



# Applications of Quasitopos Axioms in Optimization





~~peer~~

**H<sup>2</sup>' 60<sup>th</sup>,  
my top cat friend**



## agenda

### **$H^2$** category theory

- ✧ topological categories
- ✧ quasitopoi

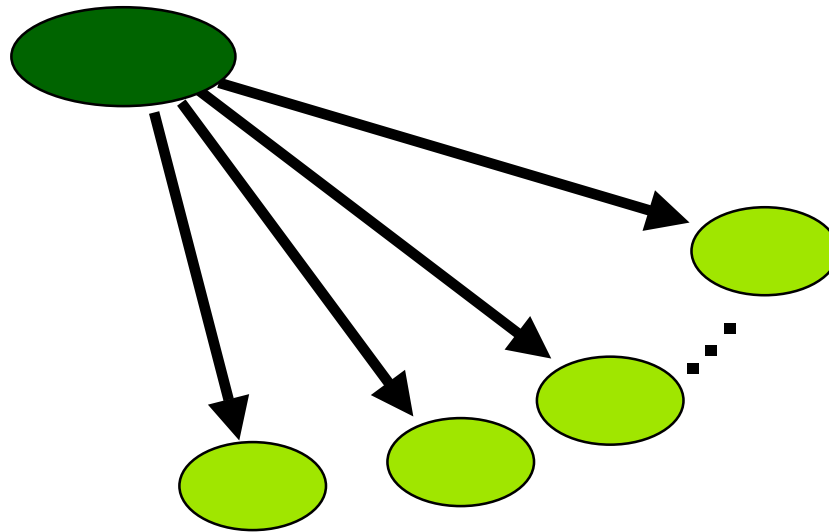
### **$H^2$** applications / optimization

- ✧ load balancing
- ✧ bin packing
- ✧ demand/supply balancing
- ✧ forecasting



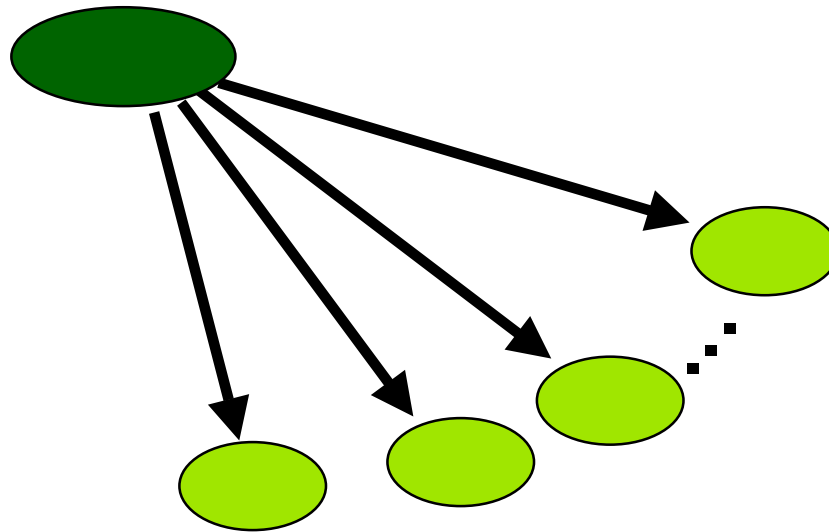
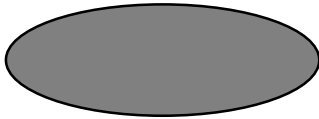
# Applications of Quasitopos Axioms in Optimization

top cats: initial structures



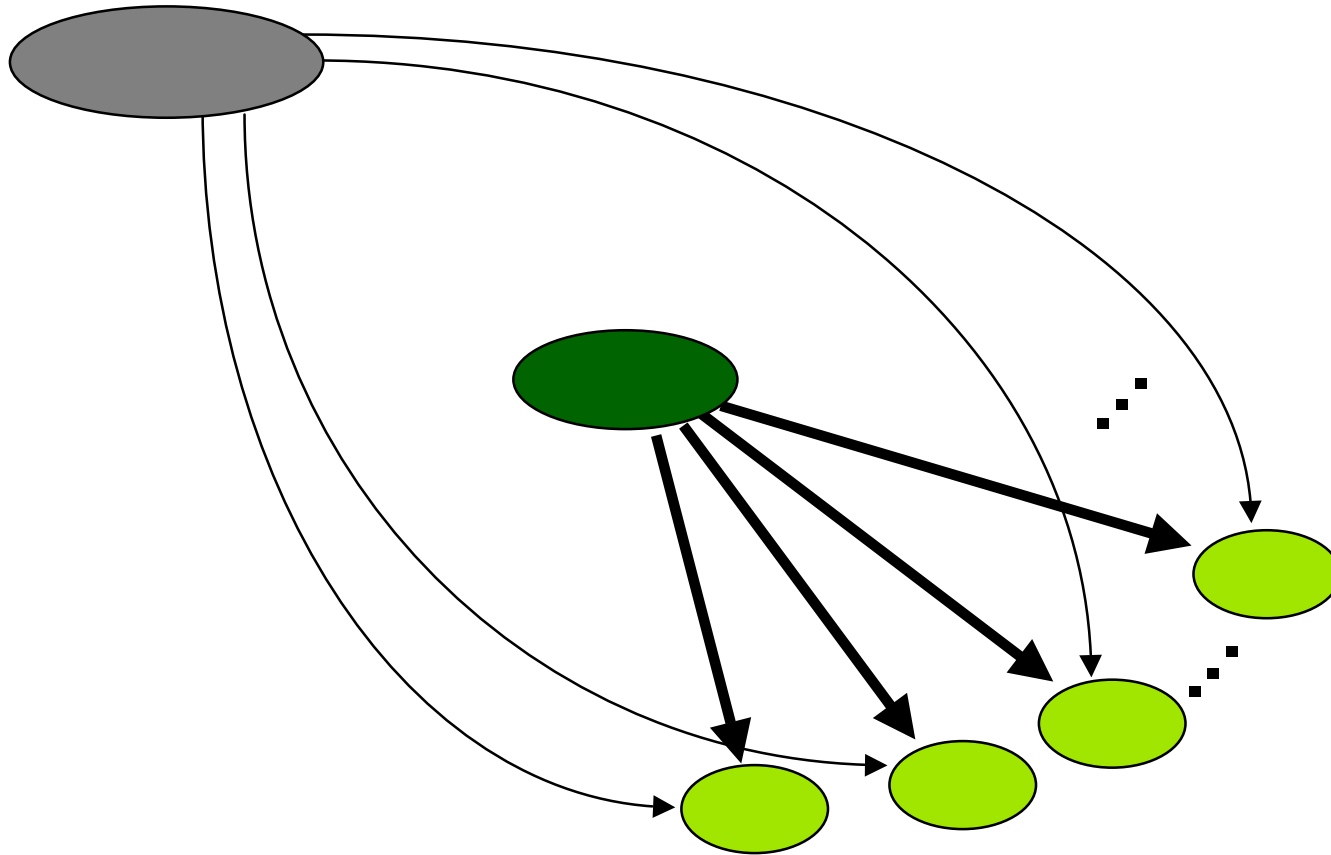
# Applications of Quasitopos Axioms in Optimization

top cats: initial structures



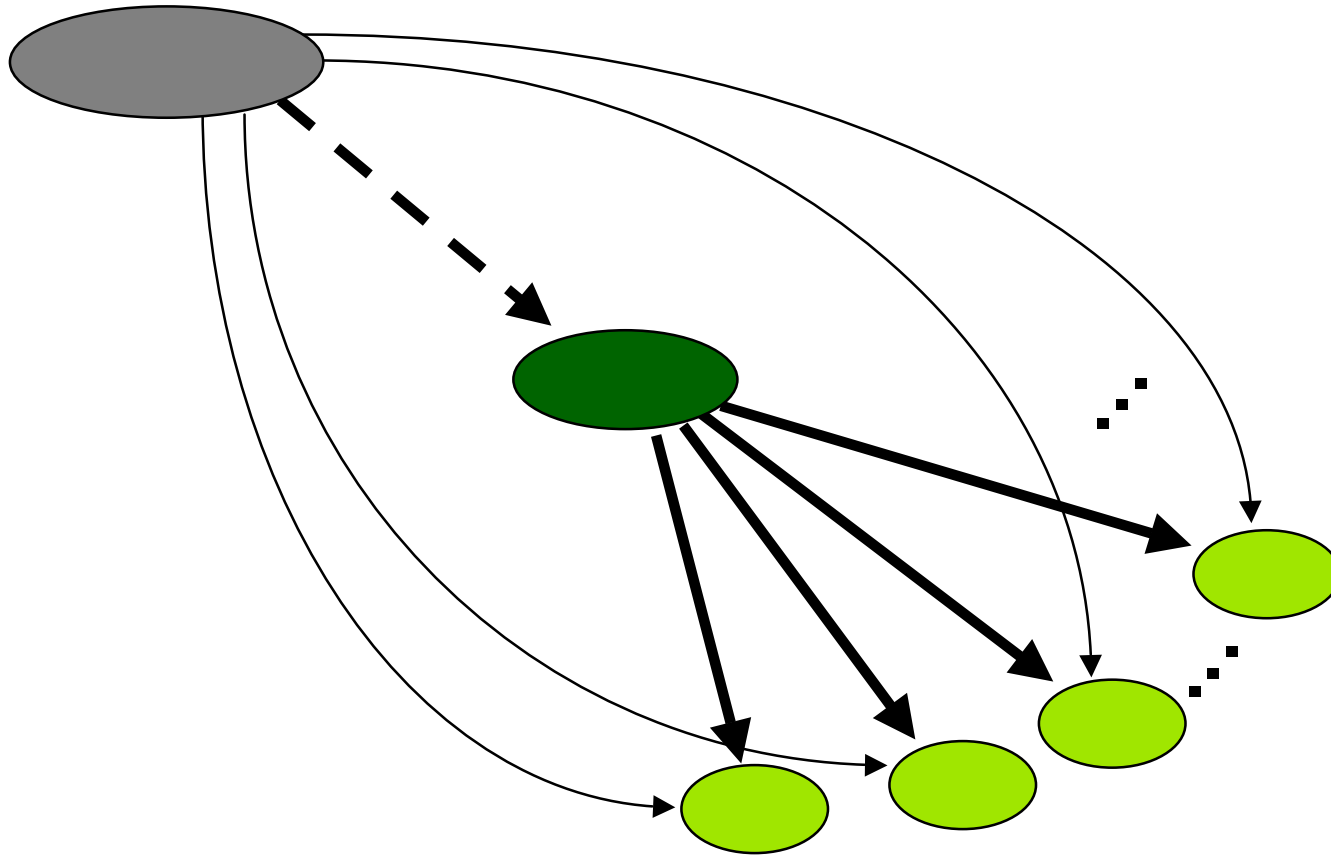
# Applications of Quasitopos Axioms in Optimization

top cats: initial structures



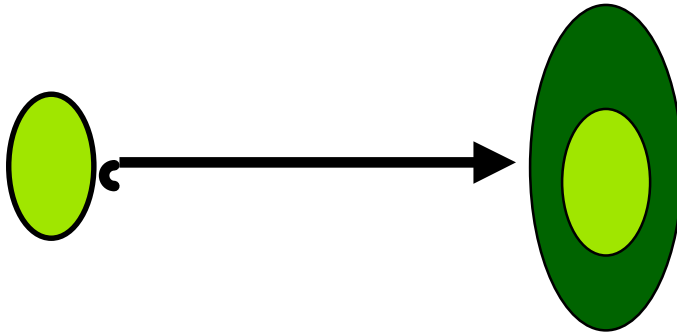
# Applications of Quasitopos Axioms in Optimization

top cats: initial structures



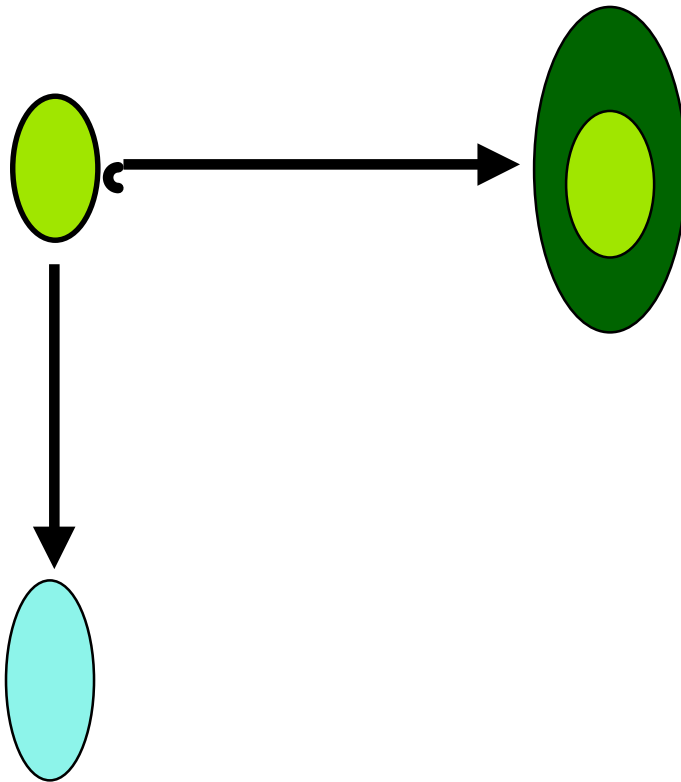
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



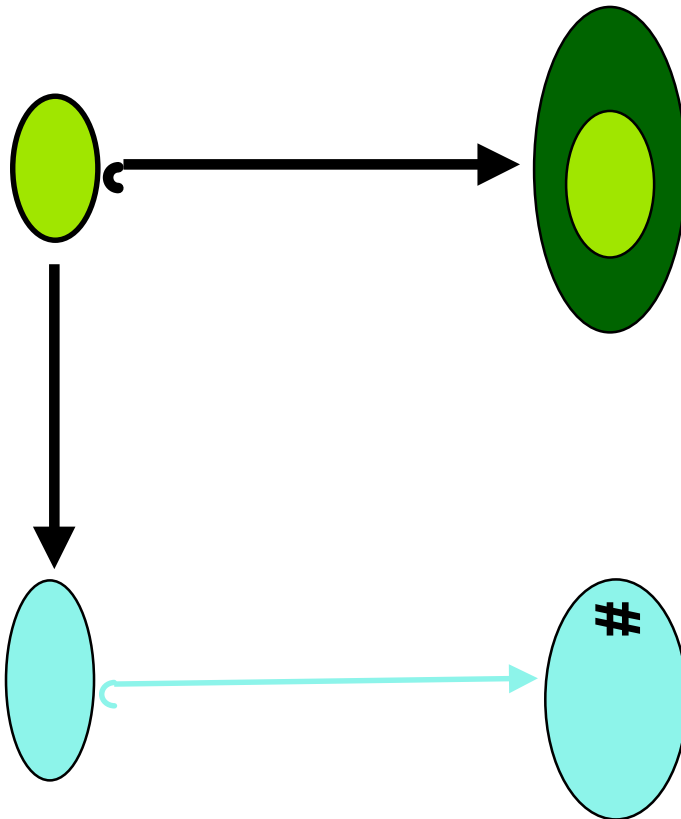
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



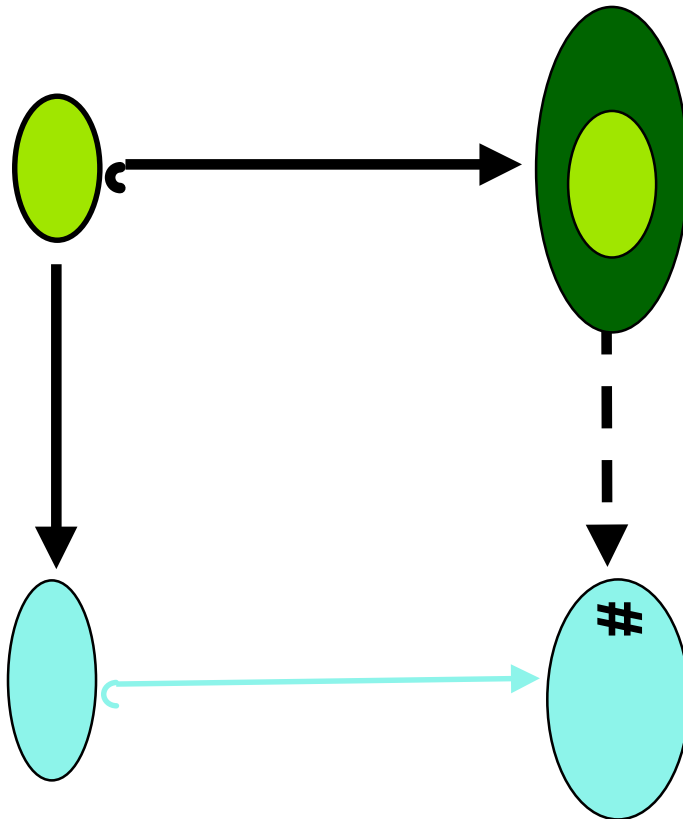
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



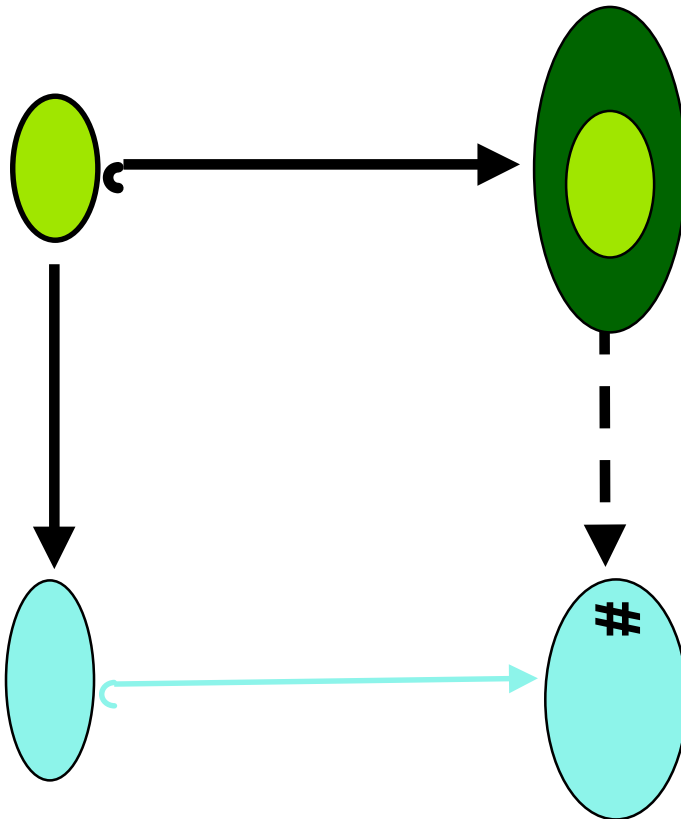
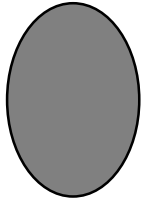
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



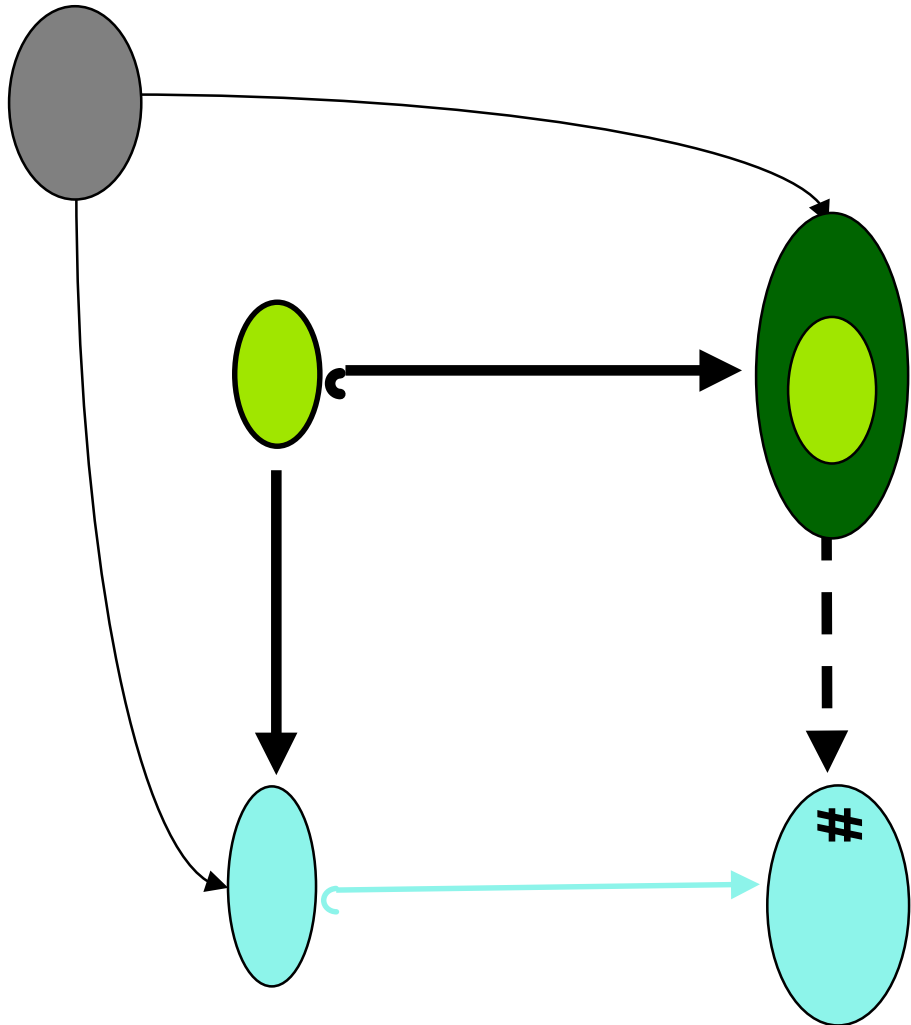
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



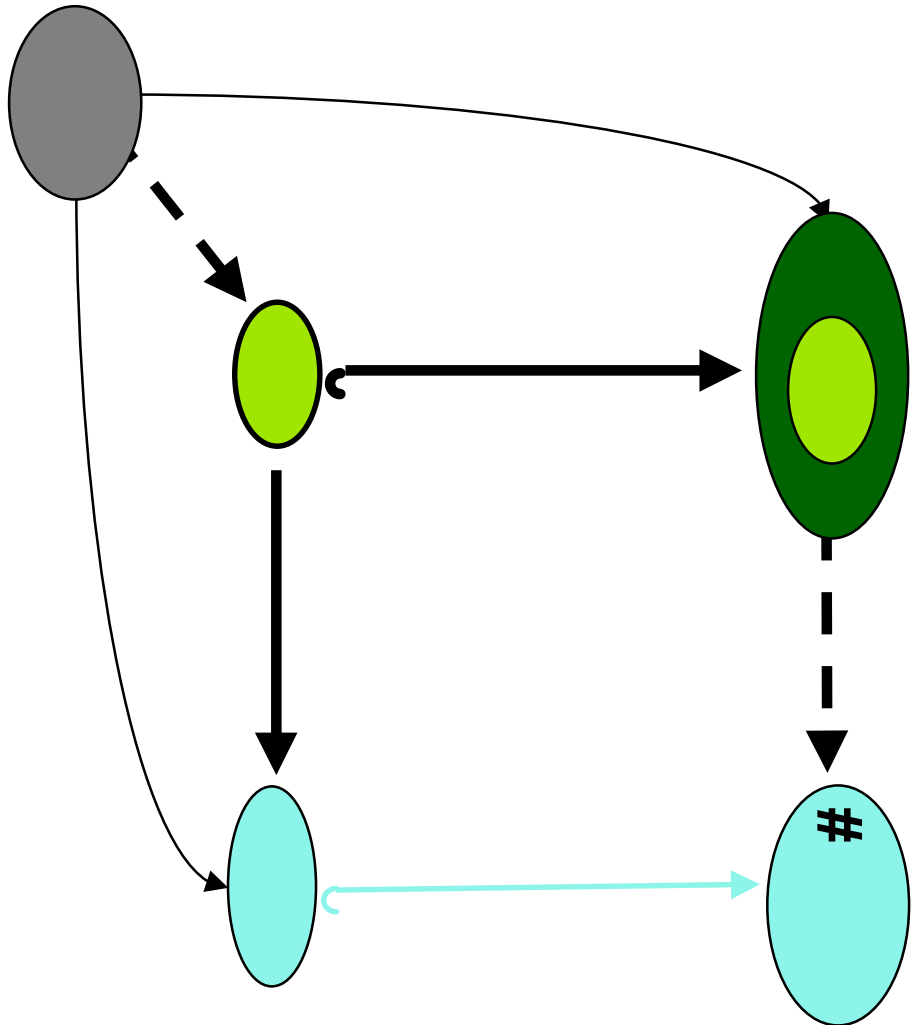
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



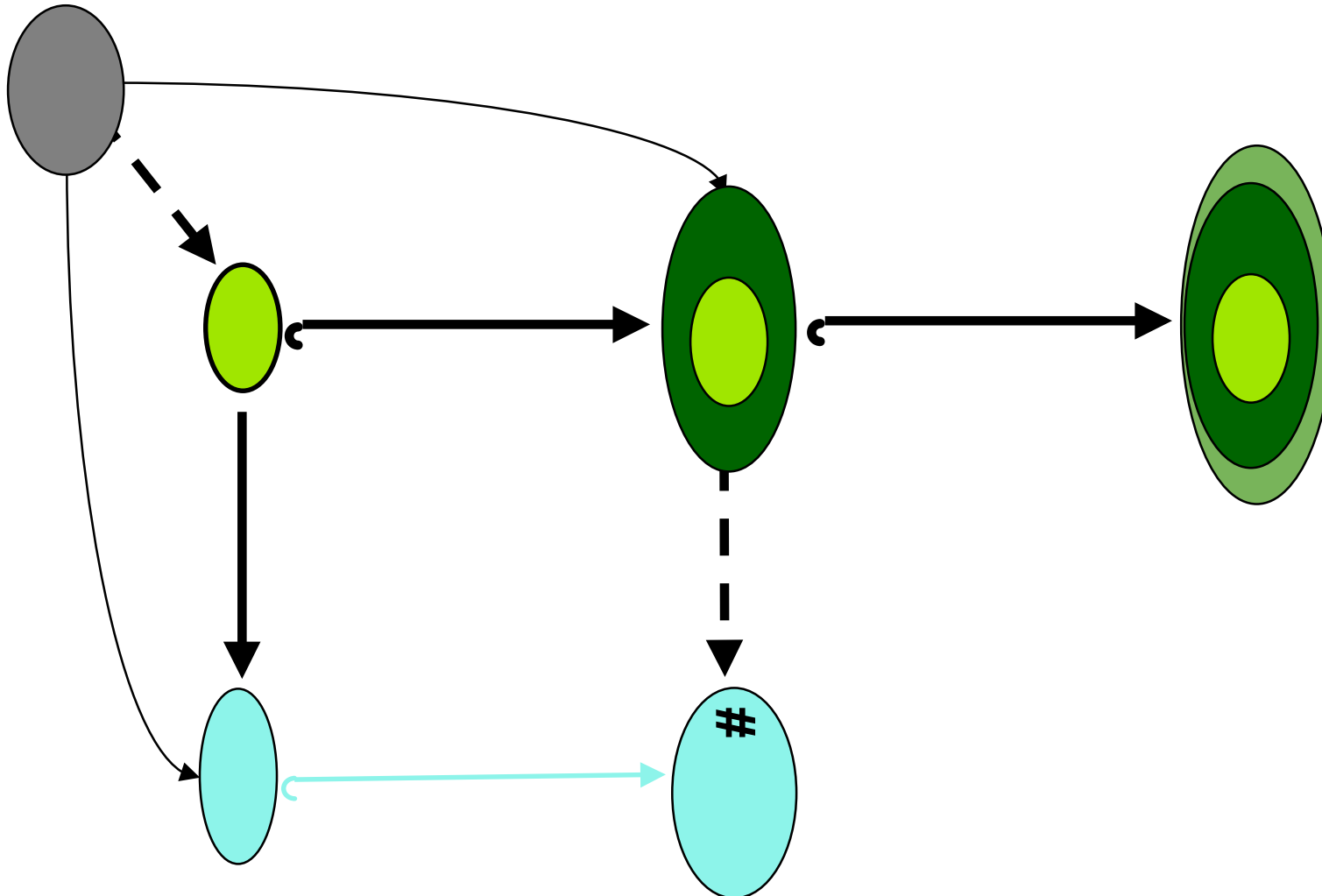
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



