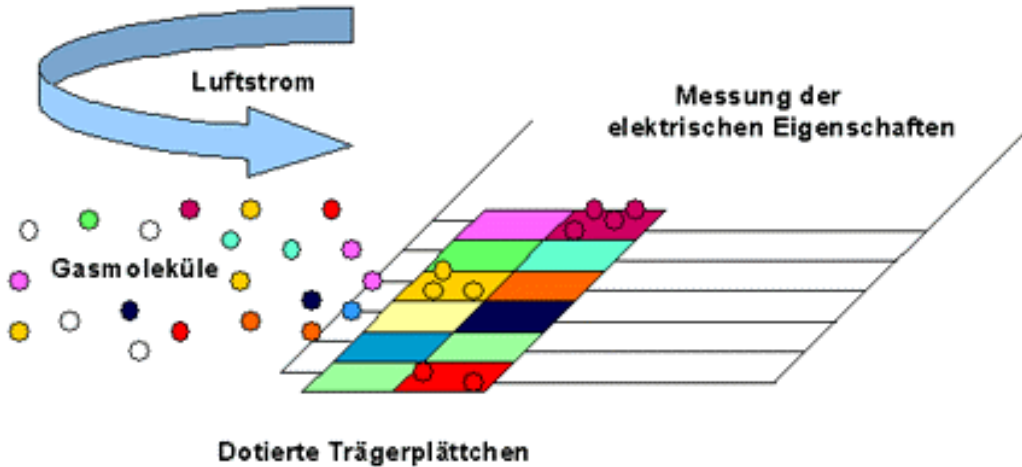


- Detection of small leaks (emissions of gases)
- Detection of faults (e.g. damage to pumps, bearings, etc.)
- Detection of malfunctions from the prevailing ambient noises



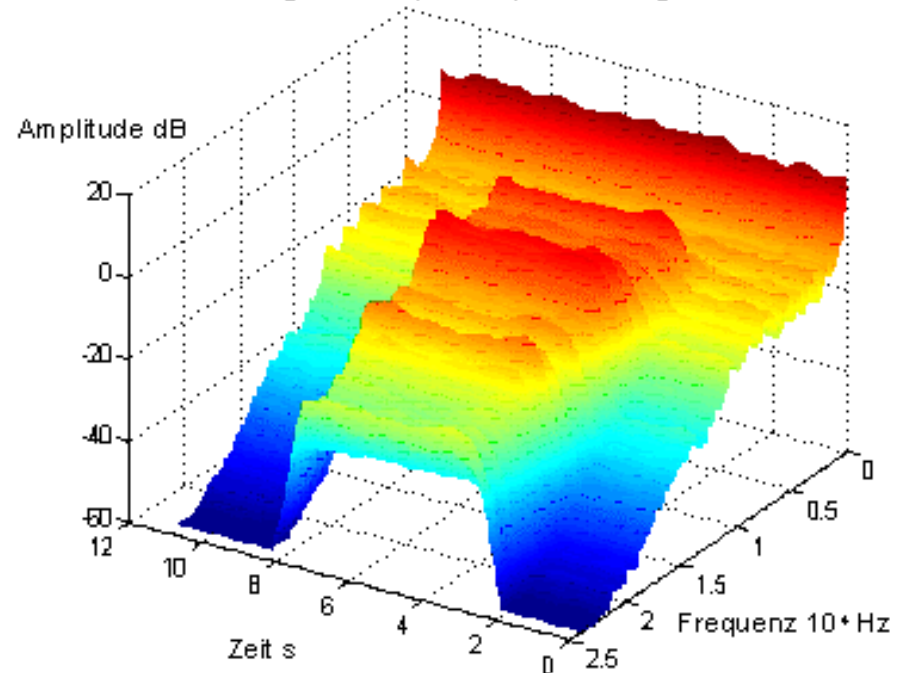
# Newest Mathematics Applied in Energy Industry