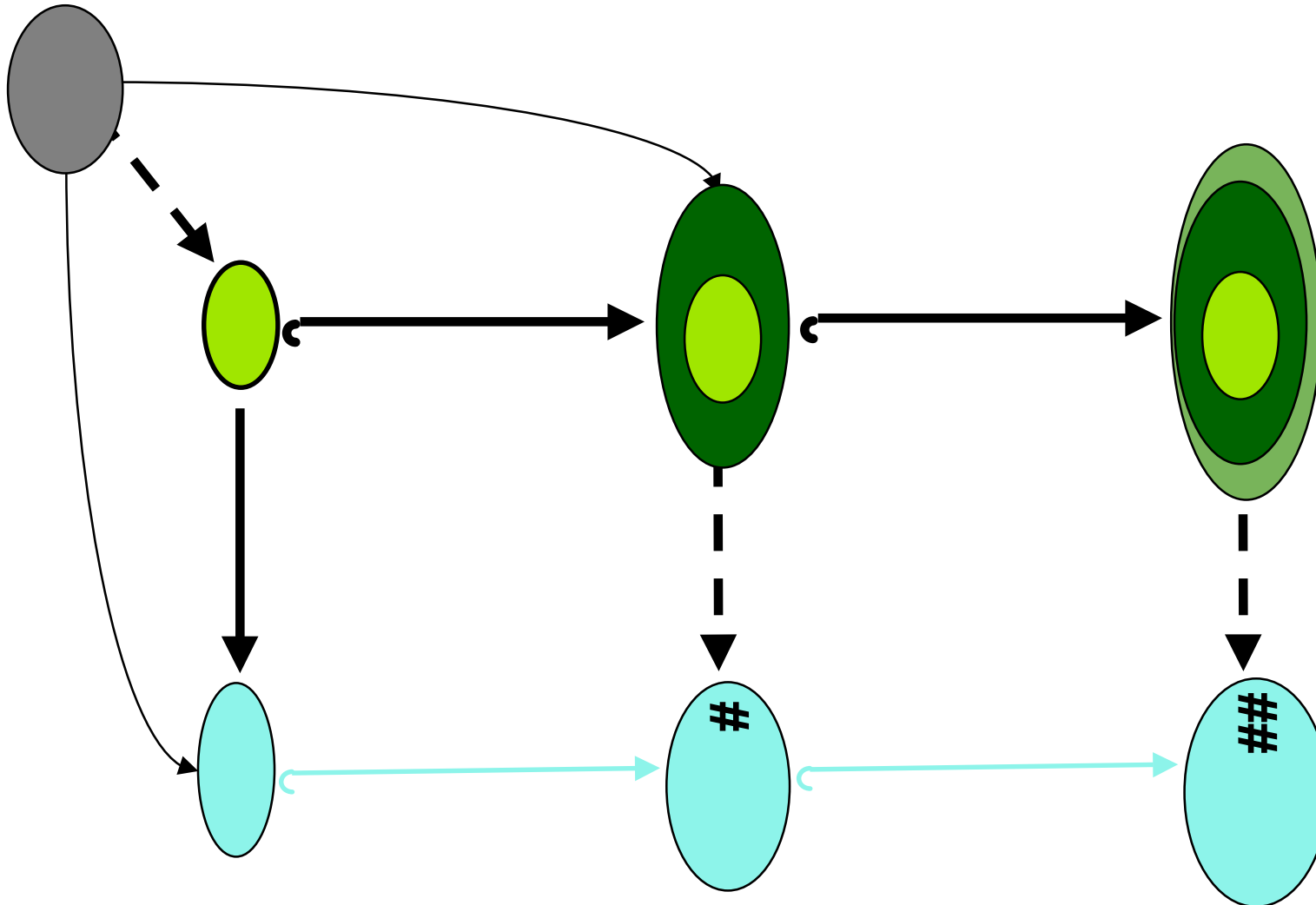
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



# Applications of Quasitopos Axioms in Optimization

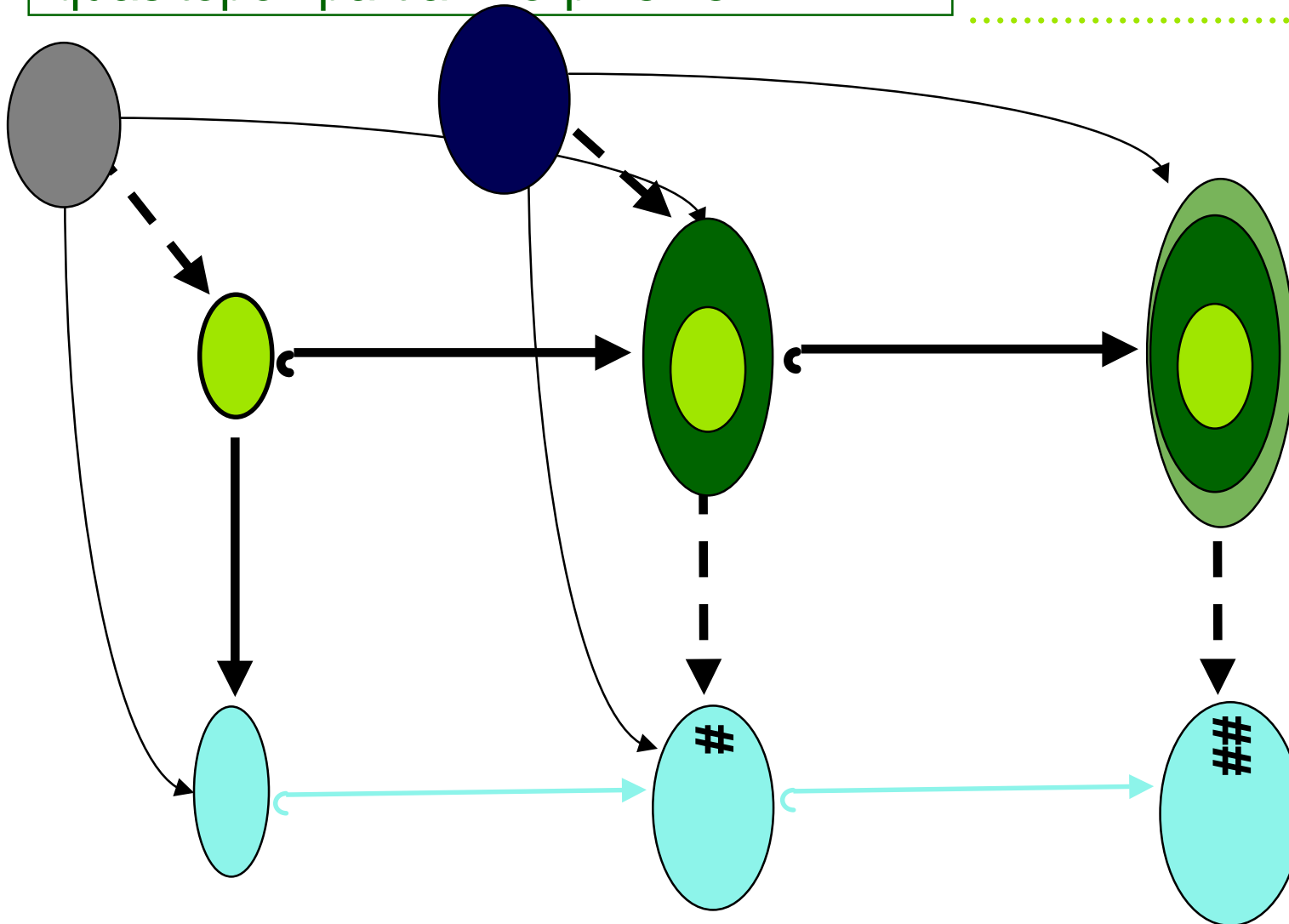
quasitopoi: partial morphisms





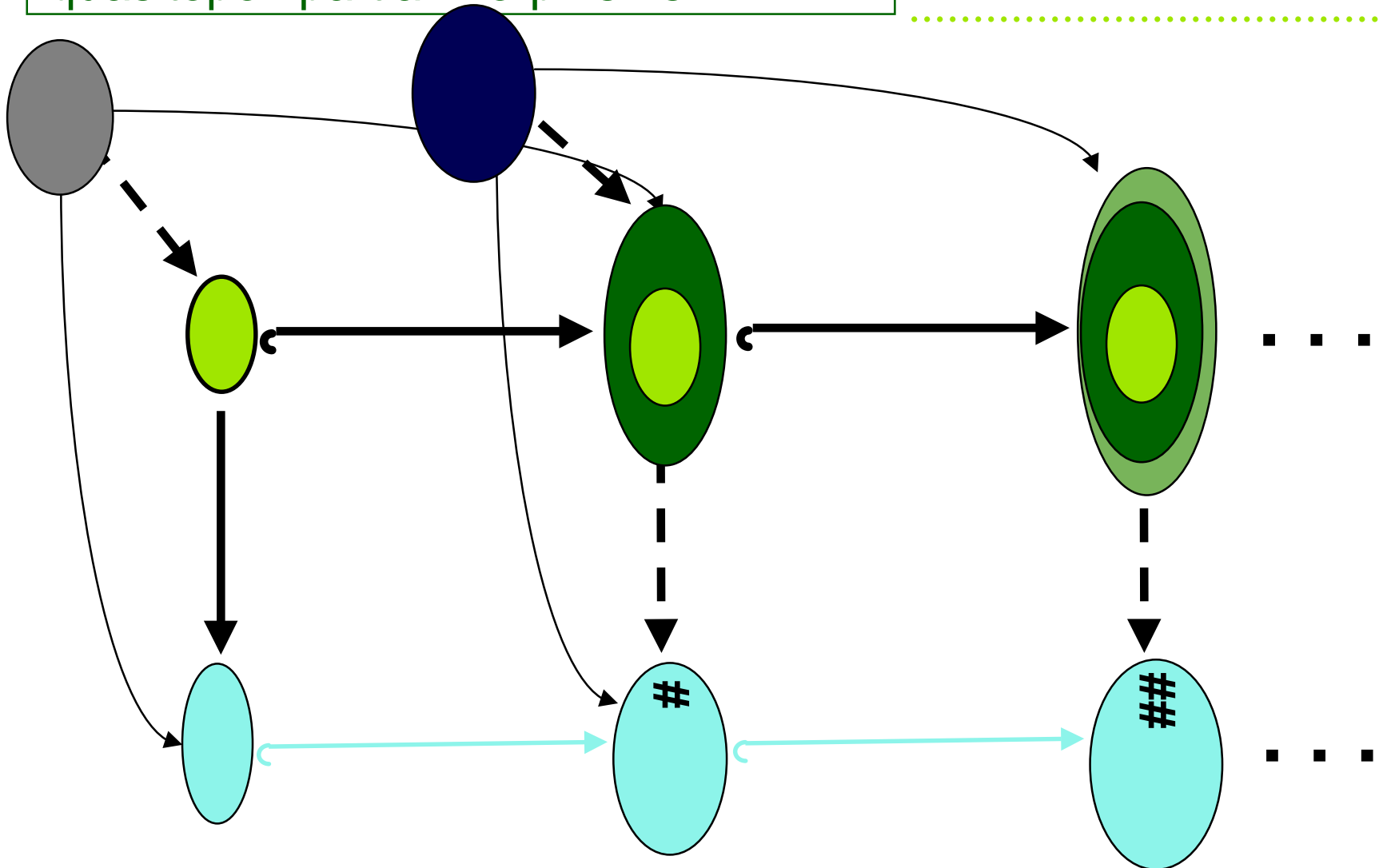
# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



# Applications of Quasitopos Axioms in Optimization

quasitopoi: partial morphisms



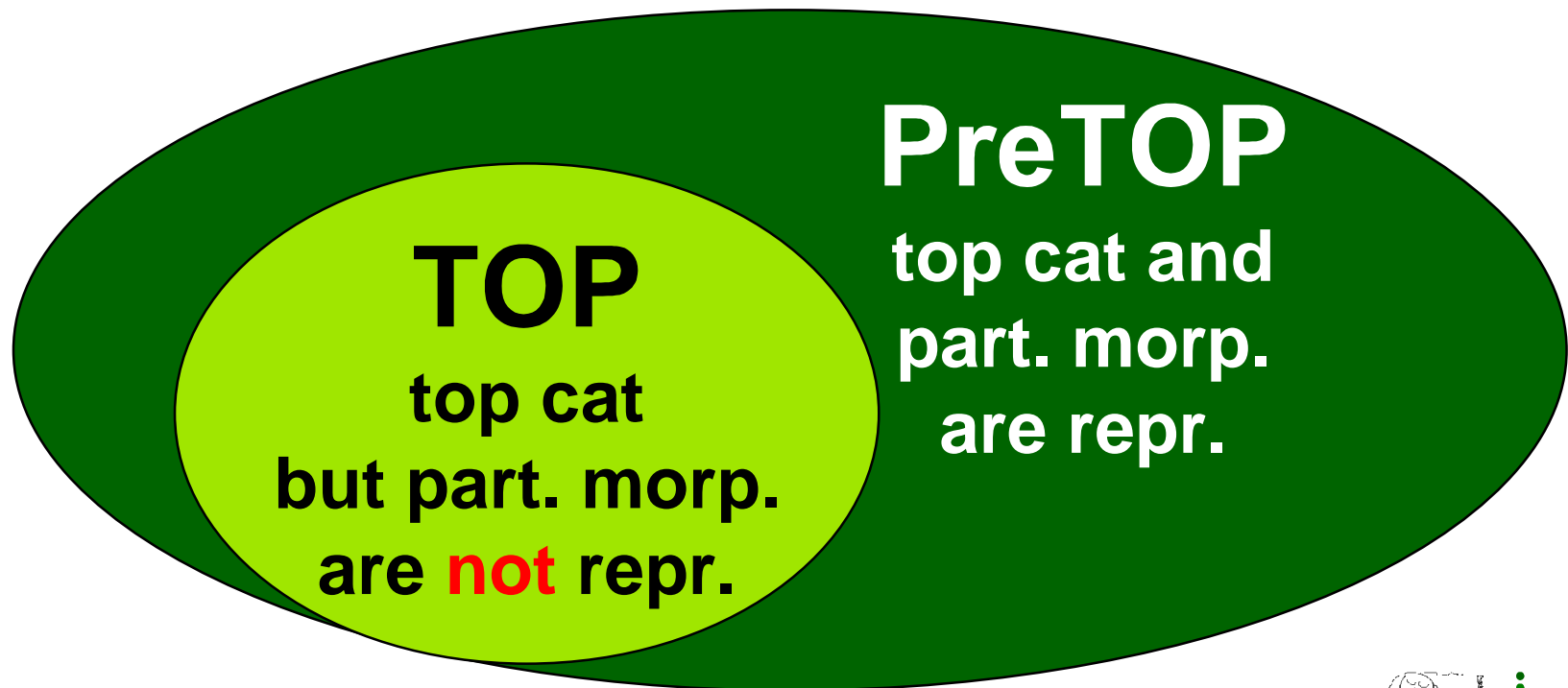
“partial morphisms hull” of TOP ???

**TOP**  
top cat  
but part. morp.  
are **not** repr.

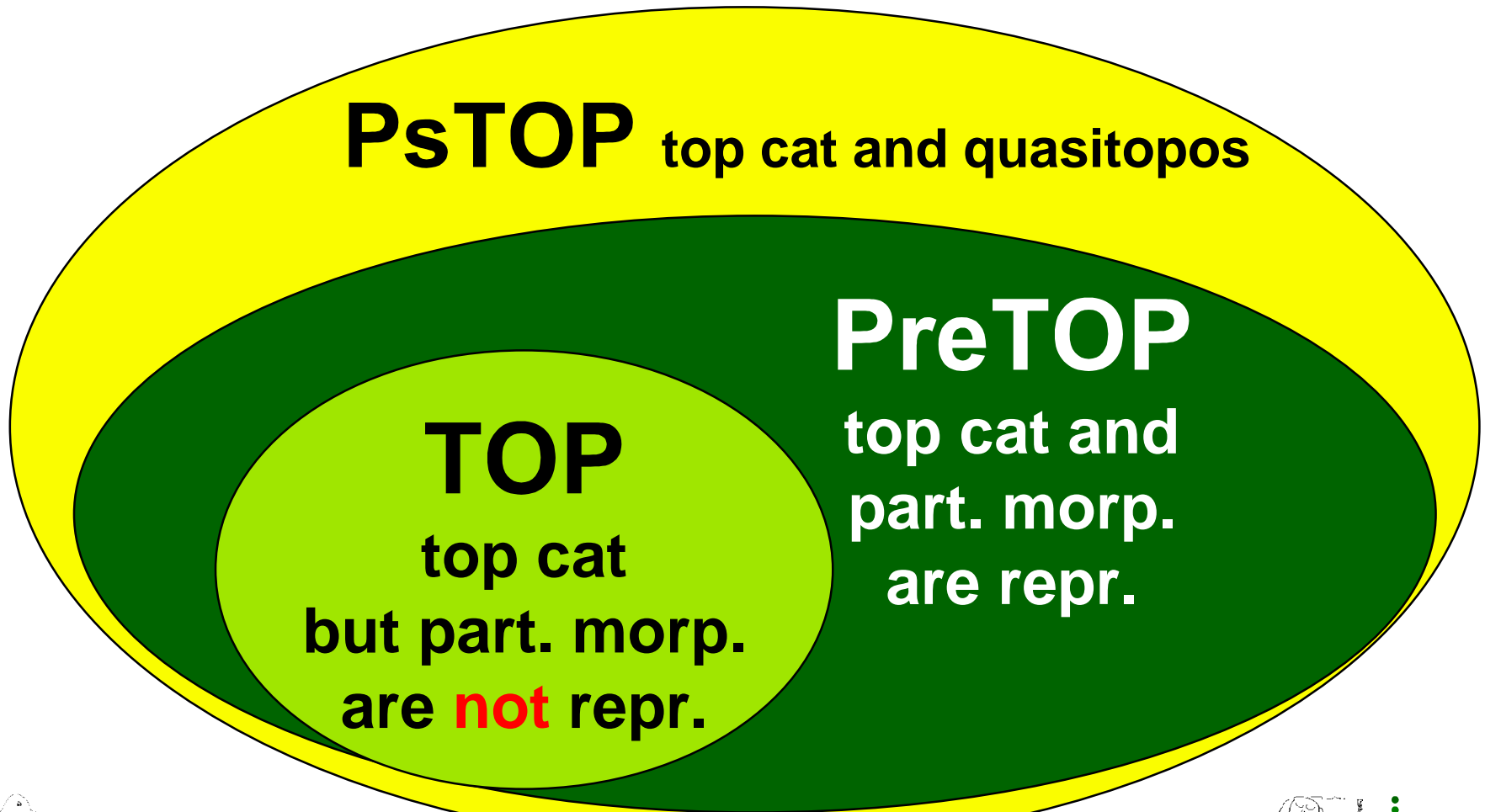


## Applications of Quasitopos Axioms in Optimization

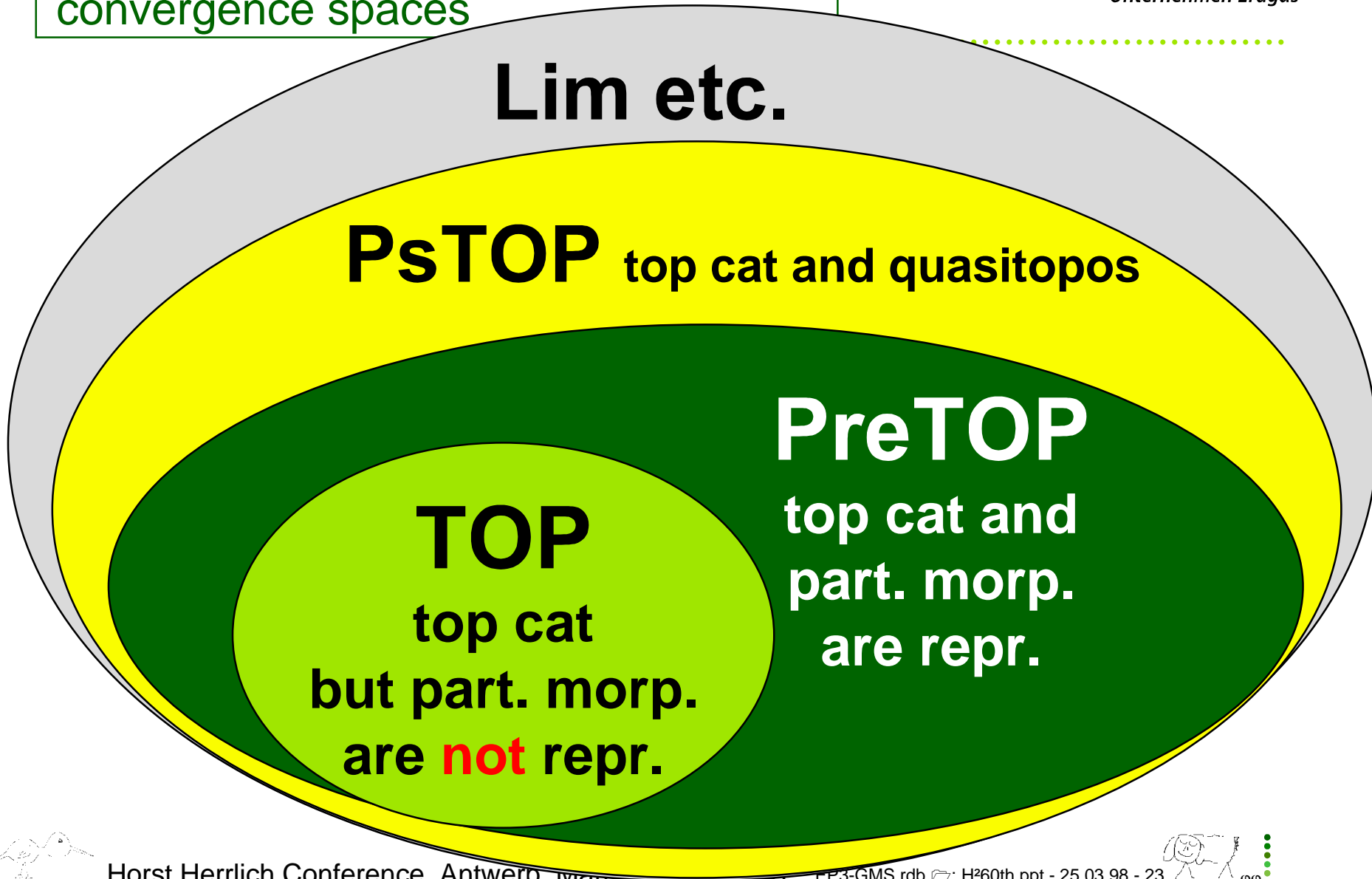
= extensional topological hull of TOP



quasitopos hull of TOP



convergence spaces



viva PreTOP ...

in practice:

Lim etc.

 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 !!!**

PreTOP  
top cat and  
are repl.

TOP  
top  
but part. morp.  
can't rep.



## agenda

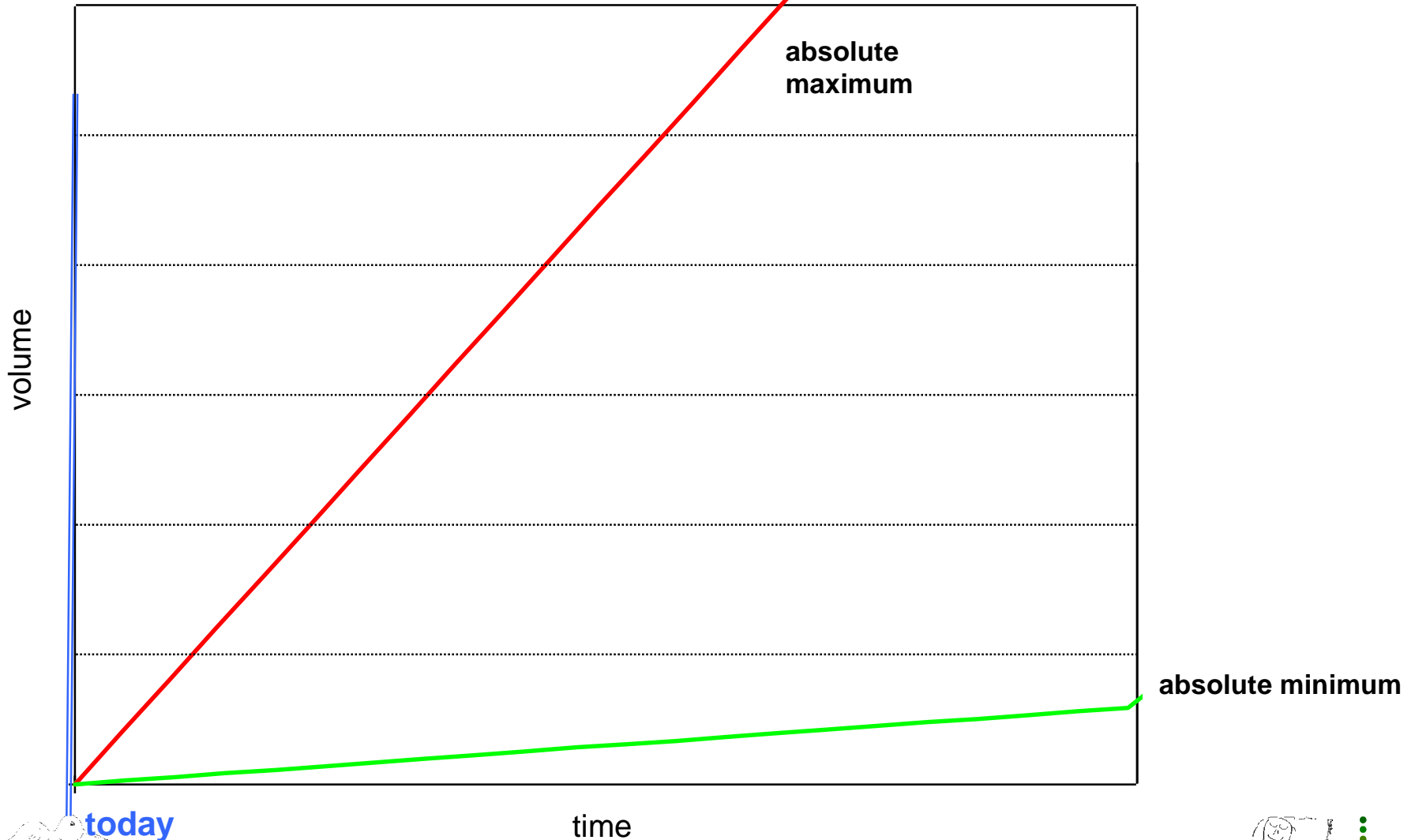
- $H^2$**  category theory
- ✧ topological categories
  - ✧ quasitopoi

- $H^2$**  applications / optimization
- ✧ load balancing
  - ✧ bin packing
  - ✧ demand/supply balancing
  - ✧ forecasting



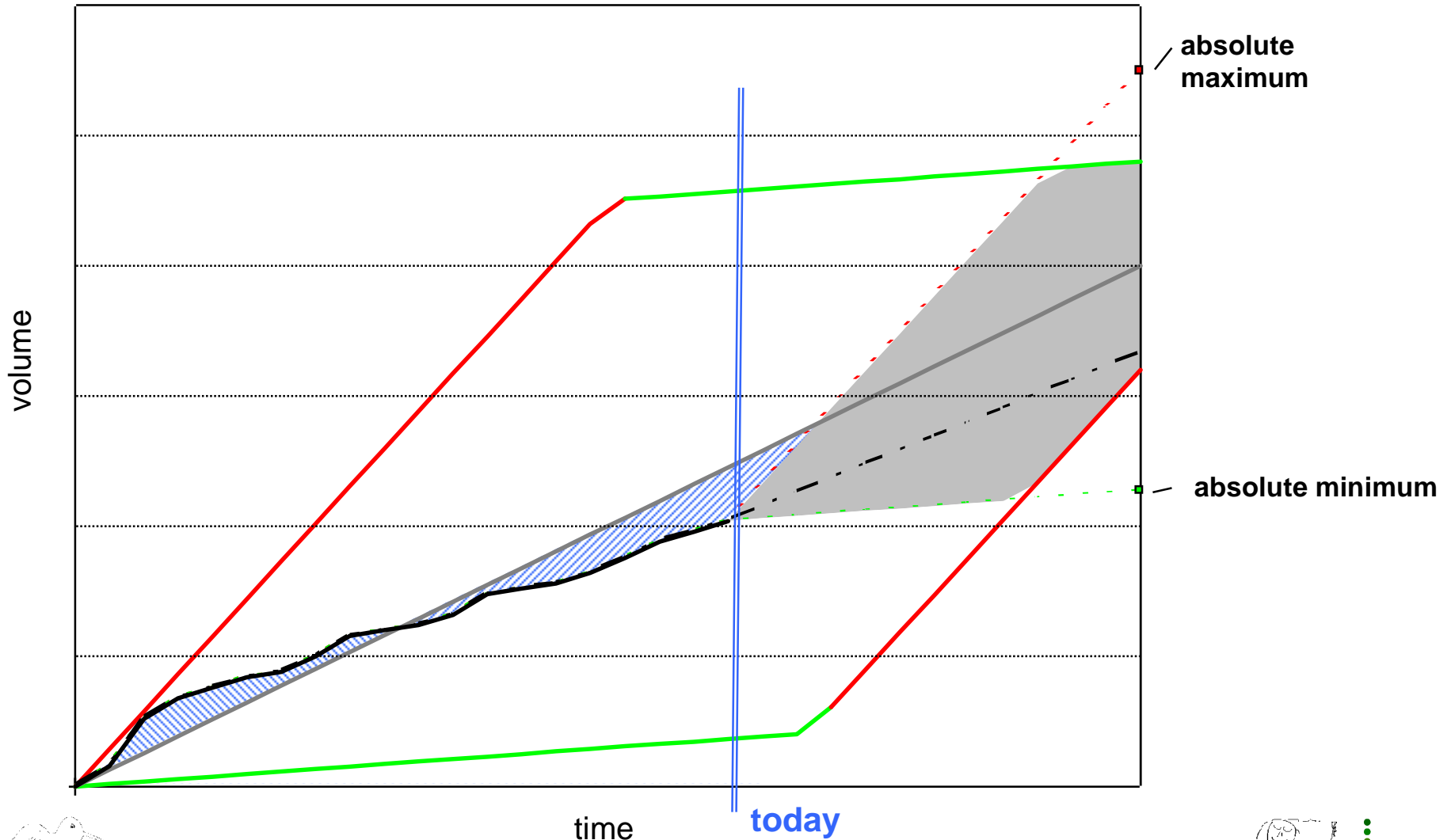
# Applications of Quasitopos Axioms in Optimization

side constraints: production/contracts



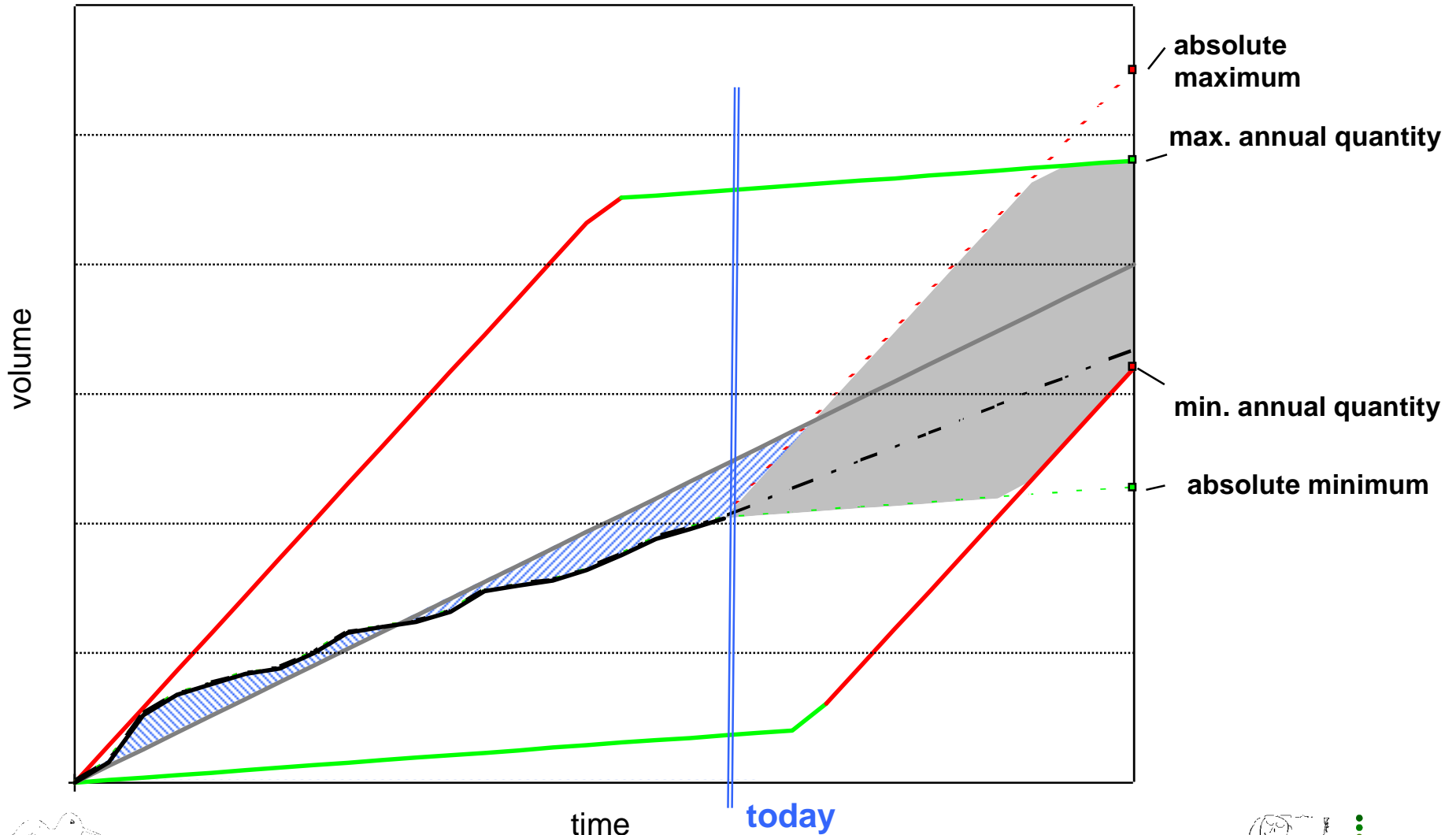
# Applications of Quasitopos Axioms in Optimization

side constraints: production/contracts



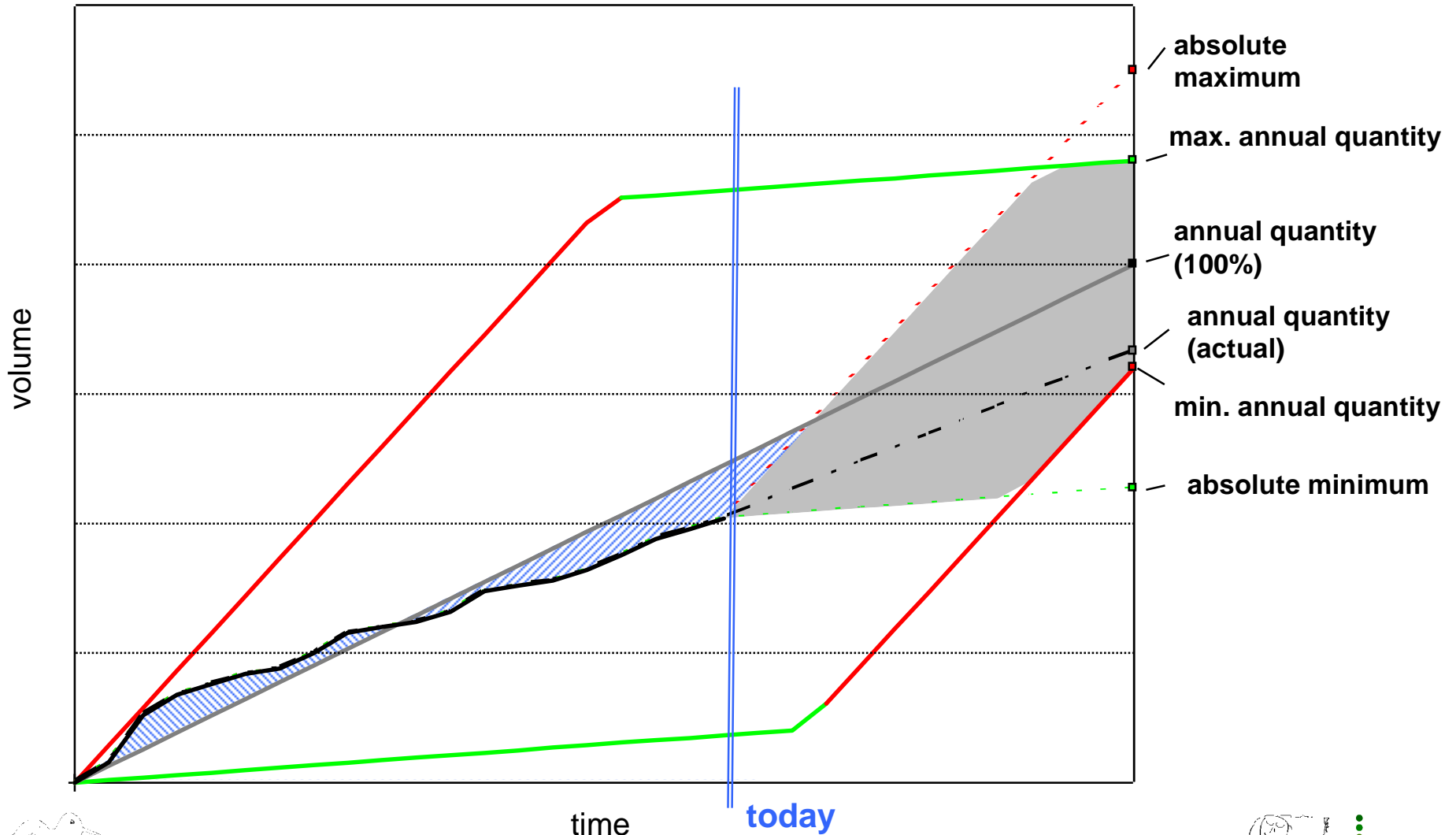
# Applications of Quasitopos Axioms in Optimization

side constraints: production/contracts



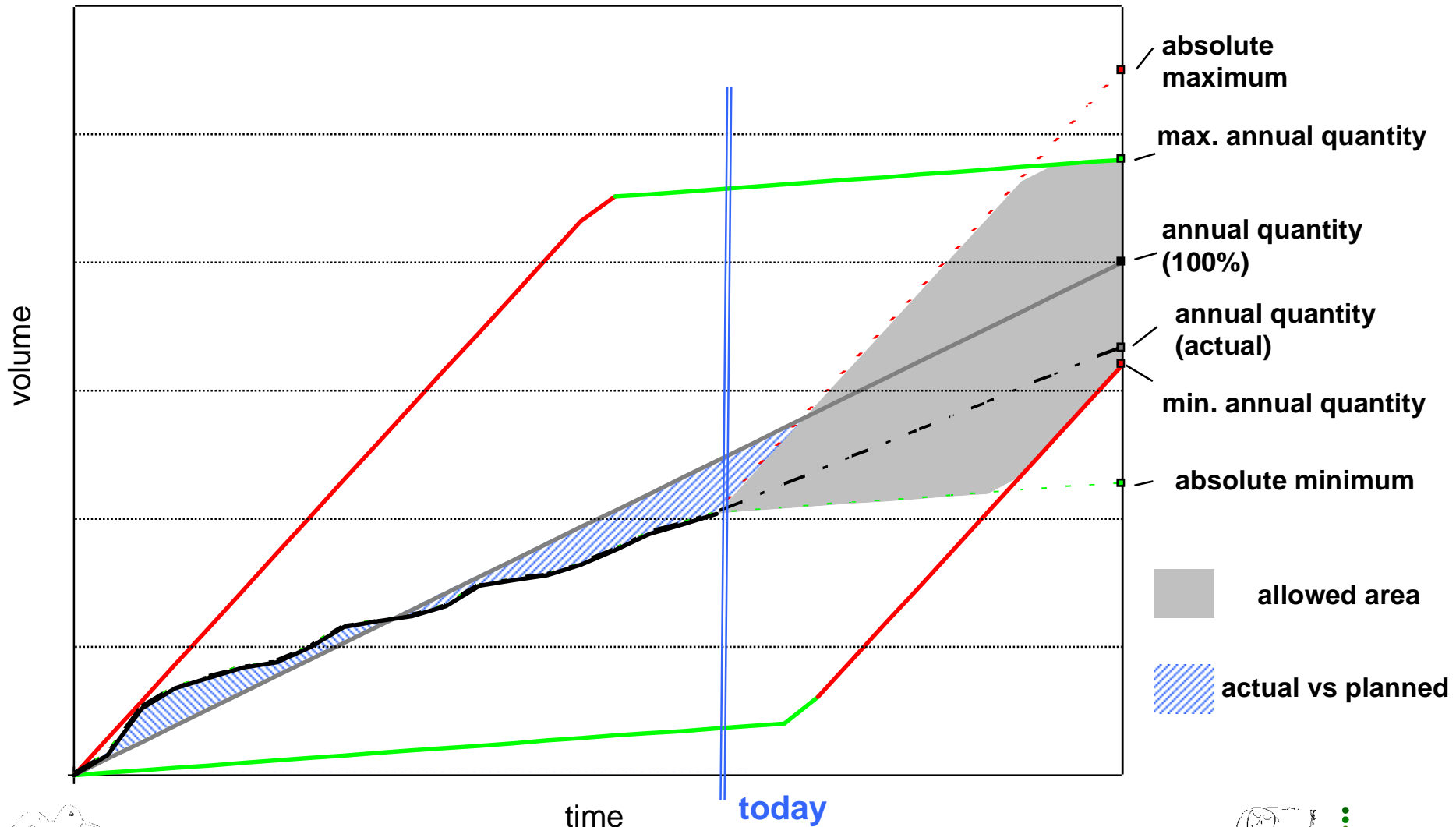
# Applications of Quasitopos Axioms in Optimization

side constraints: production/contracts



# Applications of Quasitopos Axioms in Optimization

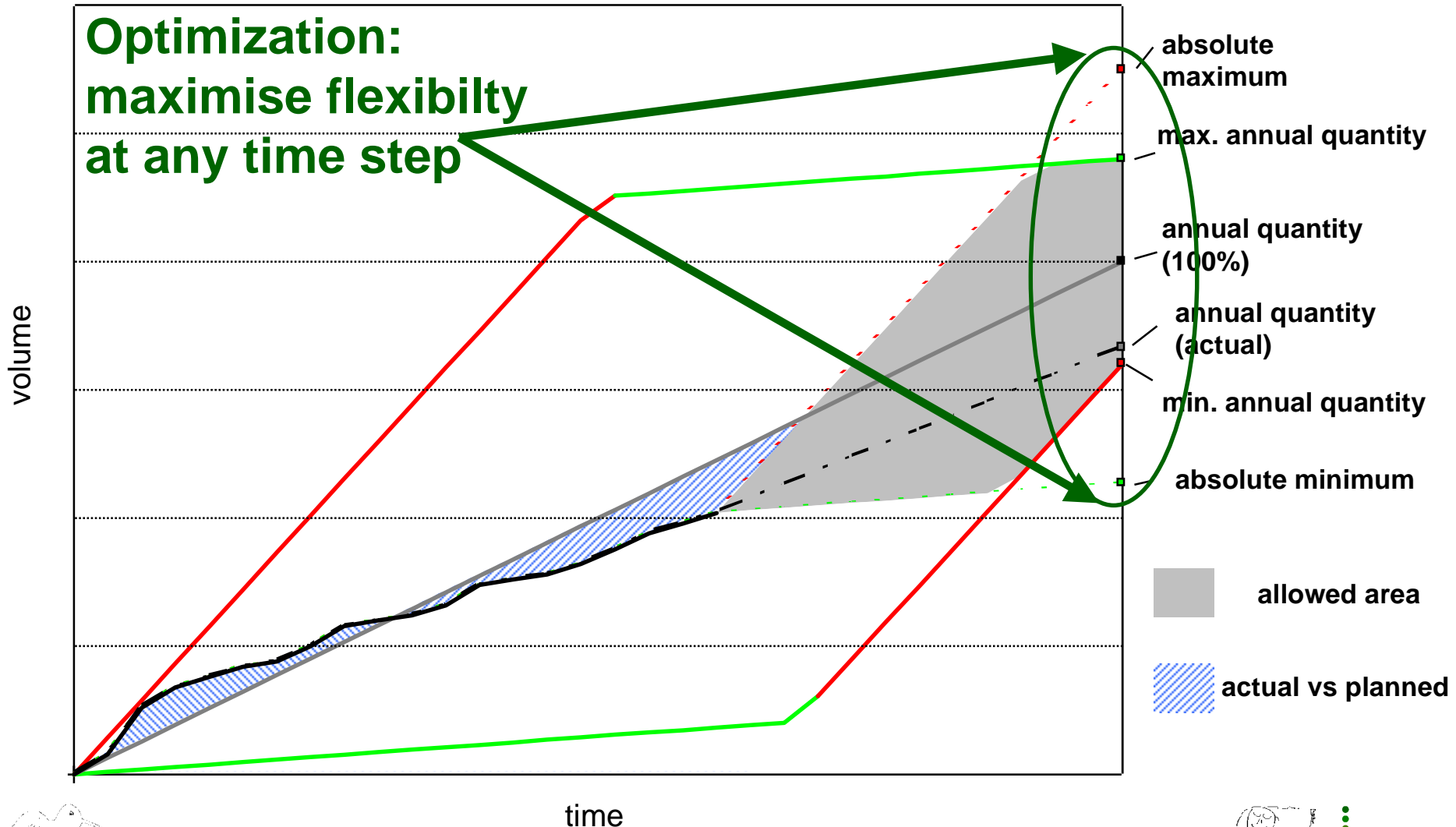
side constraints: production/contracts



# Applications of Quasitopos Axioms in Optimization

side constraints: production/contracts

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



## agenda

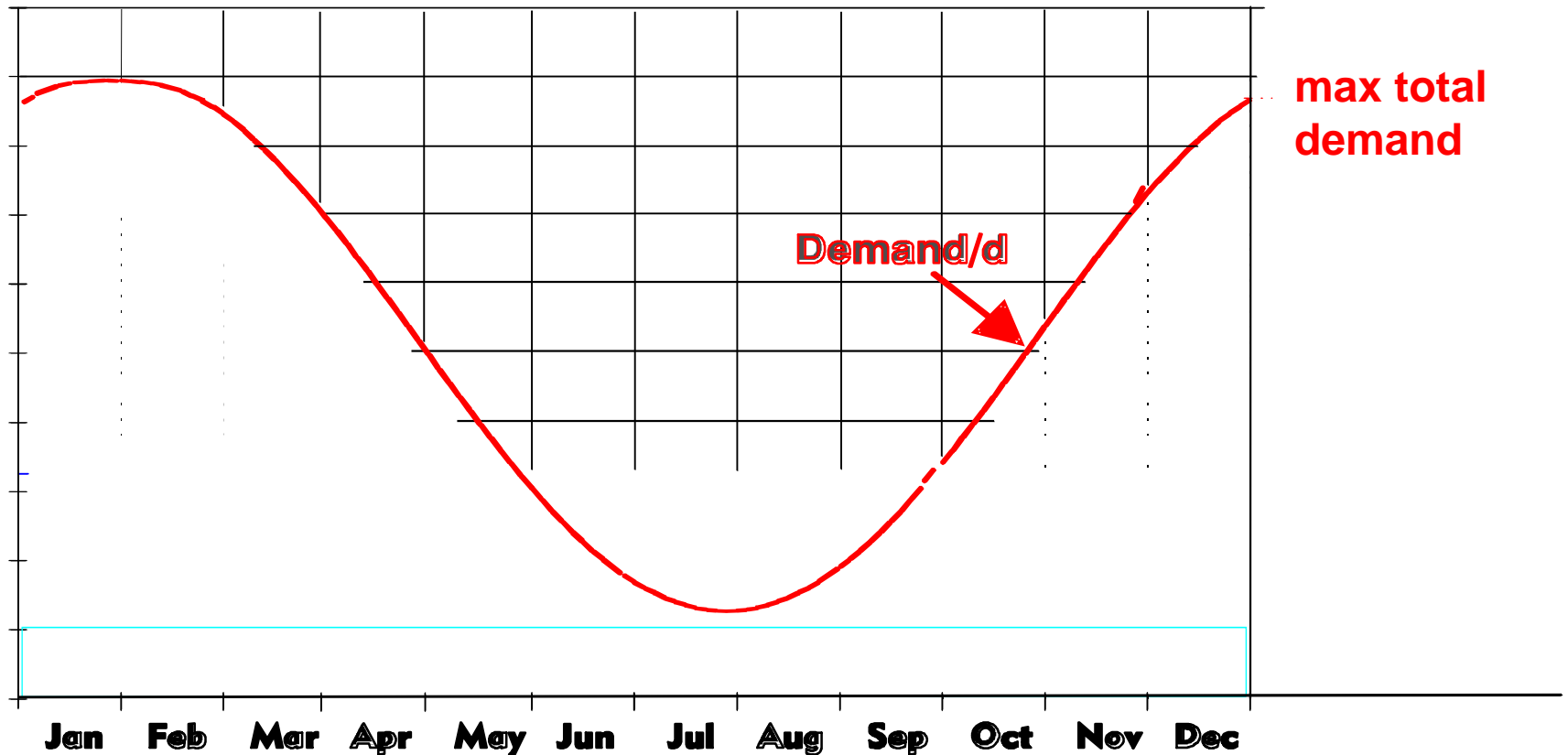
- $H^2$**  category theory
- ✧ topological categories
  - ✧ quasitopoi

- $H^2$**  applications / optimization
- ✧ load balancing
  - ✧ bin packing
  - ✧ demand/supply balancing
  - ✧ forecasting



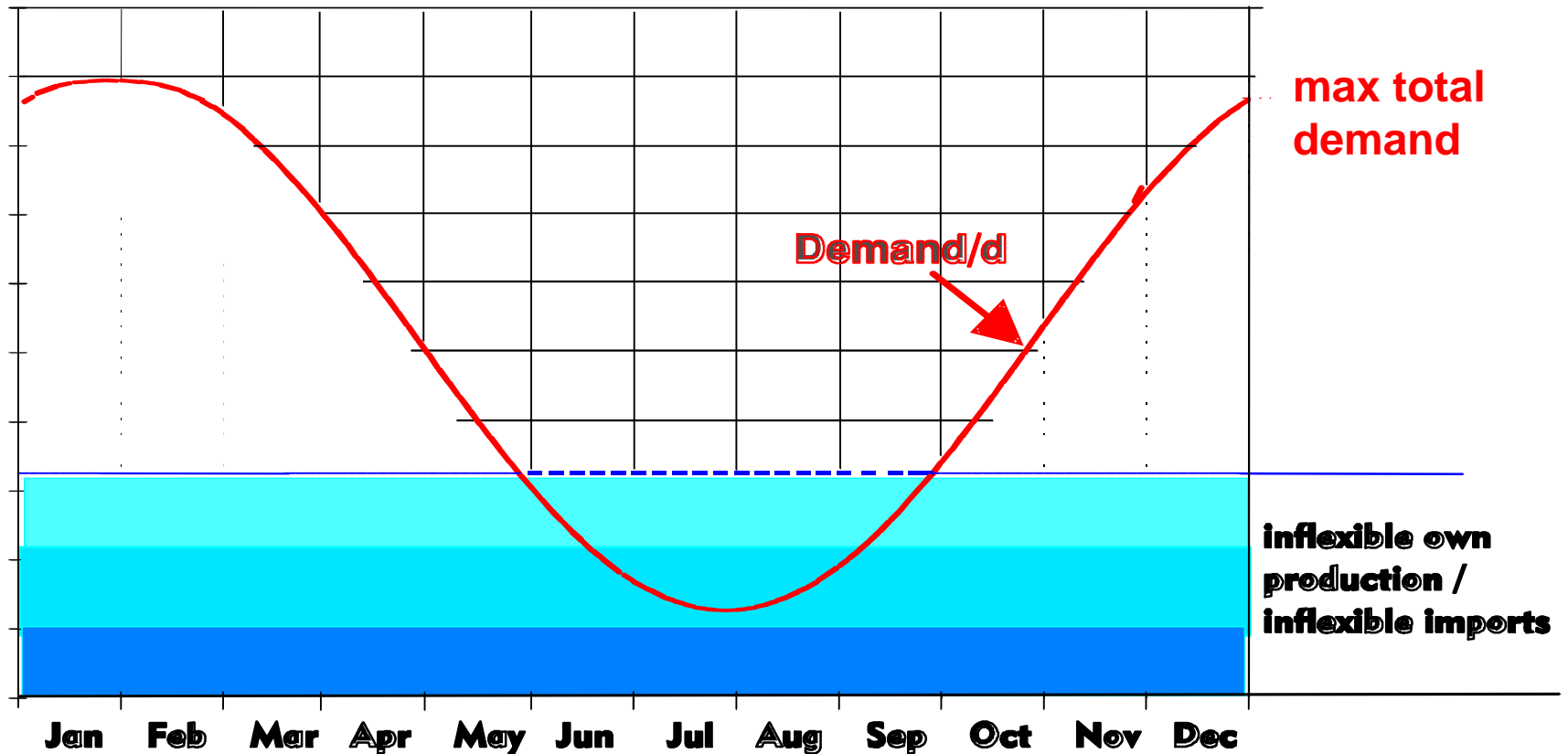
# Applications of Quasitopos Axioms in Optimization