s: HISS



**pattern recognition:**  
**fuzzy logic & neural nets**  
**better => PreTOPs**

Ausströmgeräusch (5Nm<sup>3</sup>/h) mit Grundgeräusch



<http://www.beb.de>



Intelligente Erdgasförderung

EXPO2000 HANNOVER

Registriertes Projekt der Weltausstellung



**CATOP 2000**

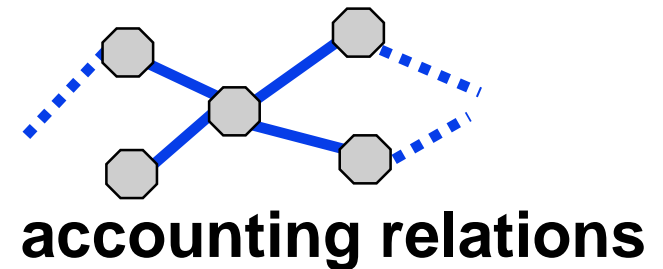
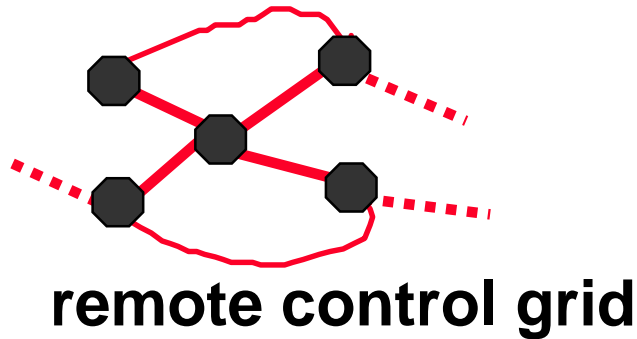
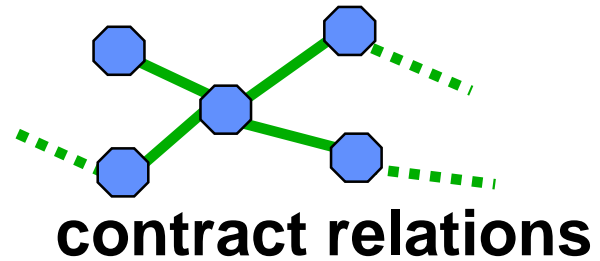
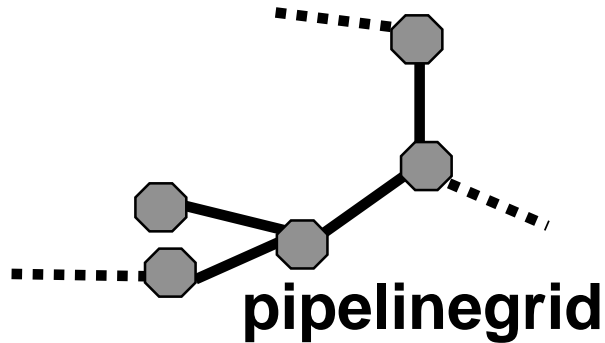
Uni Fribourg, July 4-6, 2000

rolf.brandt@beb.de - cattopinenergy.ppt - 04.07.2000





# I: urgent help from cat top ?





I: where we have to go ... ?

my 5-point-program: computer assistance for  
 $\cong$  better isos e.g. automatisms for order, optimiser  
for visualisation, ...



part of grid (sub spaces)



gluing together of grids (coproducts)



simplifying grids (quotients)



product of grids (products)