load balancing = optimal packing



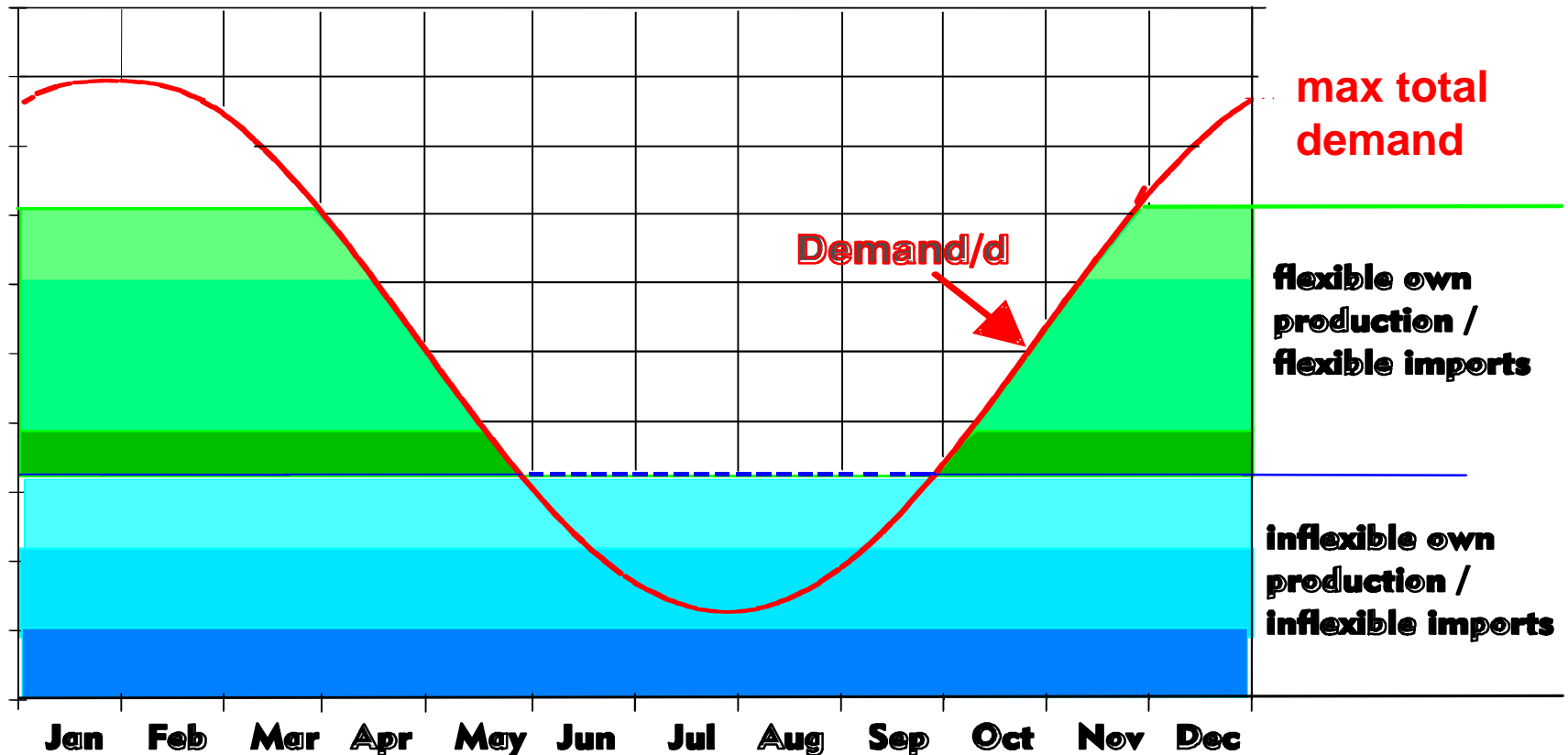
# Applications of Quasitopos Axioms in Optimization

load balancing = optimal packing



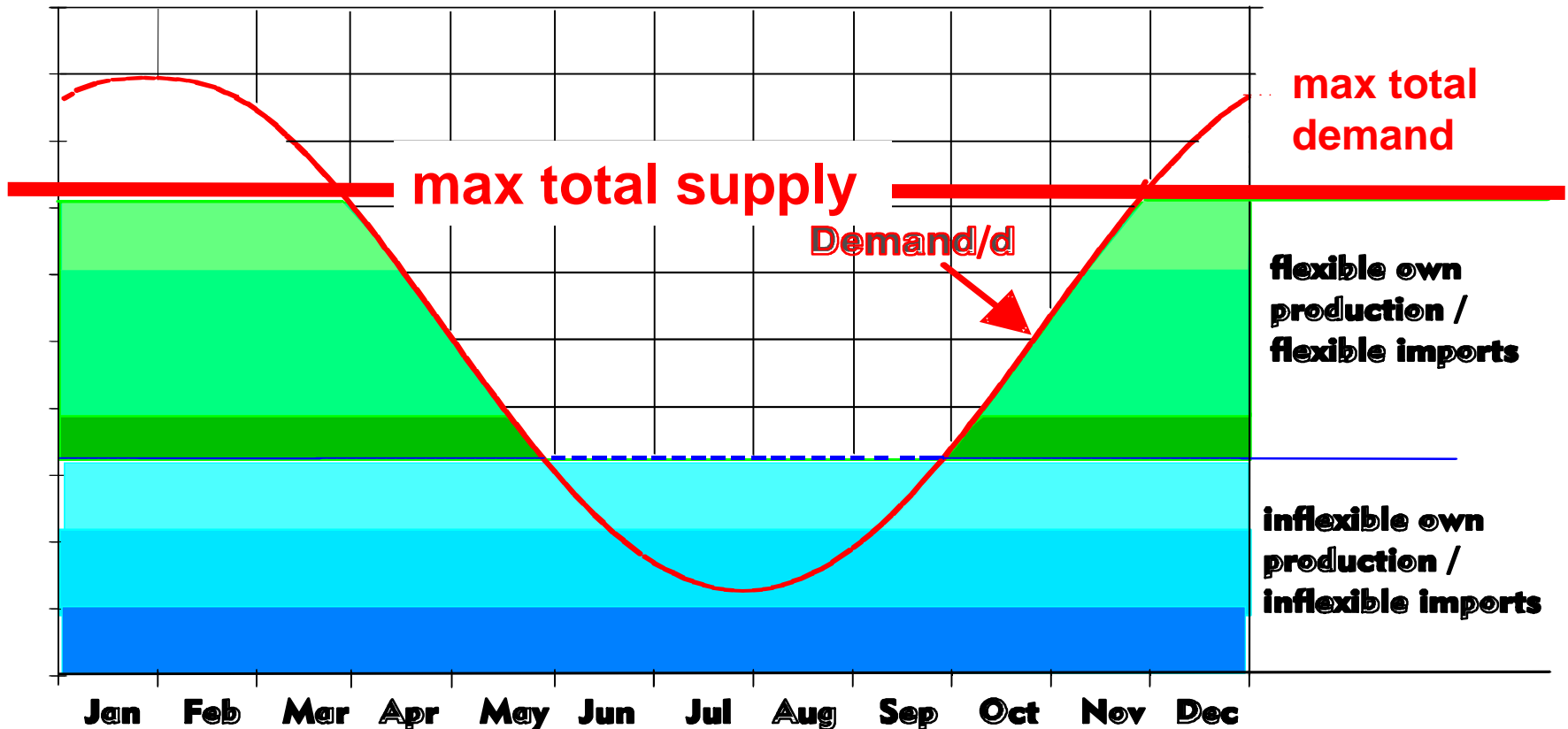
# Applications of Quasitopos Axioms in Optimization

load balancing = optimal packing



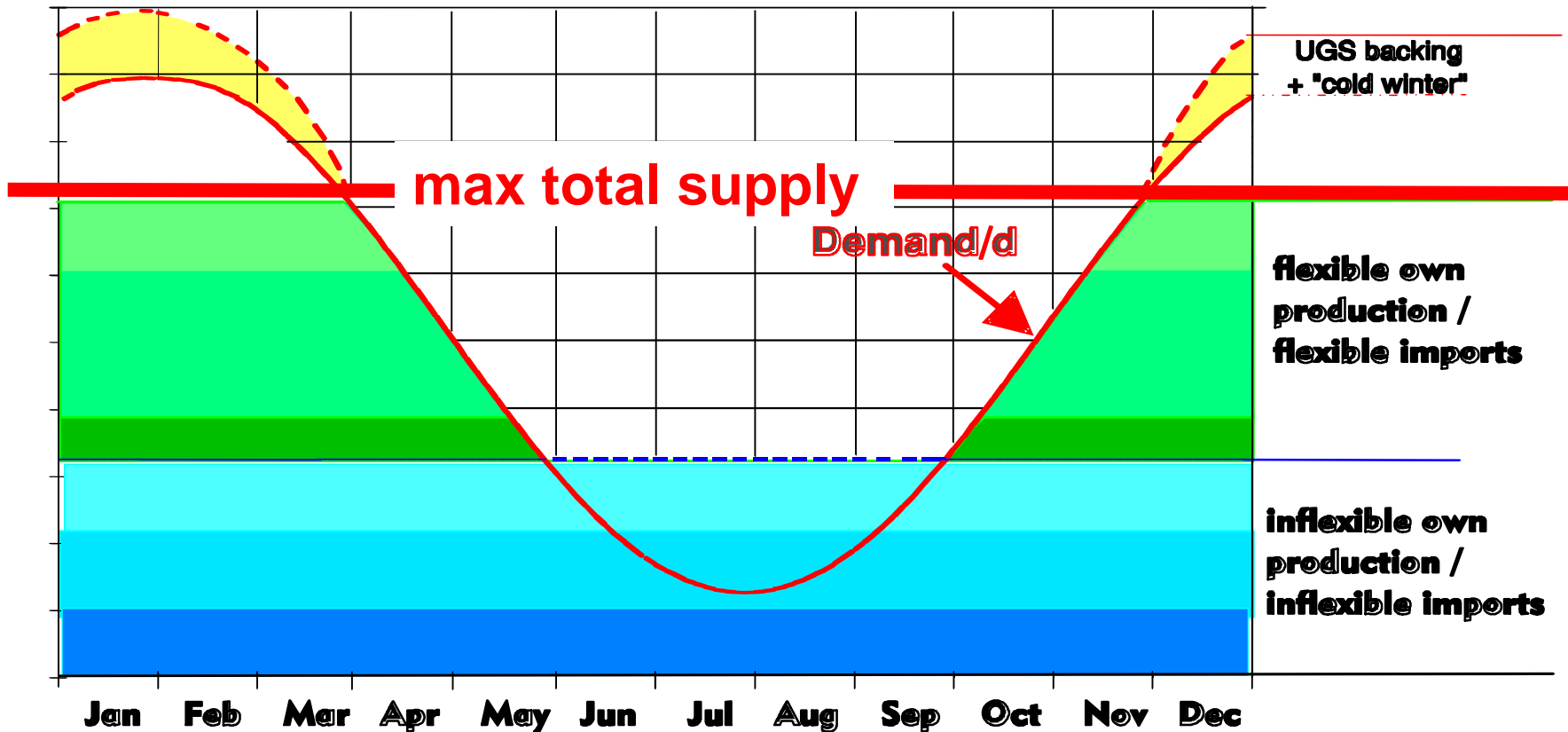
# Applications of Quasitopos Axioms in Optimization

load balancing = optimal packing



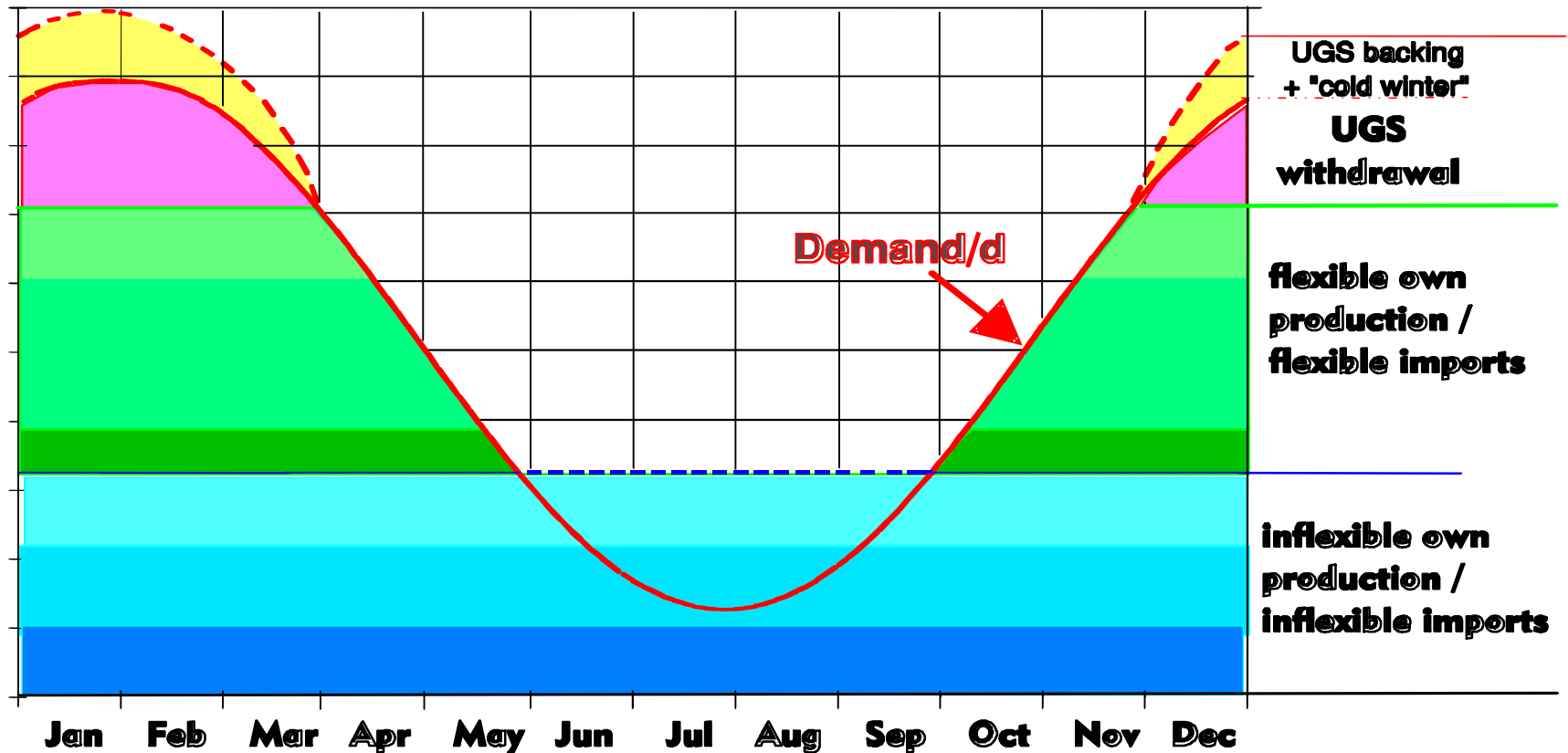
# Applications of Quasitopos Axioms in Optimization

load balancing = optimal packing



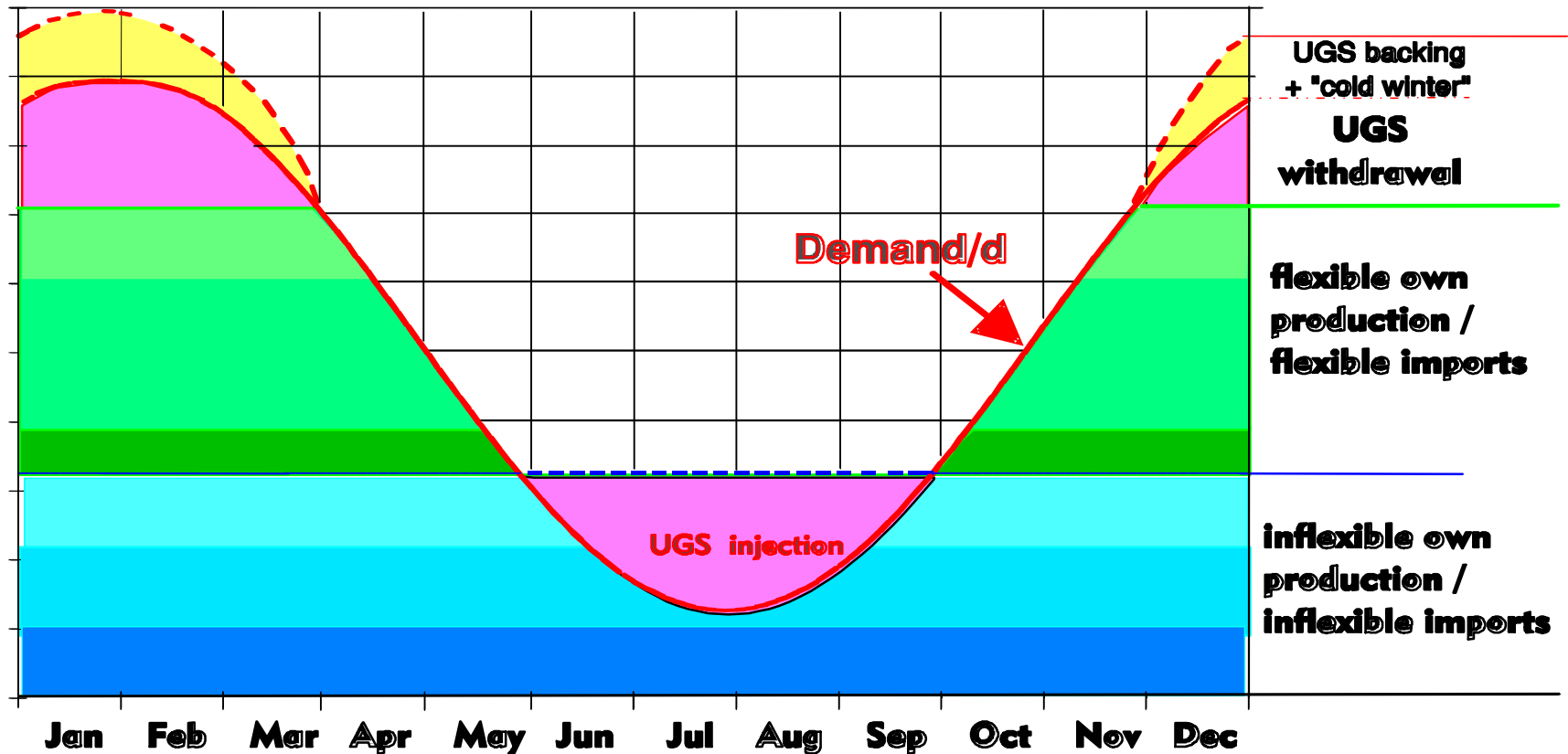
# Applications of Quasitopos Axioms in Optimization

load balancing = optimal packing



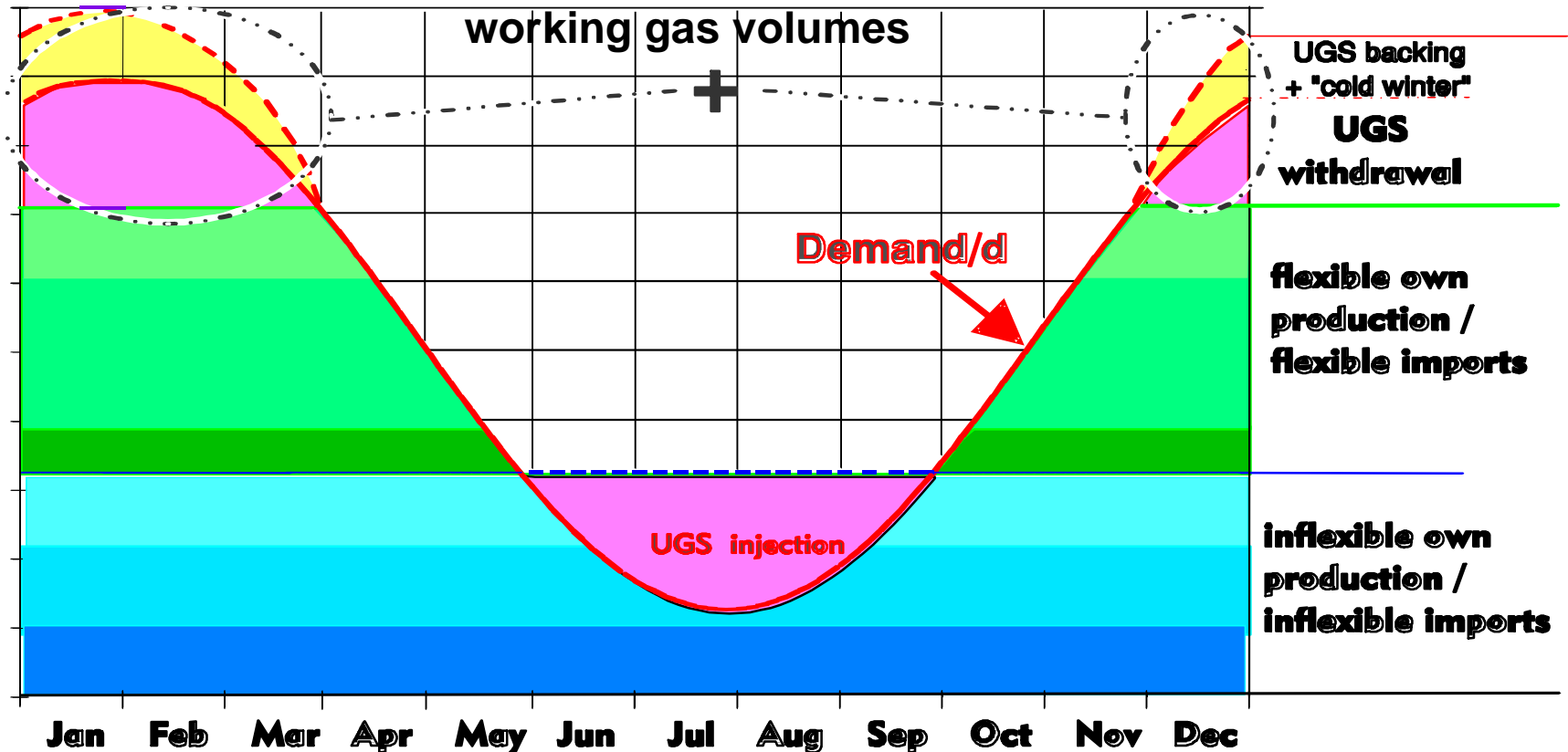
# Applications of Quasitopos Axioms in Optimization

## load balancing



## load balancing

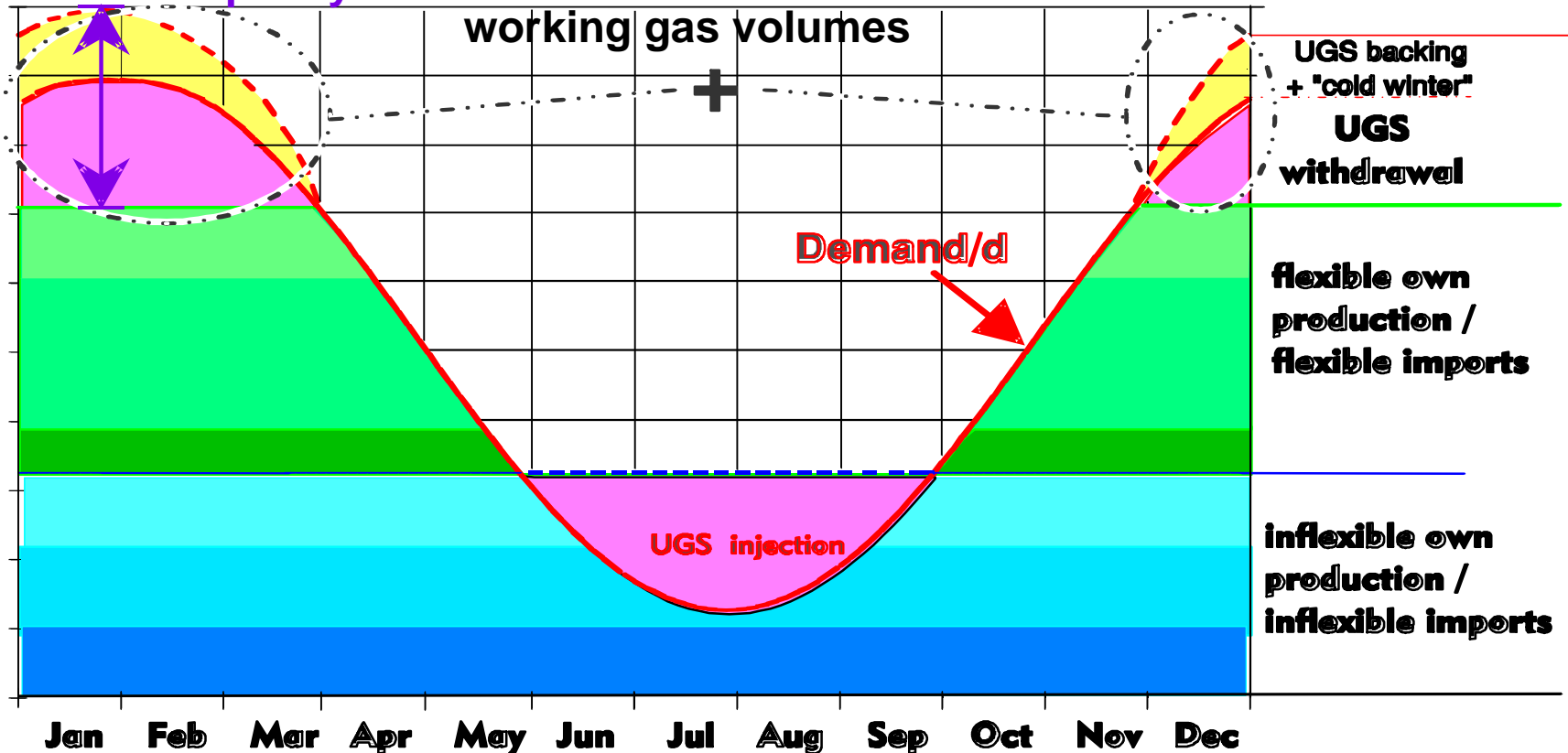
### 1. determination of required working gas volumes



## load balancing

### 2. determination of required withdrawal capacity

### 1. determination of required working gas volumes

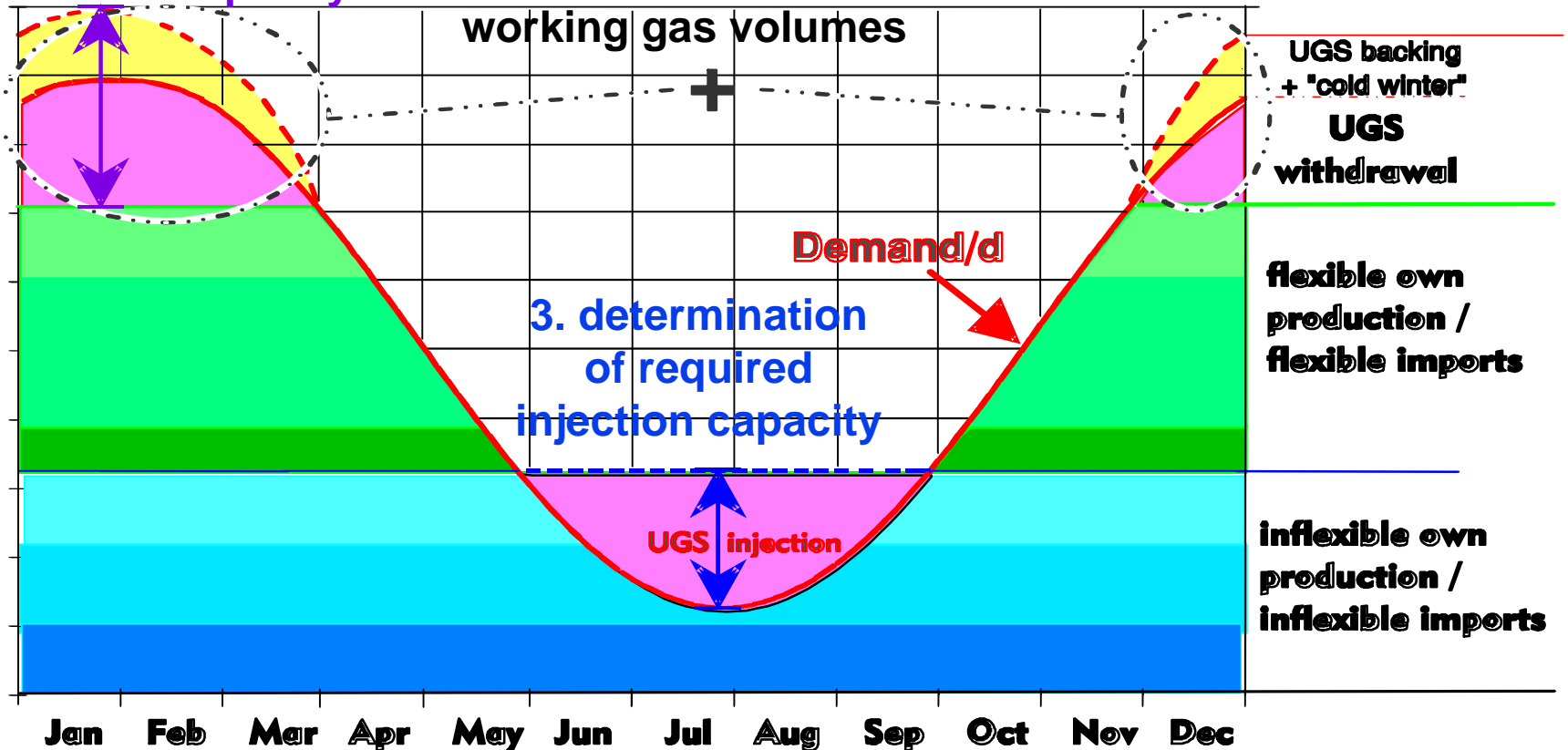


## load balancing

2. determination of required withdrawal capacity

1. determination of required working gas volumes

3. determination of required injection capacity



## agenda

- $H^2$**  category theory
- ✧ topological categories
  - ✧ quasitopoi

- $H^2$**  applications / optimization
- ✧ load balancing
  - ✧ bin packing
  - ✧ demand/supply balancing
  - ✧ forecasting



## applications of bin packing

### $H^2$ category theory

- ✧ topological categories
- ✧ quasitopoi

### $H^2$ applications / optimization

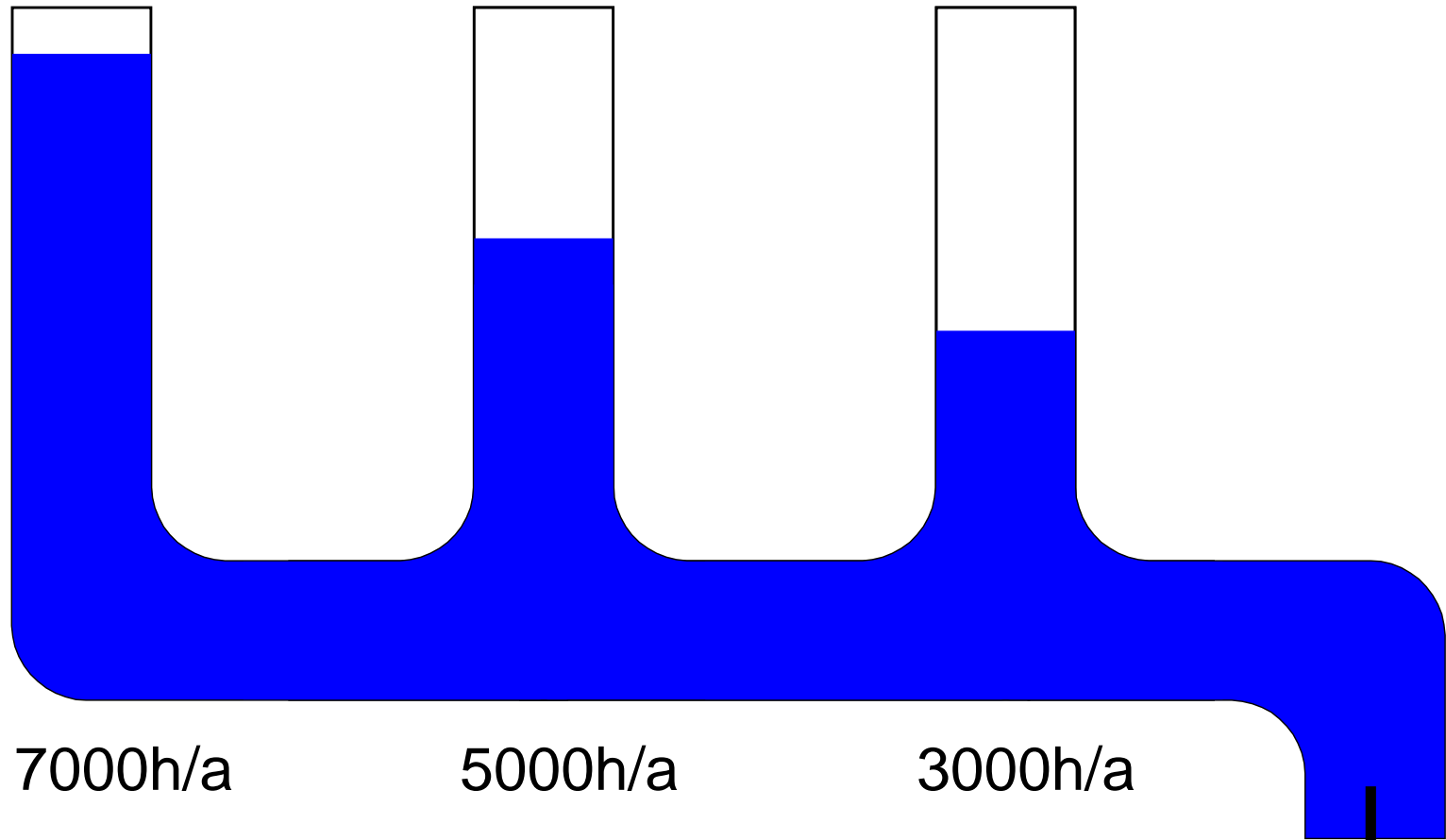
- ✧ load balancing
- ✧ **bin packing**
- ✧ demand/supply balance
- ✧ forecasting

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



# Applications of Quasitopos Axioms in Optimization

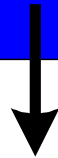
communicating tubes = bin packing



7000h/a

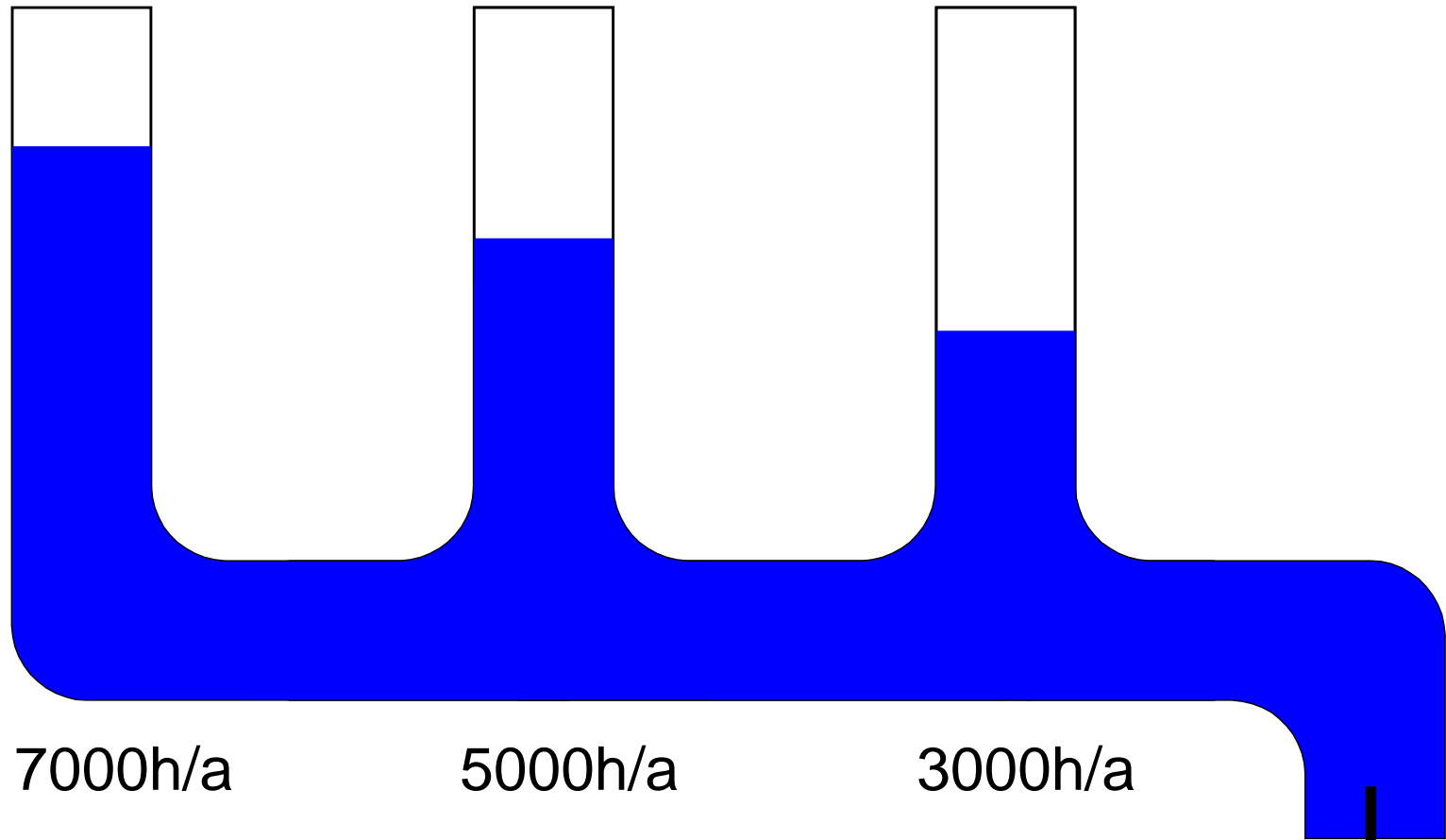
5000h/a

3000h/a



# Applications of Quasitopos Axioms in Optimization

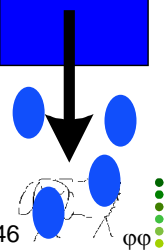
communicating tubes = bin packing



7000h/a

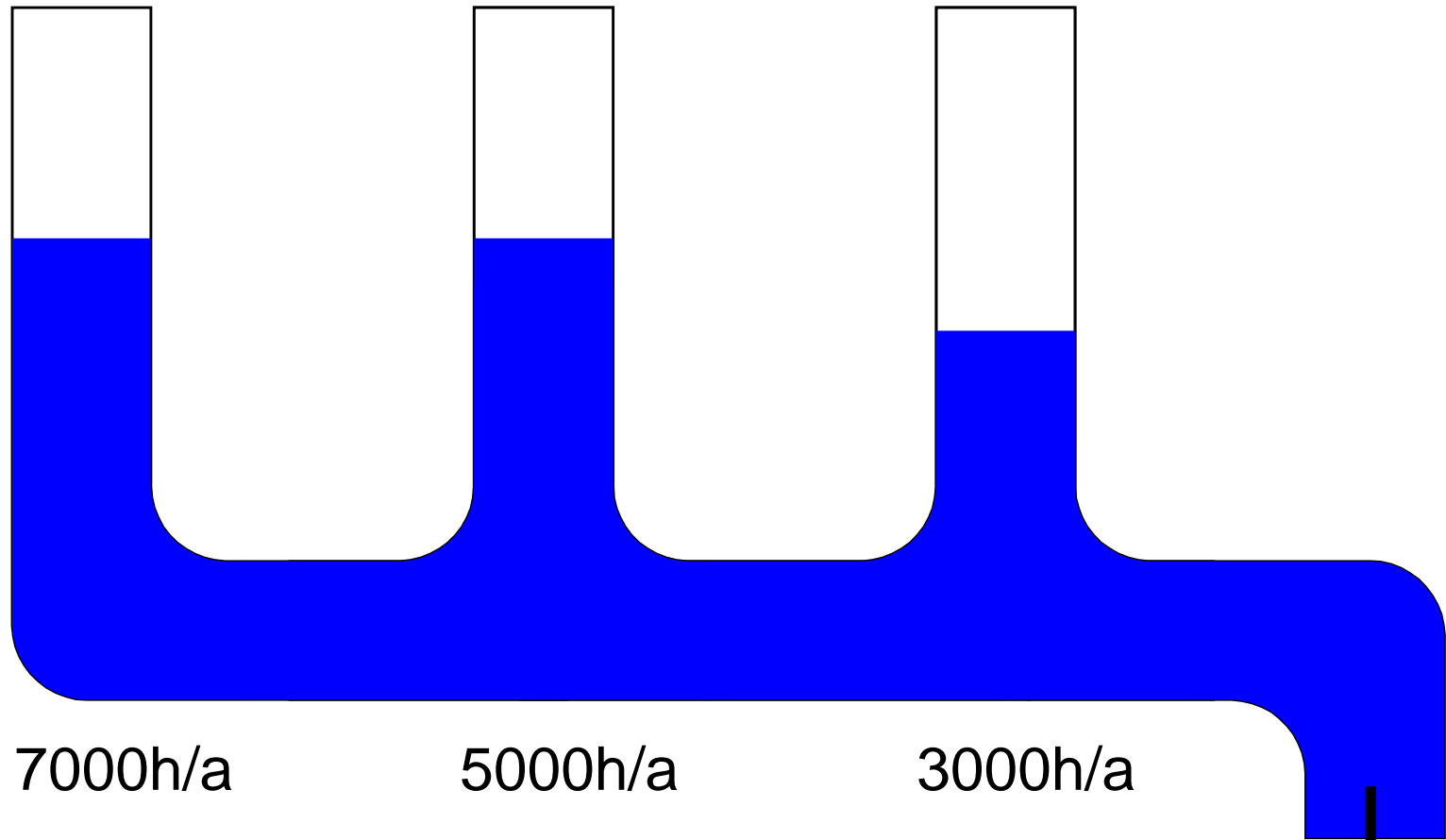
5000h/a

3000h/a



# Applications of Quasitopos Axioms in Optimization

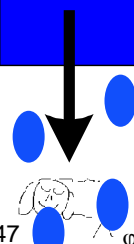
communicating tubes = bin packing



7000h/a

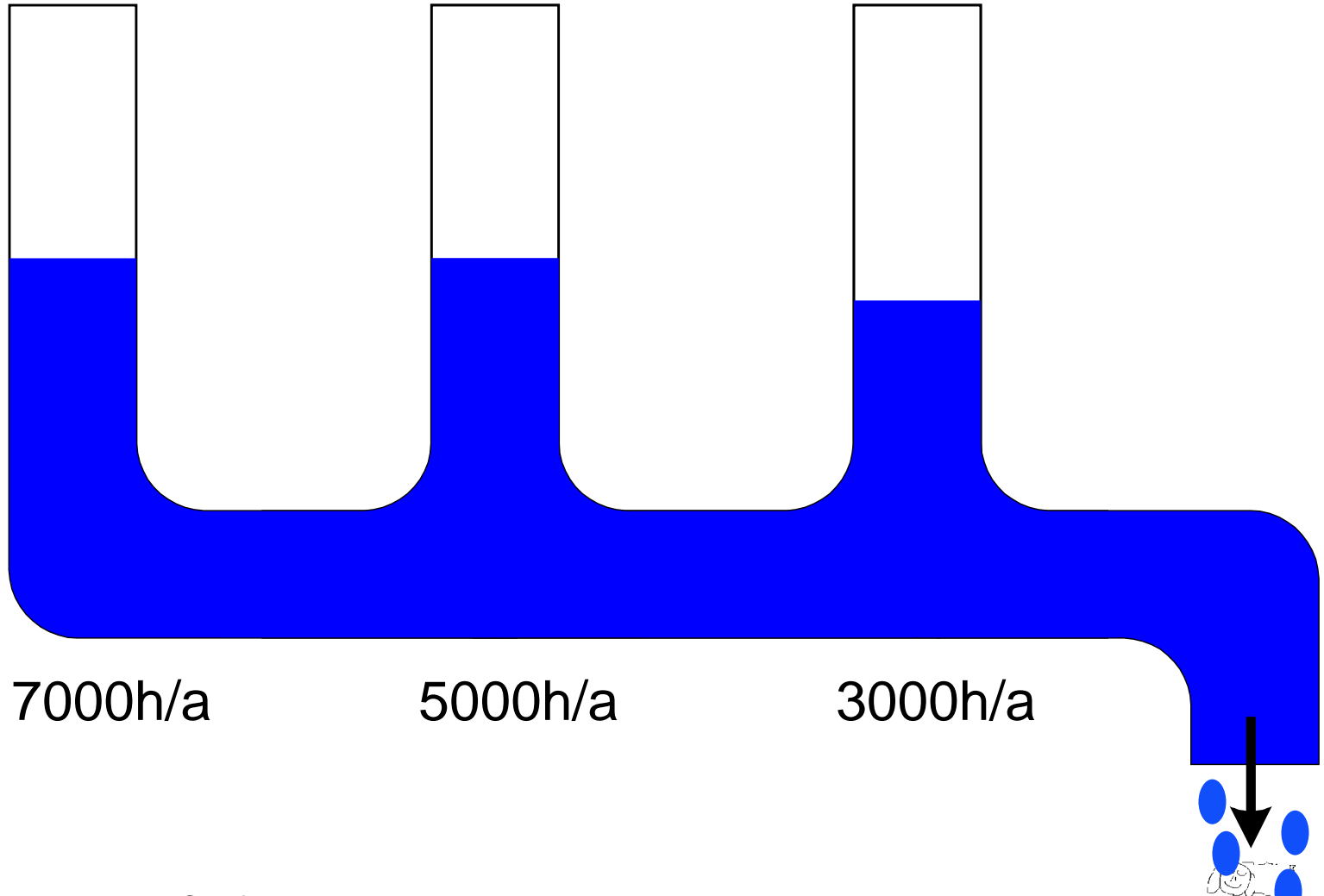
5000h/a

3000h/a



# Applications of Quasitopos Axioms in Optimization

communicating tubes = bin packing



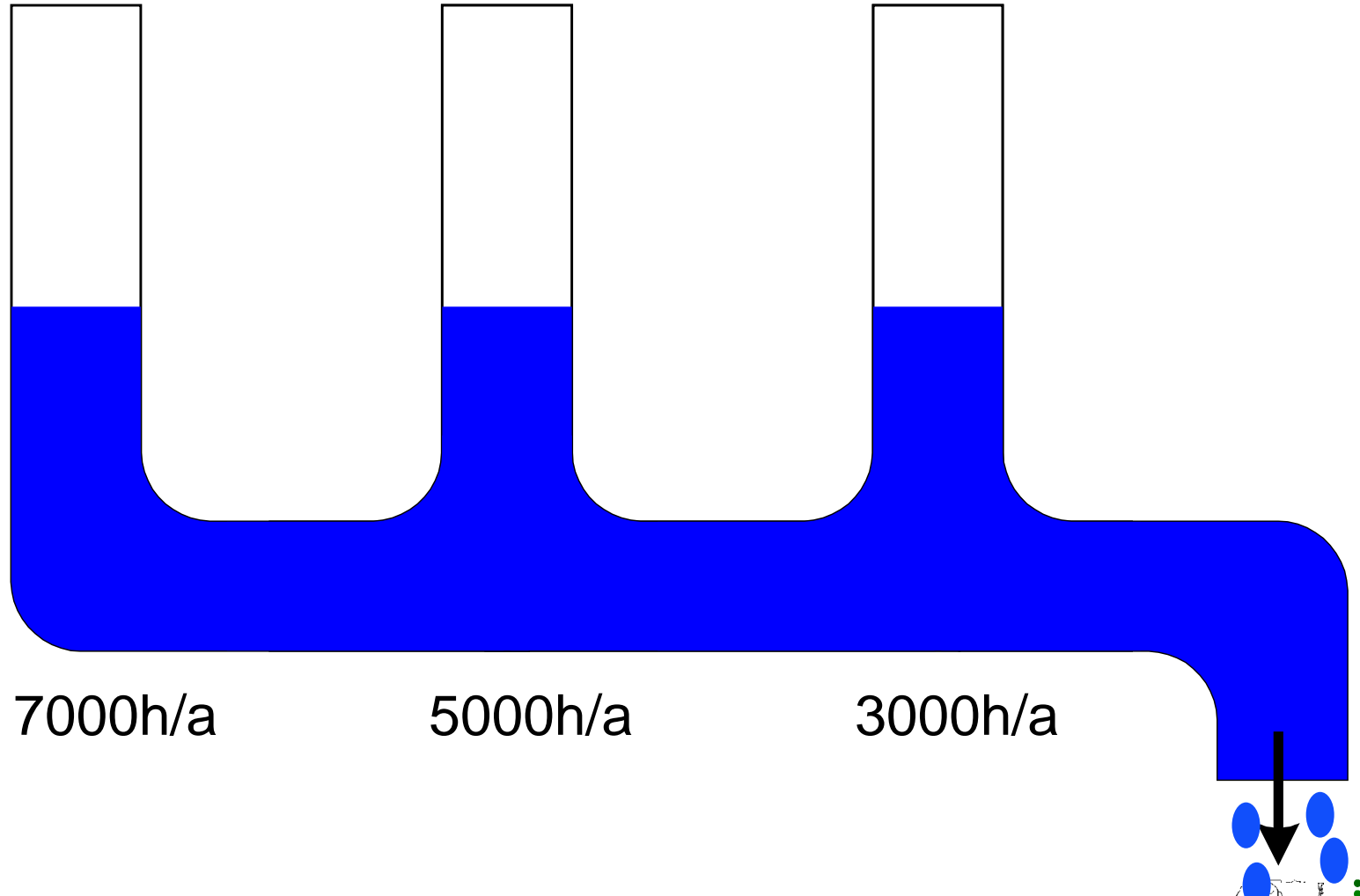
7000h/a

5000h/a

3000h/a

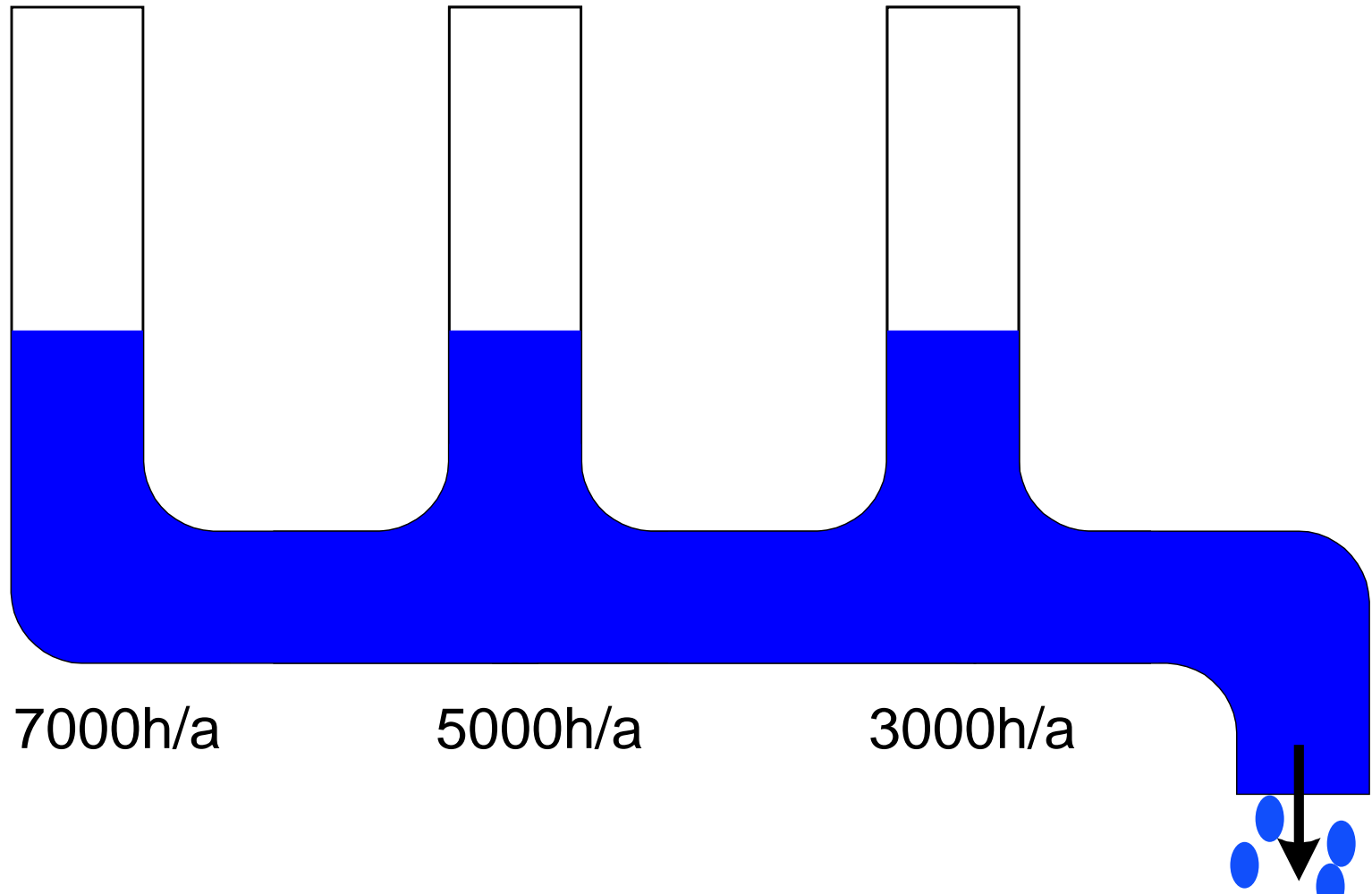
# Applications of Quasitopos Axioms in Optimization

communicating tubes = bin packing



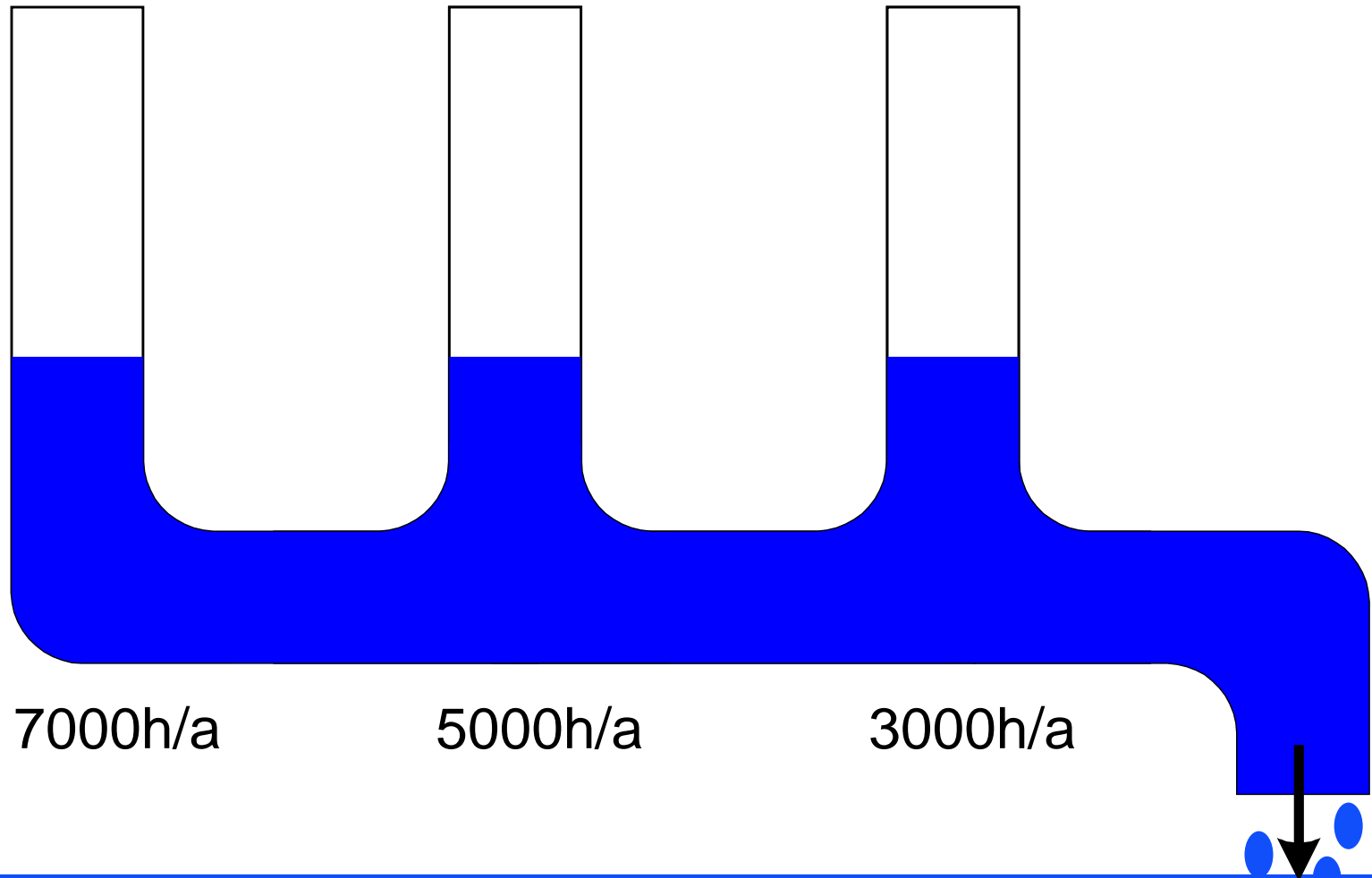
## Applications of Quasitopos Axioms in Optimization