**=> New topological features required !!!**

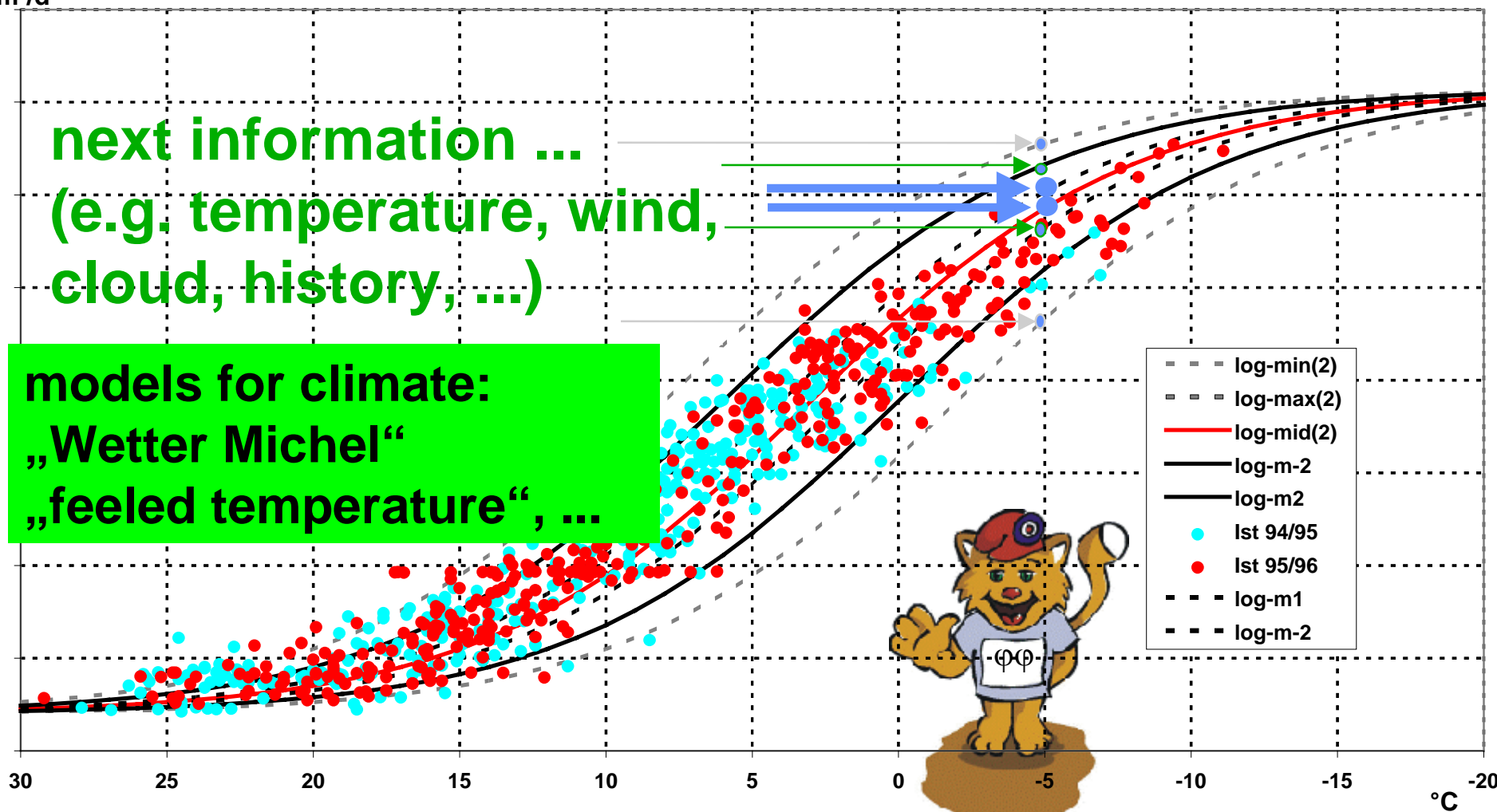


## i: forecasting energy over temperature

m<sup>3</sup>/d

next information ...  
(e.g. temperature, wind,  
cloud, history, ...)

models for climate:  
„Wetter Michel“  
„feeled temperature“, ...



... thank you  
for your  
kind  
attention ...