communicating tubes = bin packing



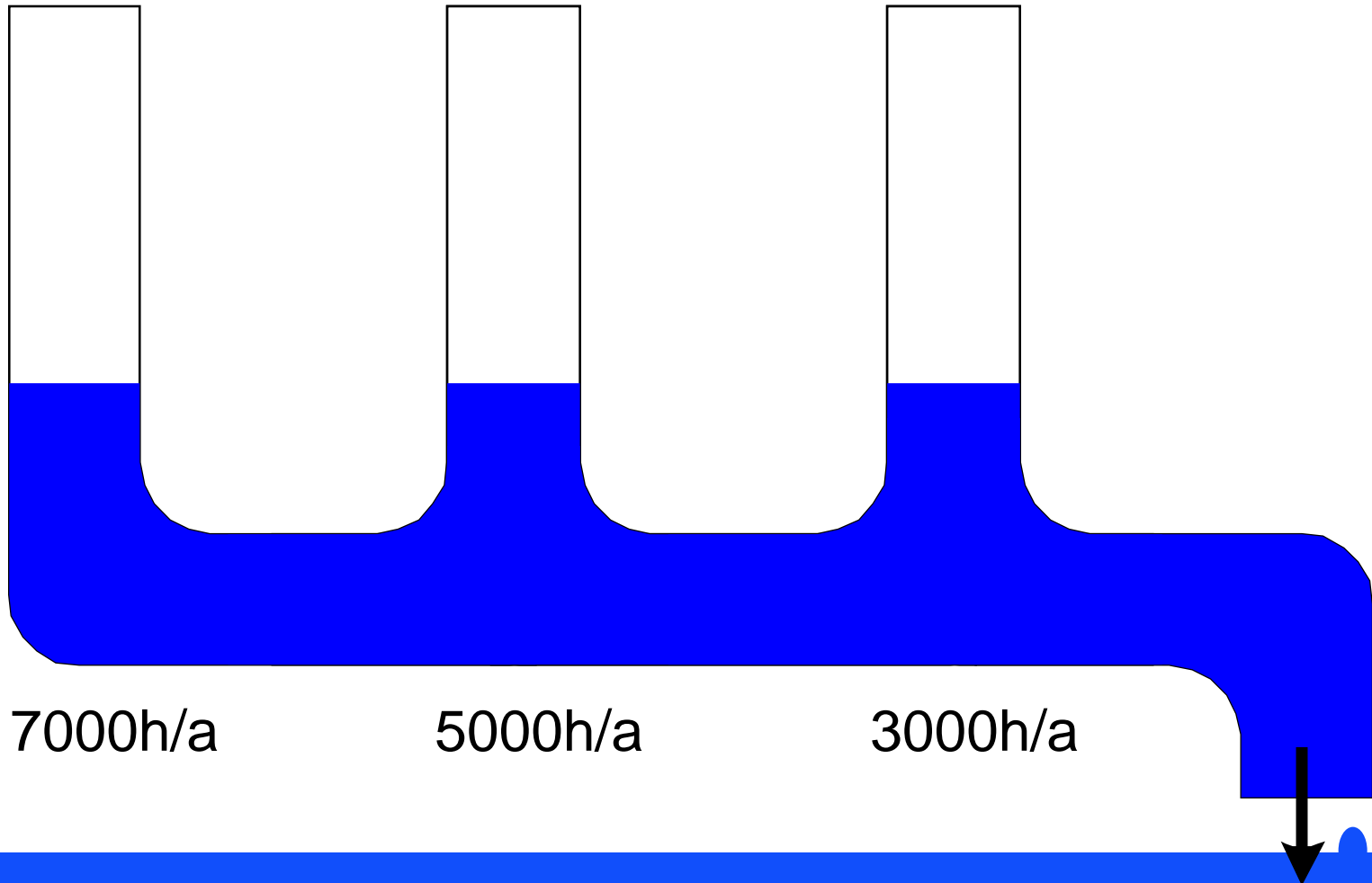
## Applications of Quasitopos Axioms in Optimization

communicating tubes = bin packing



## Applications of Quasitopos Axioms in Optimization

communicating tubes = bin packing



## agenda

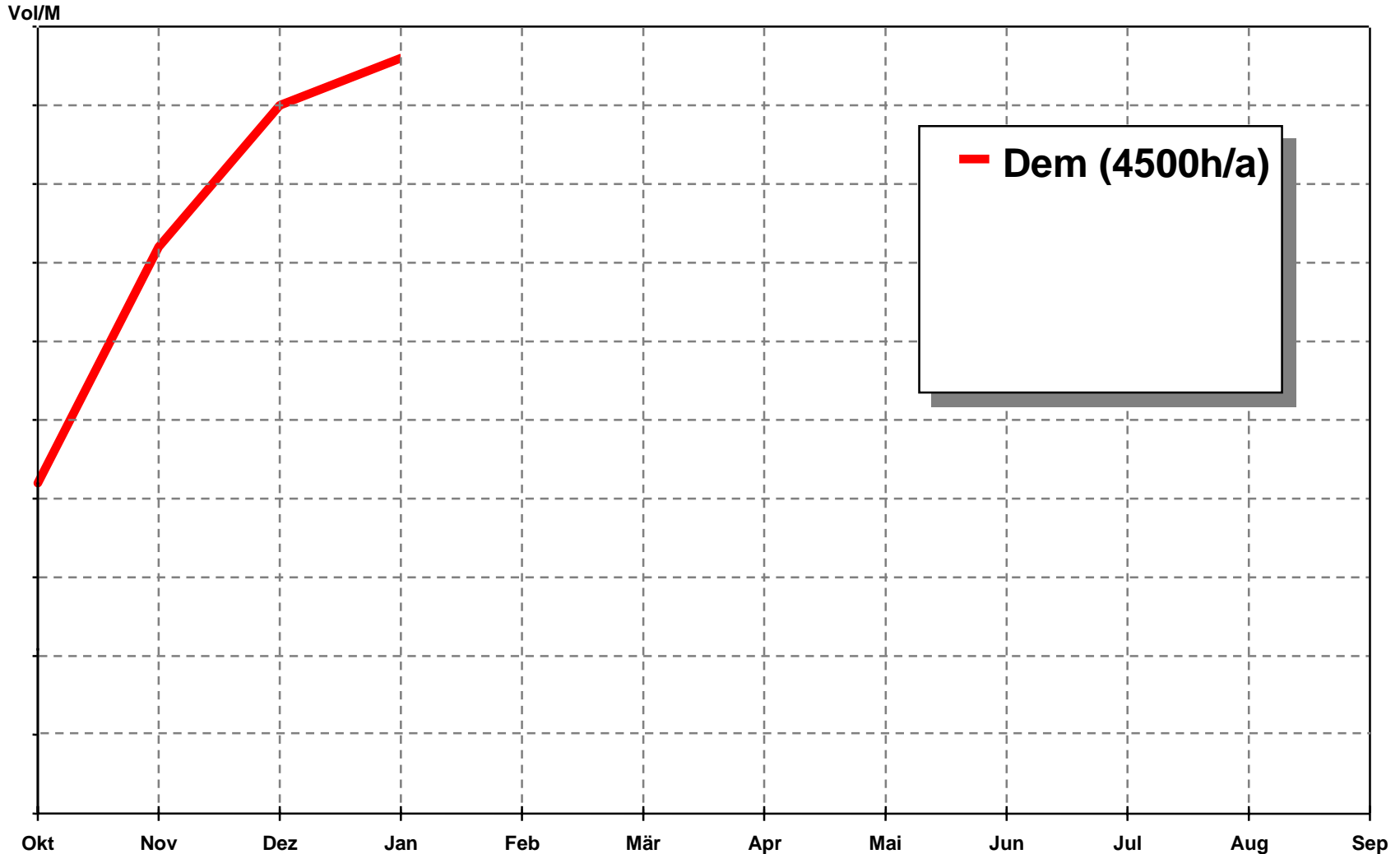
- $H^2$**  category theory
- ✧ topological categories
  - ✧ quasitopoi

- $H^2$**  applications / optimization
- ✧ load balancing
  - ✧ bin packing
  - ✧ demand/supply balancing
  - ✧ forecasting



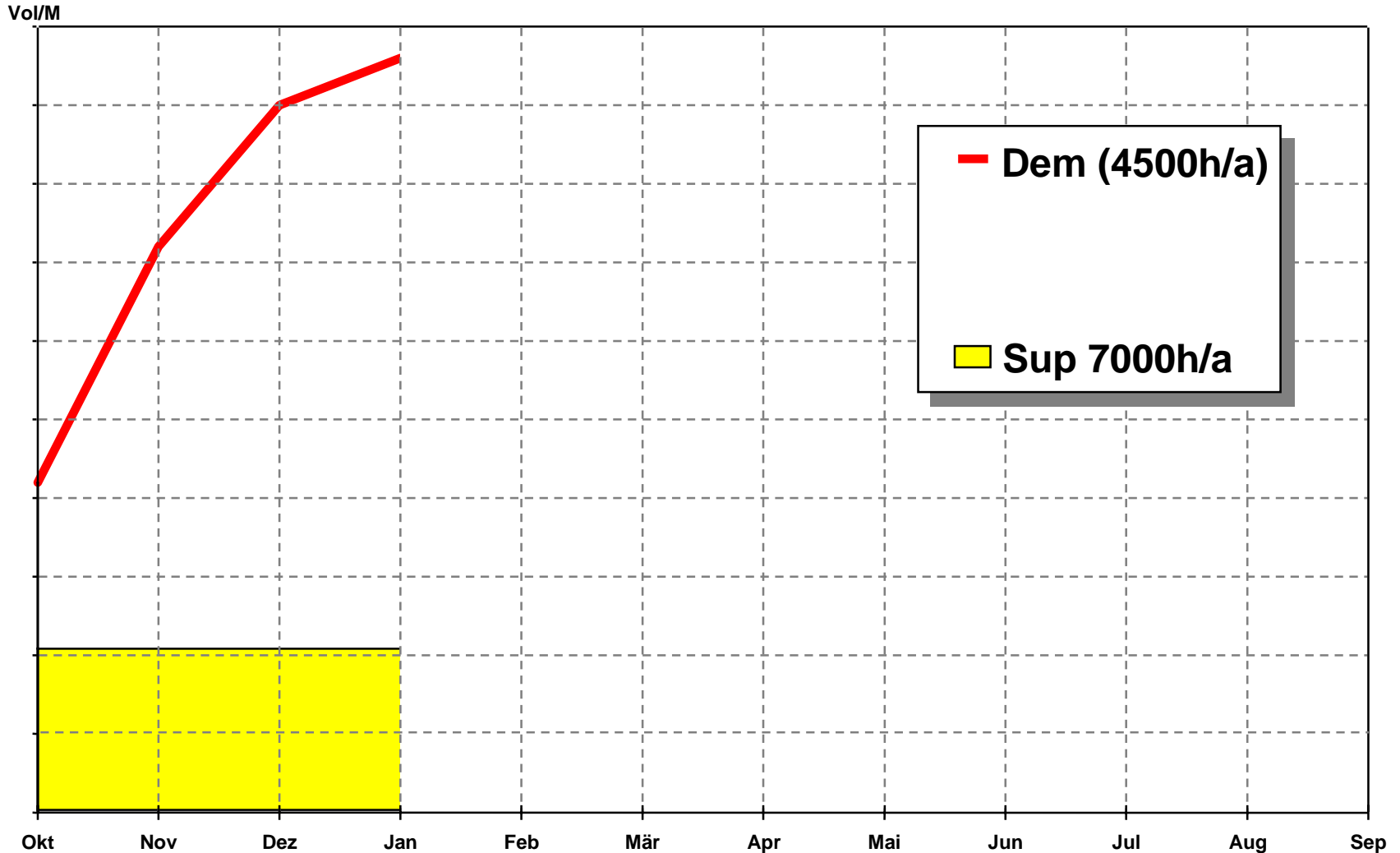
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



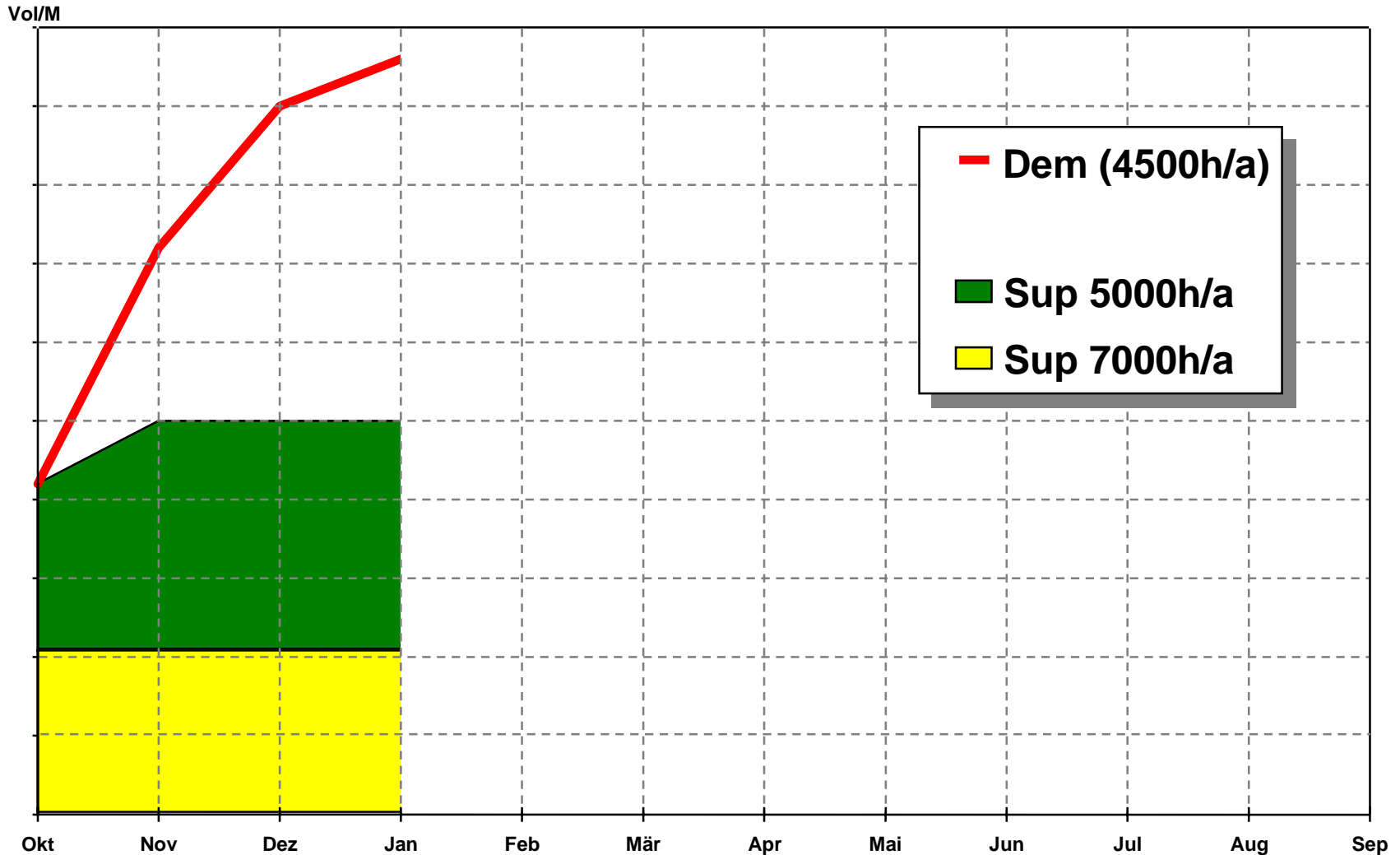
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



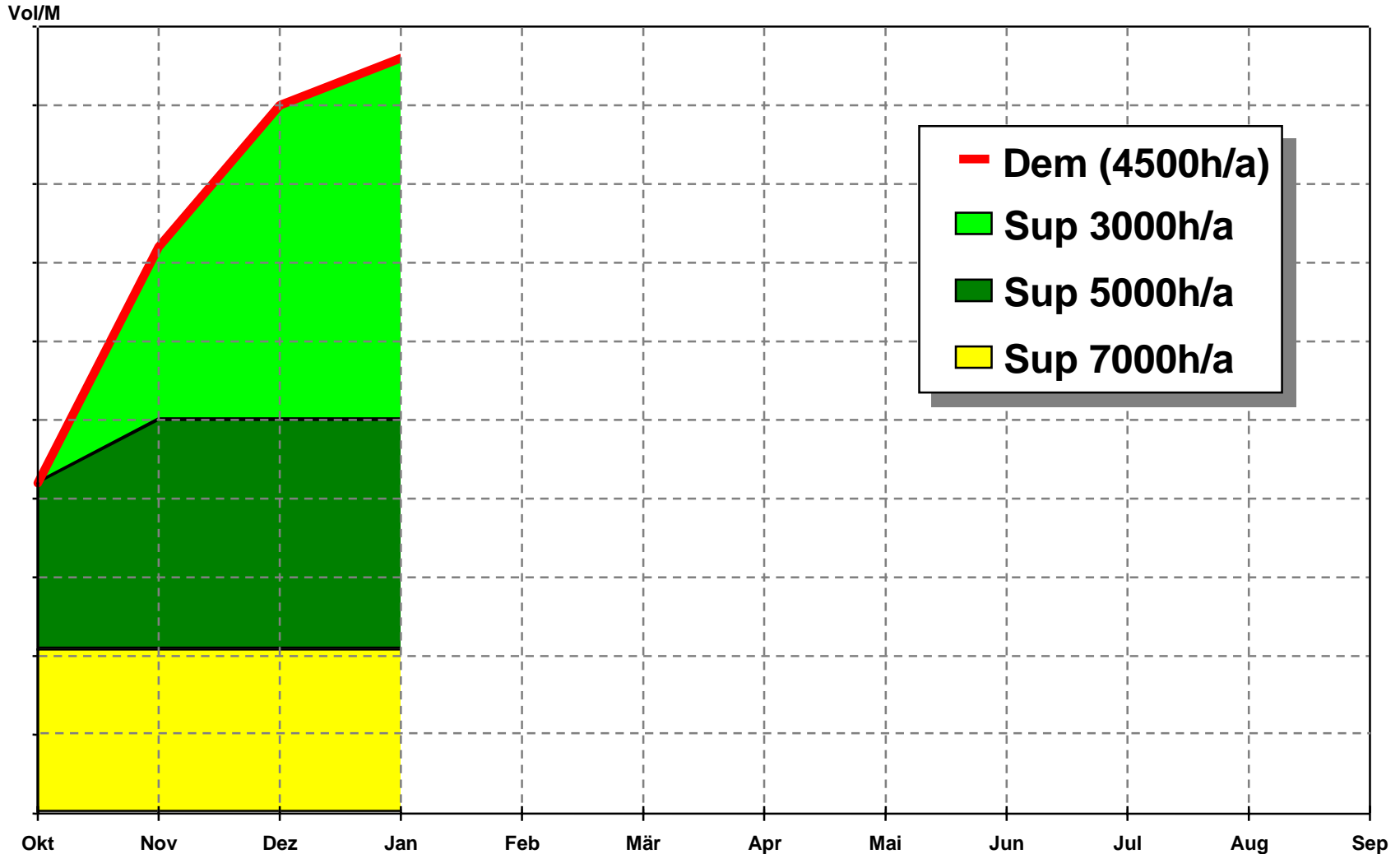
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



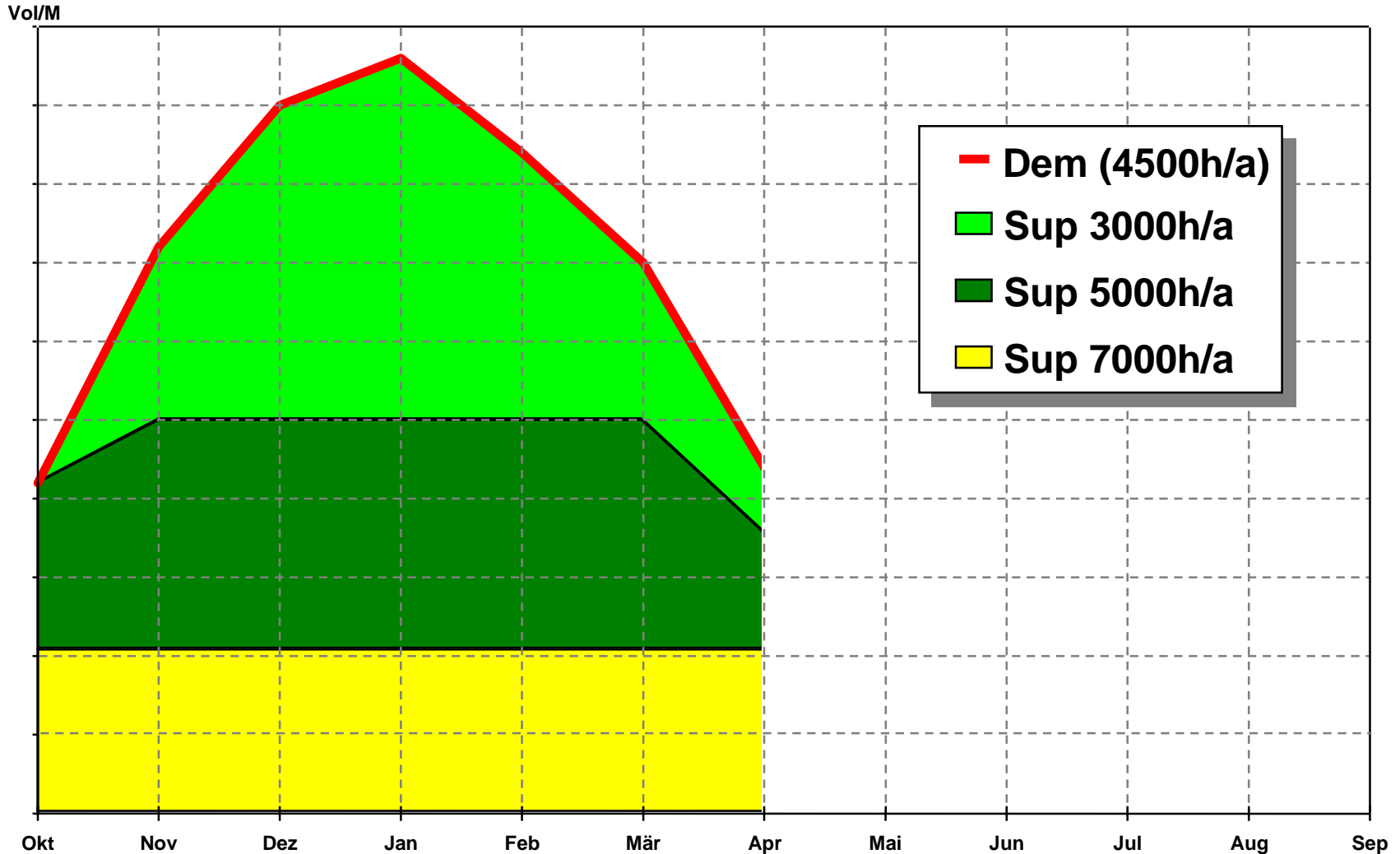
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



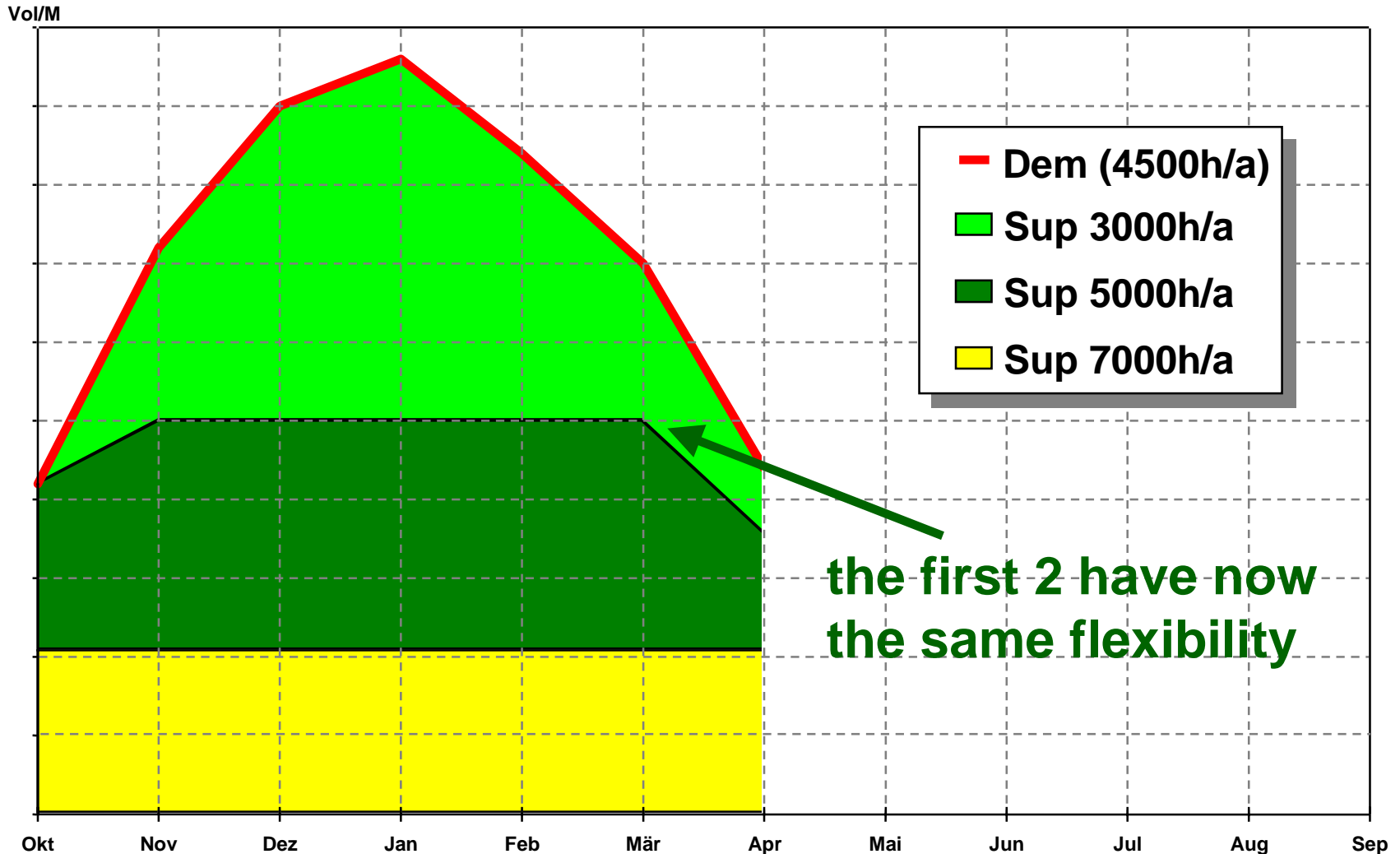
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



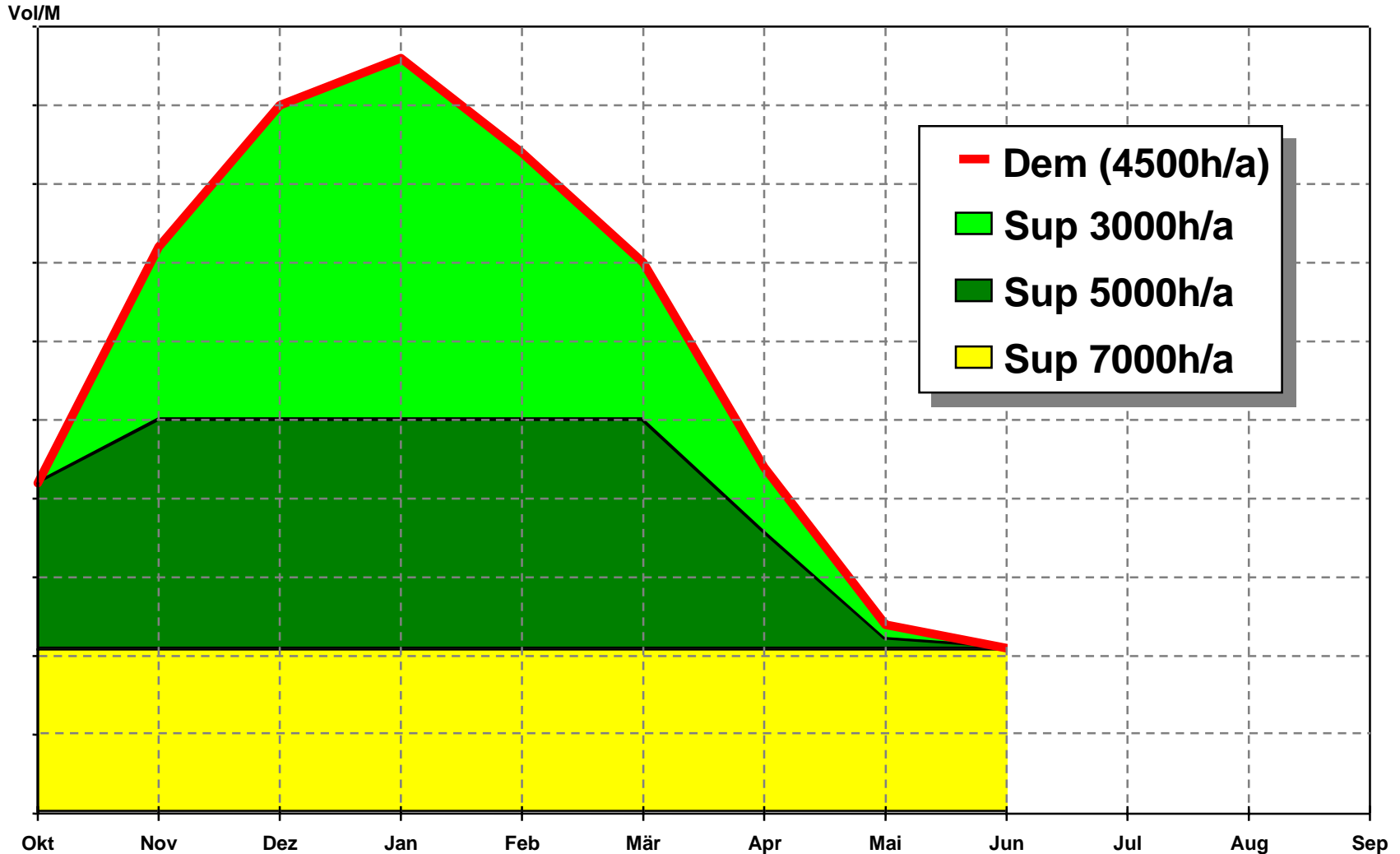
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



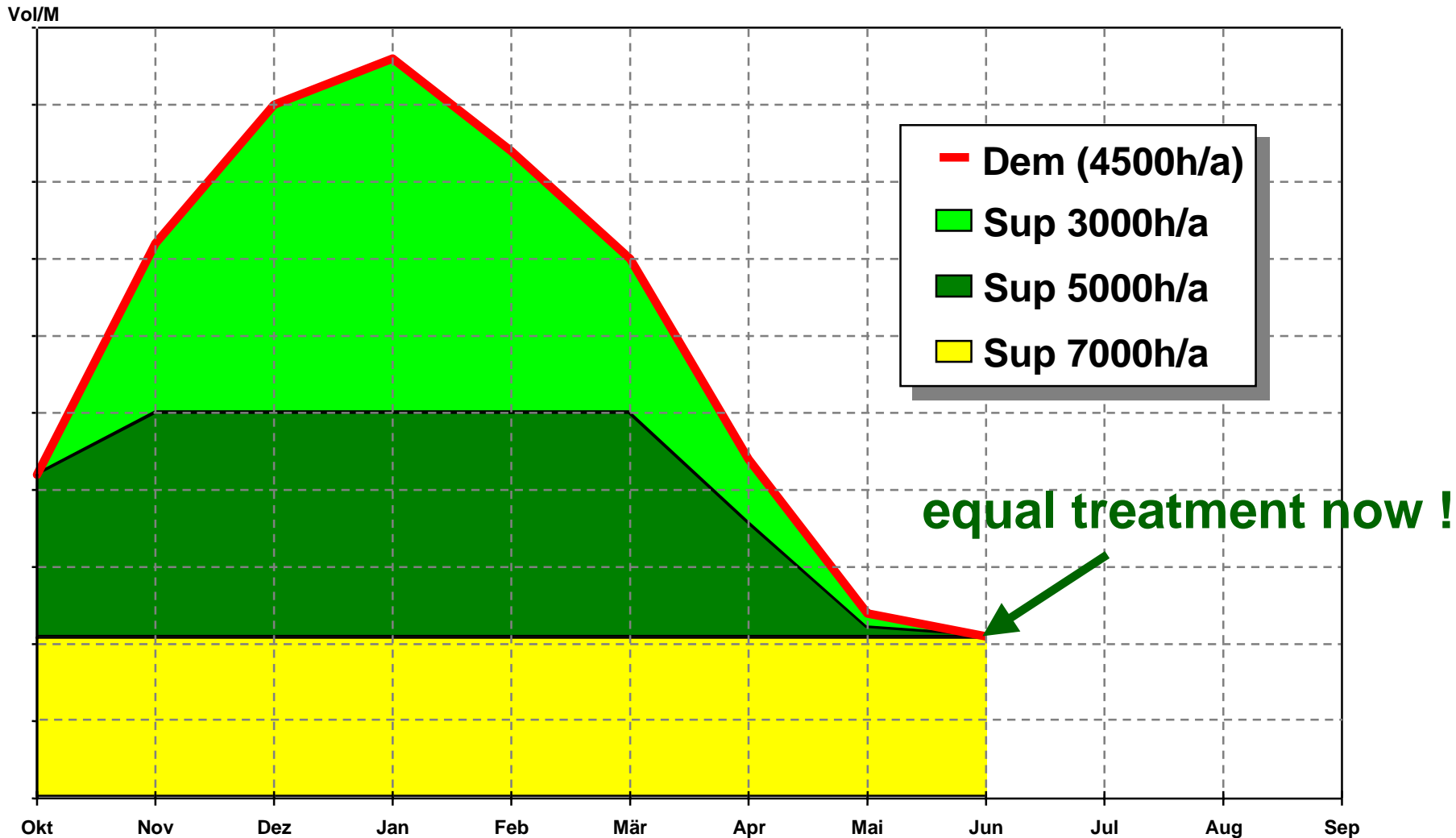
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



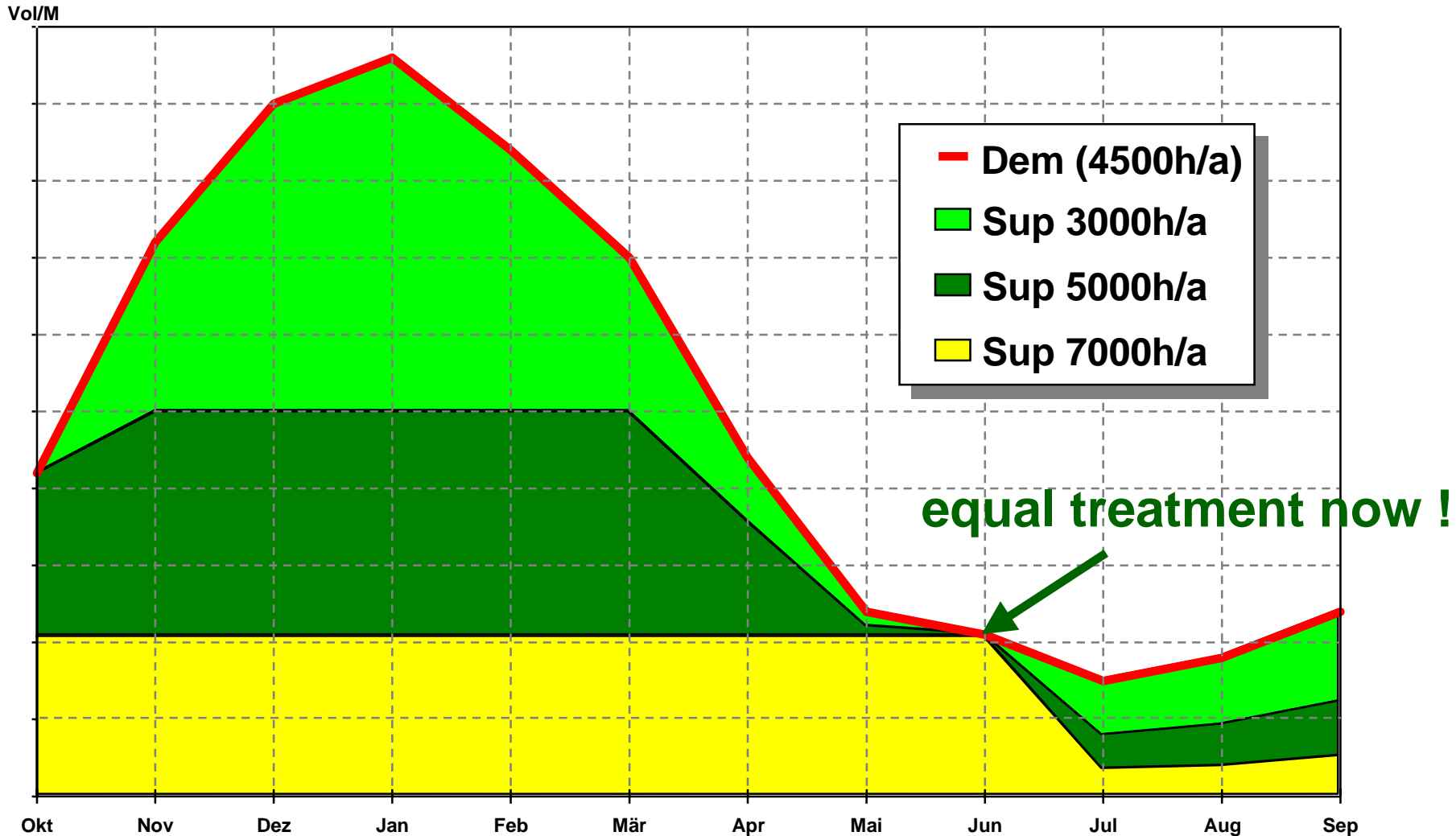
# Applications of Quasitopos Axioms in Optimization

## demand/supply balancing



# Applications of Quasitopos Axioms in Optimization

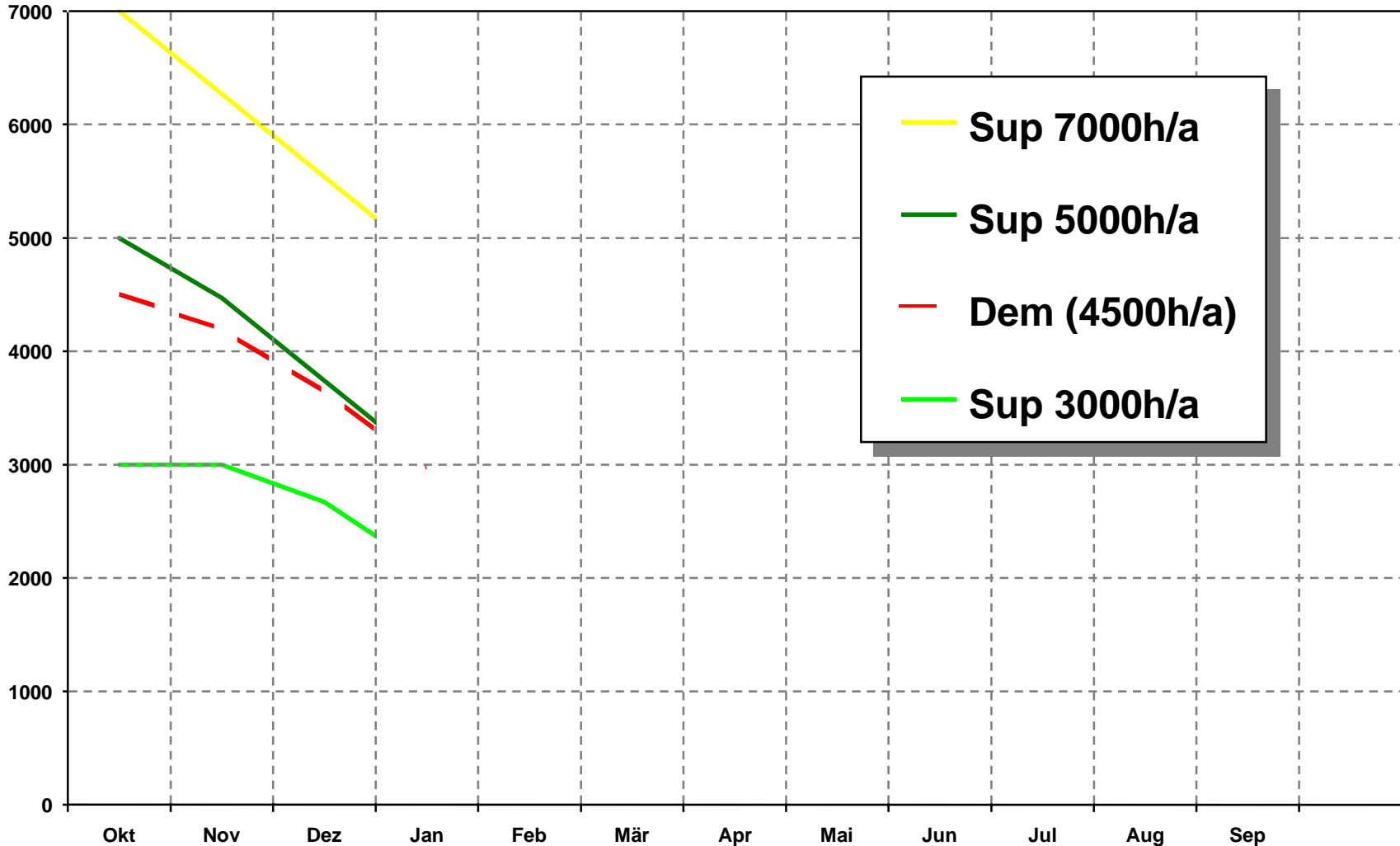
## demand/supply balancing



# Applications of Quasitopos Axioms in Optimization

equal treatment as soon as possible

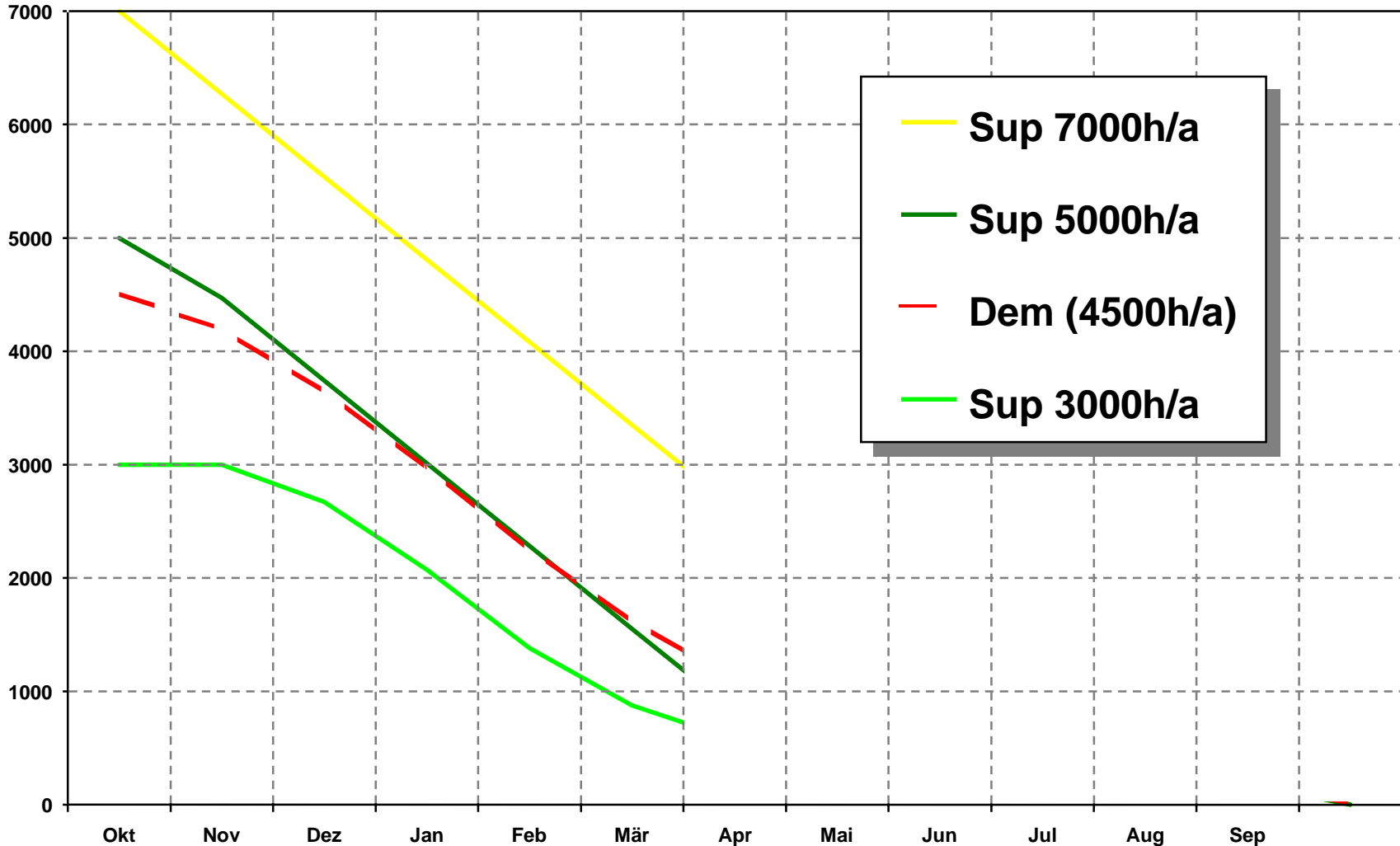
Rest Bh (Monatsbeginn)



# Applications of Quasitopos Axioms in Optimization

equal treatment as soon as possible

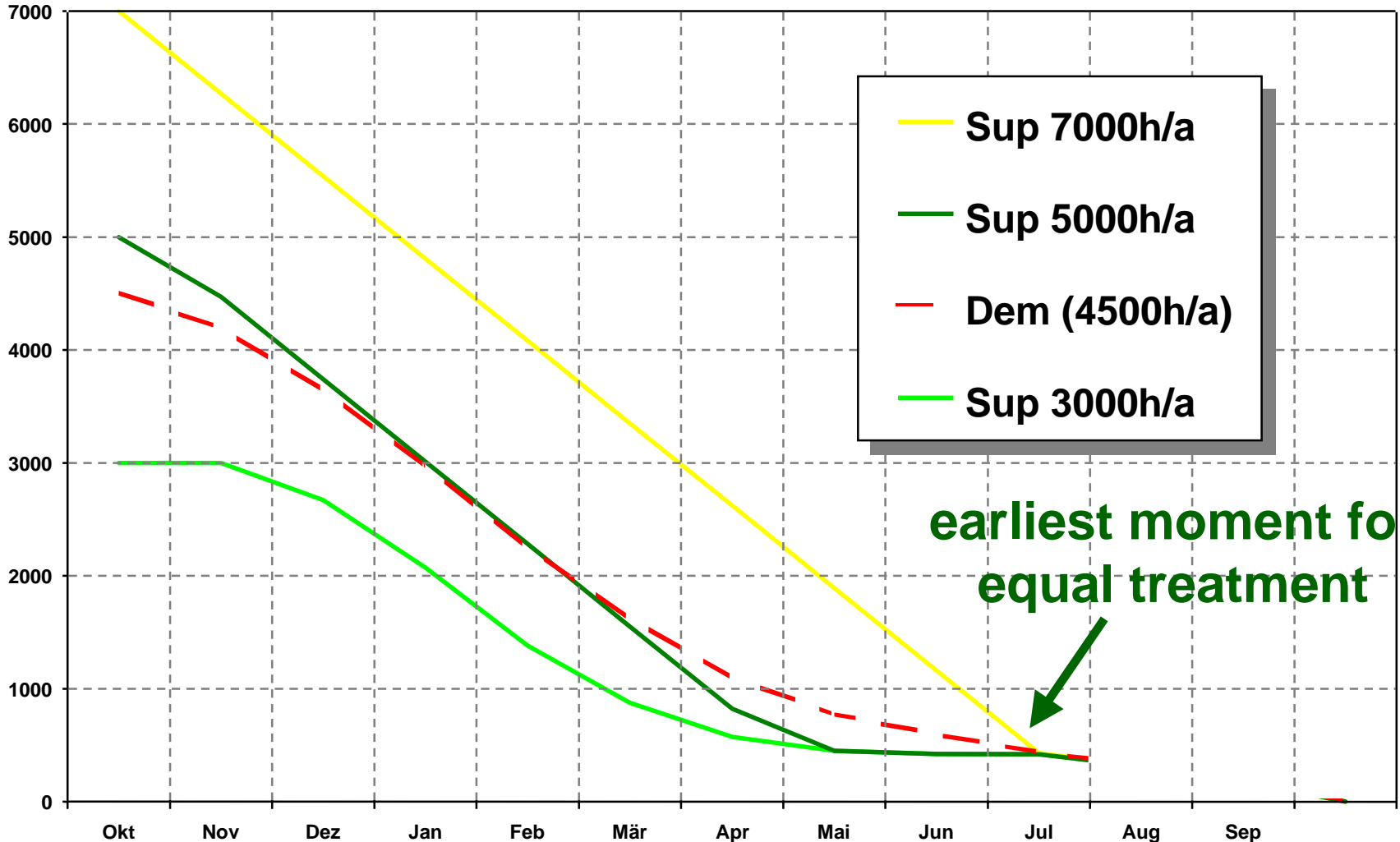
Rest Bh (Monatsbeginn)



# Applications of Quasitopos Axioms in Optimization

equal treatment as soon as possible

Rest Bh (Monatsbeginn)



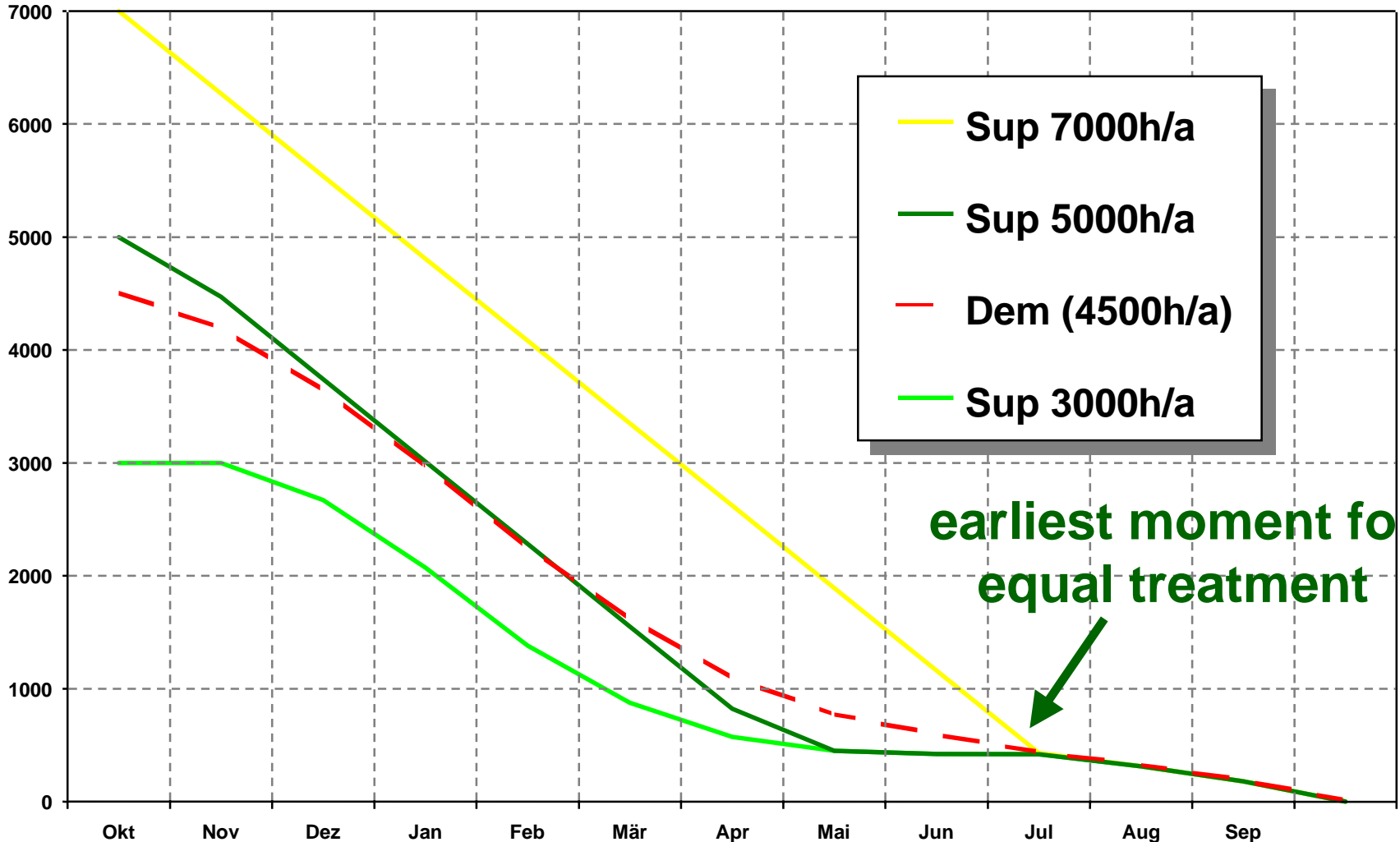
**earliest moment for equal treatment**



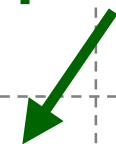
# Applications of Quasitopos Axioms in Optimization

equal treatment as soon as possible

Rest Bh (Monatsbeginn)



**earliest moment for equal treatment**



## agenda

**$H^2$**  category theory

- ✧ topological categories
- ✧ quasitopoi

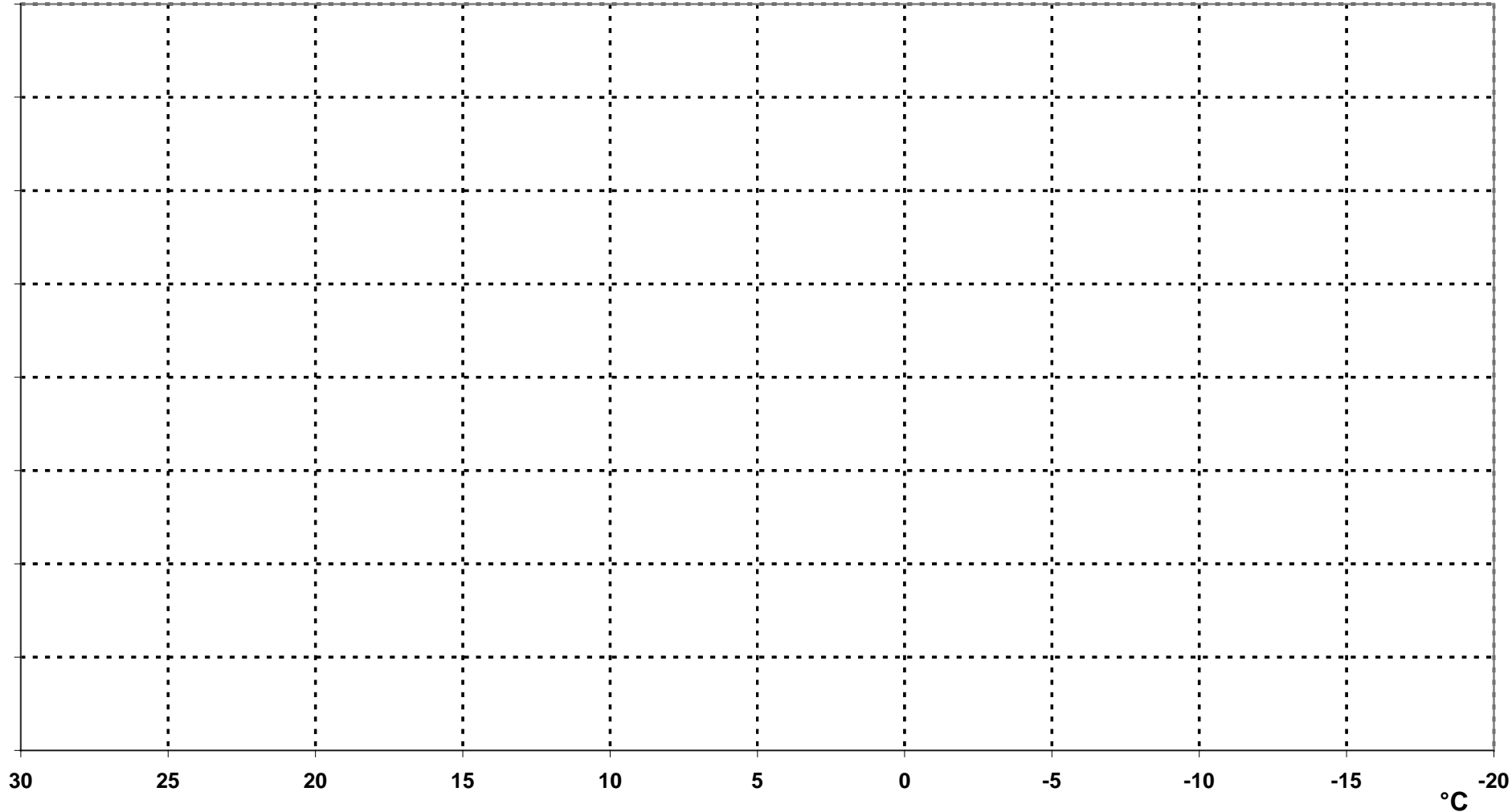
**$H^2$**  applications / optimization

- ✧ load balancing
- ✧ bin packing
- ✧ demand/supply balancing
- ✧ forecasting



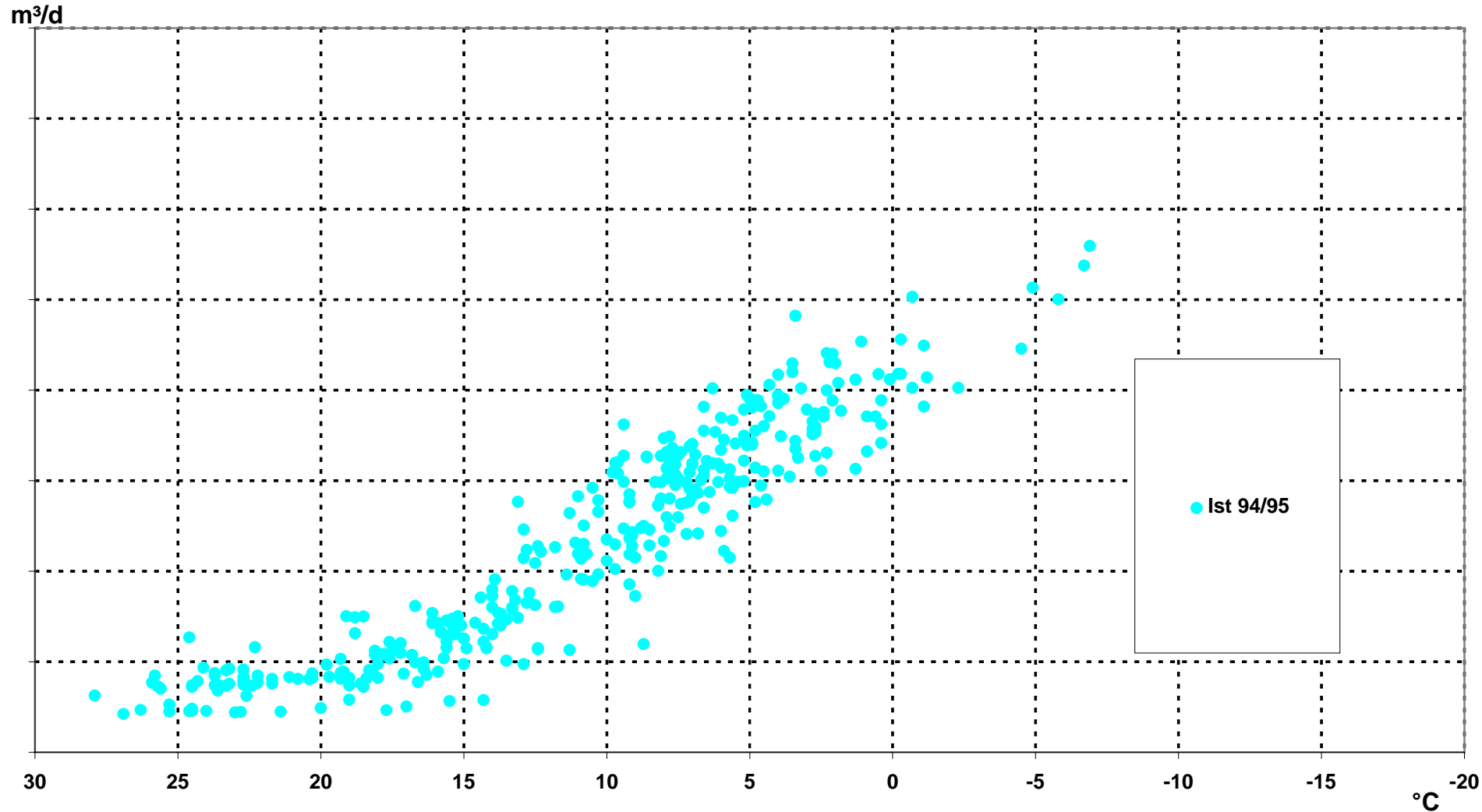
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



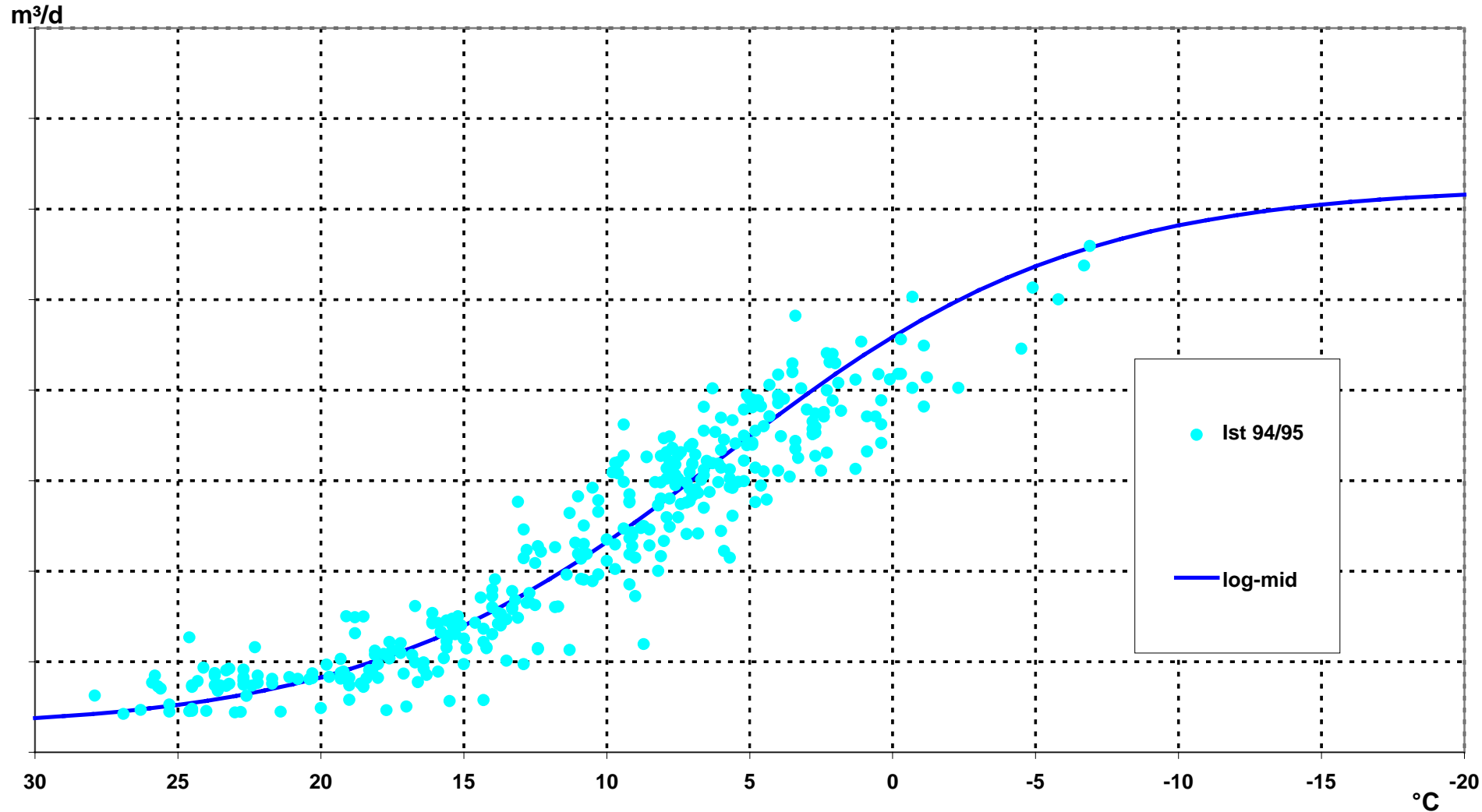
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



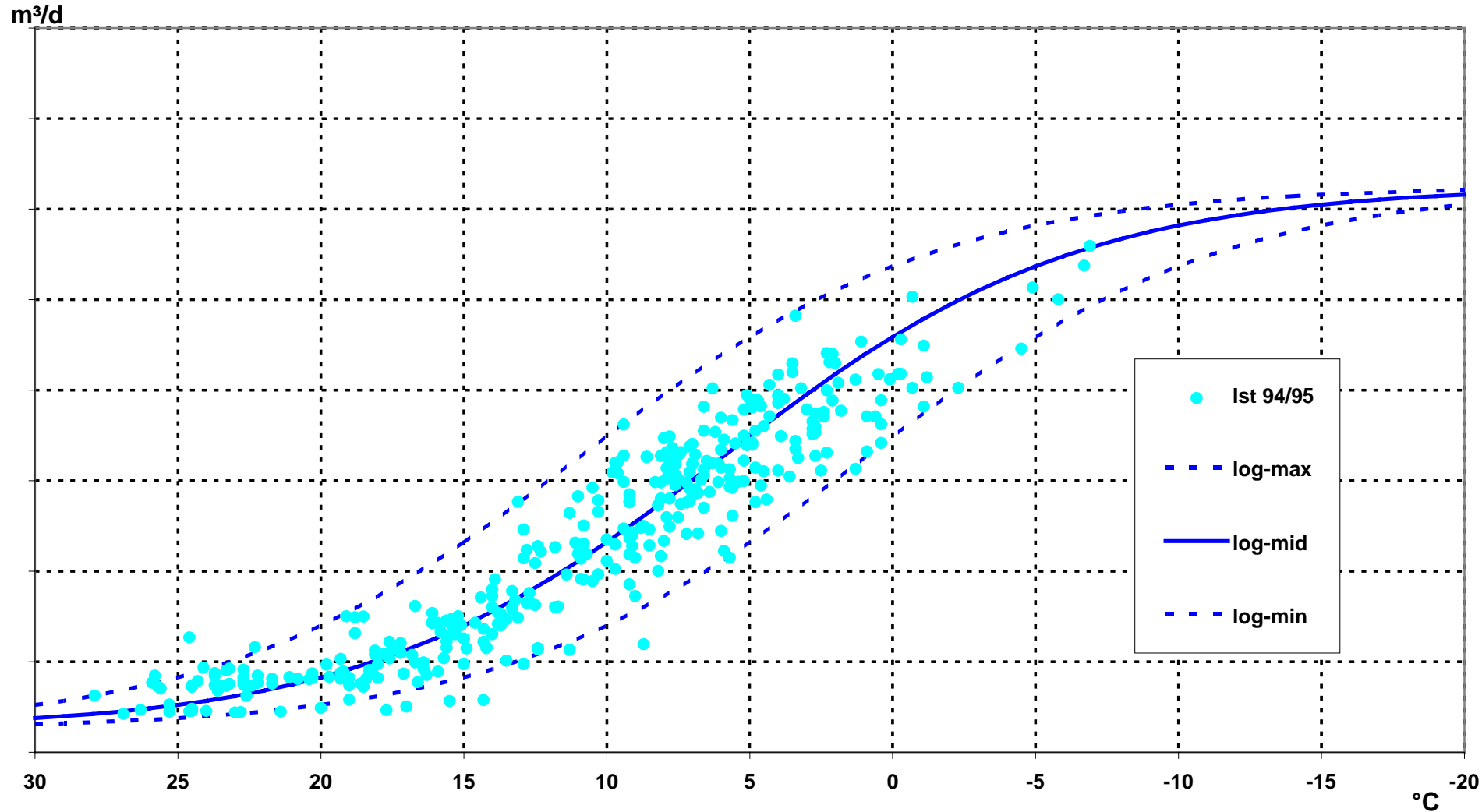
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



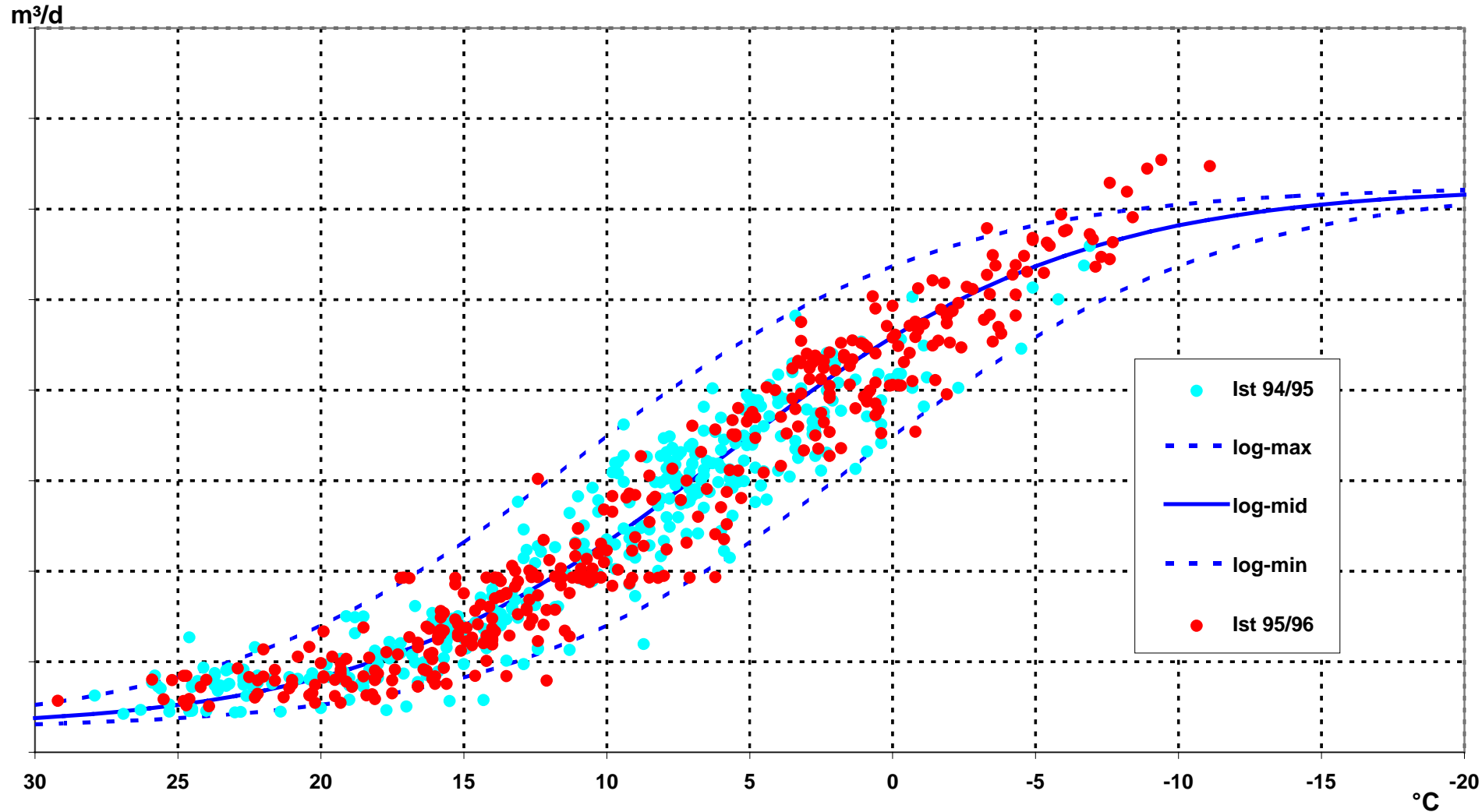
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



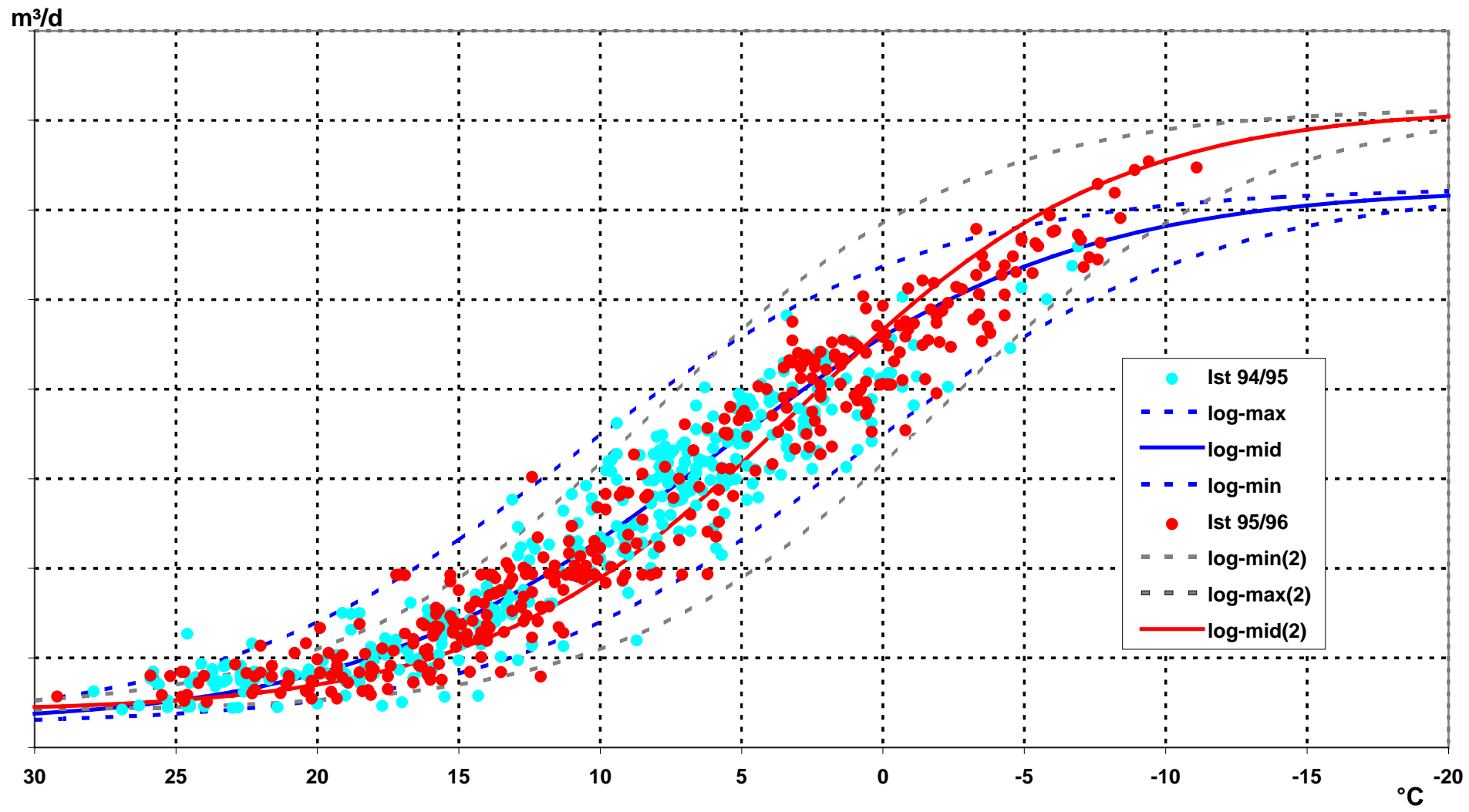
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



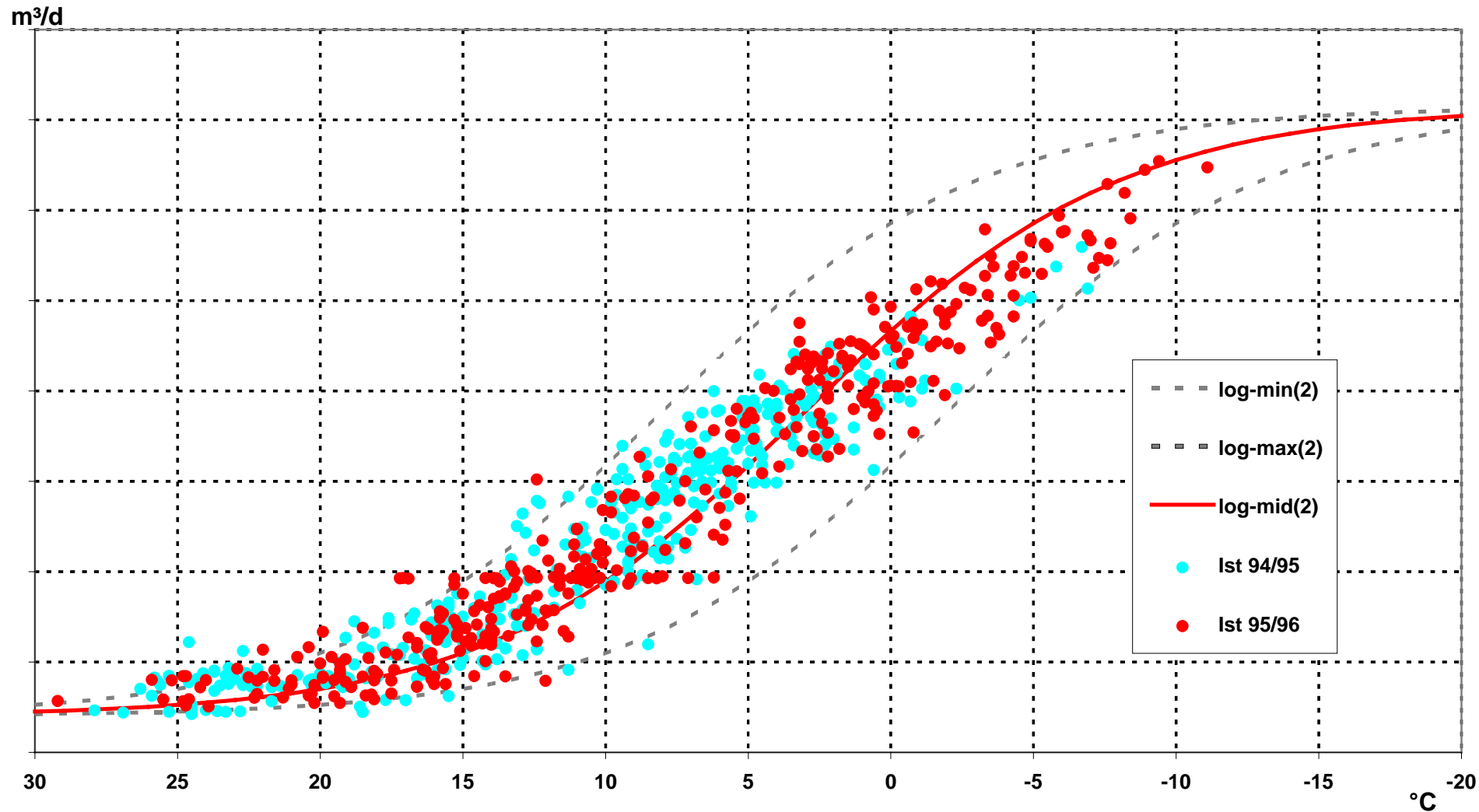
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



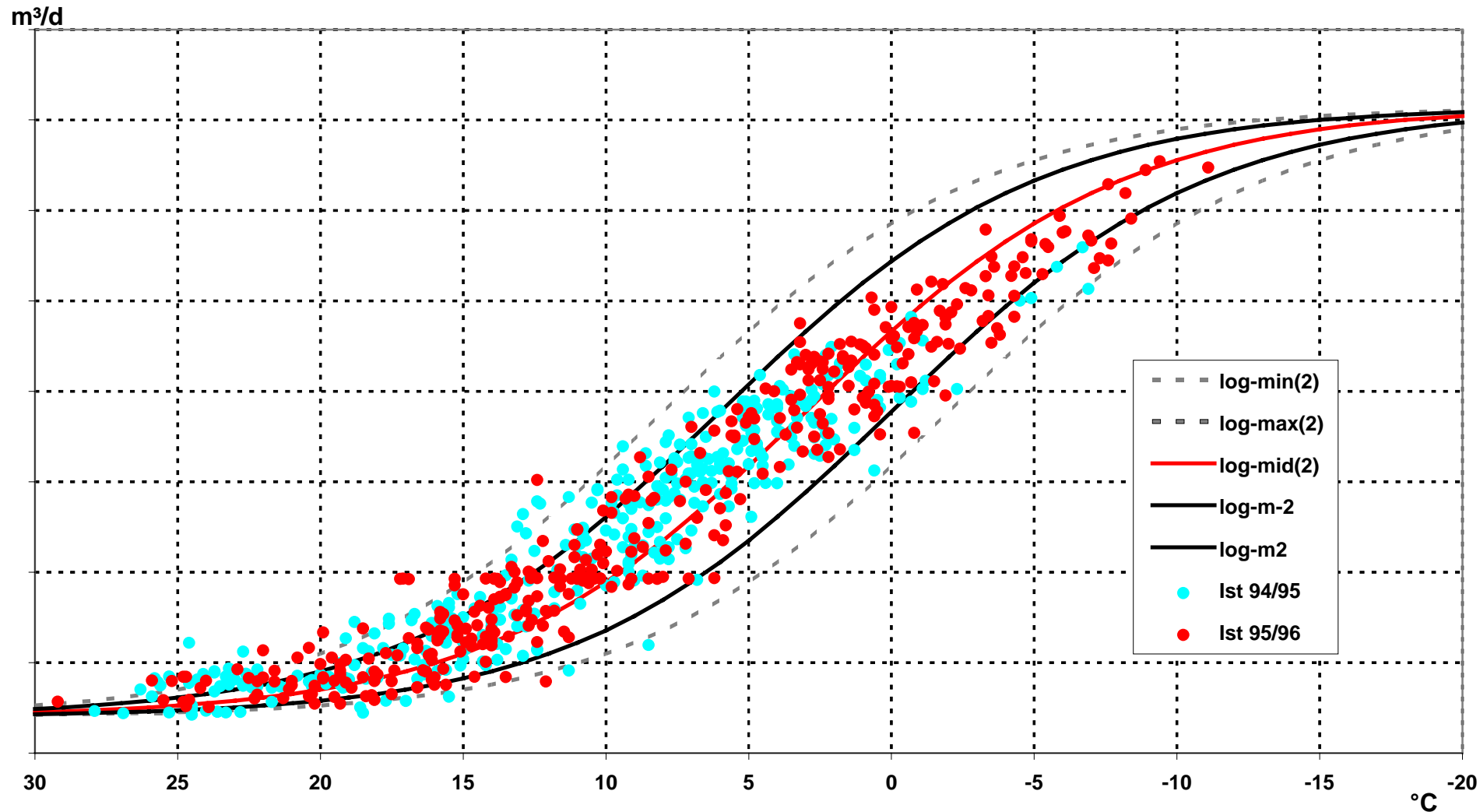
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



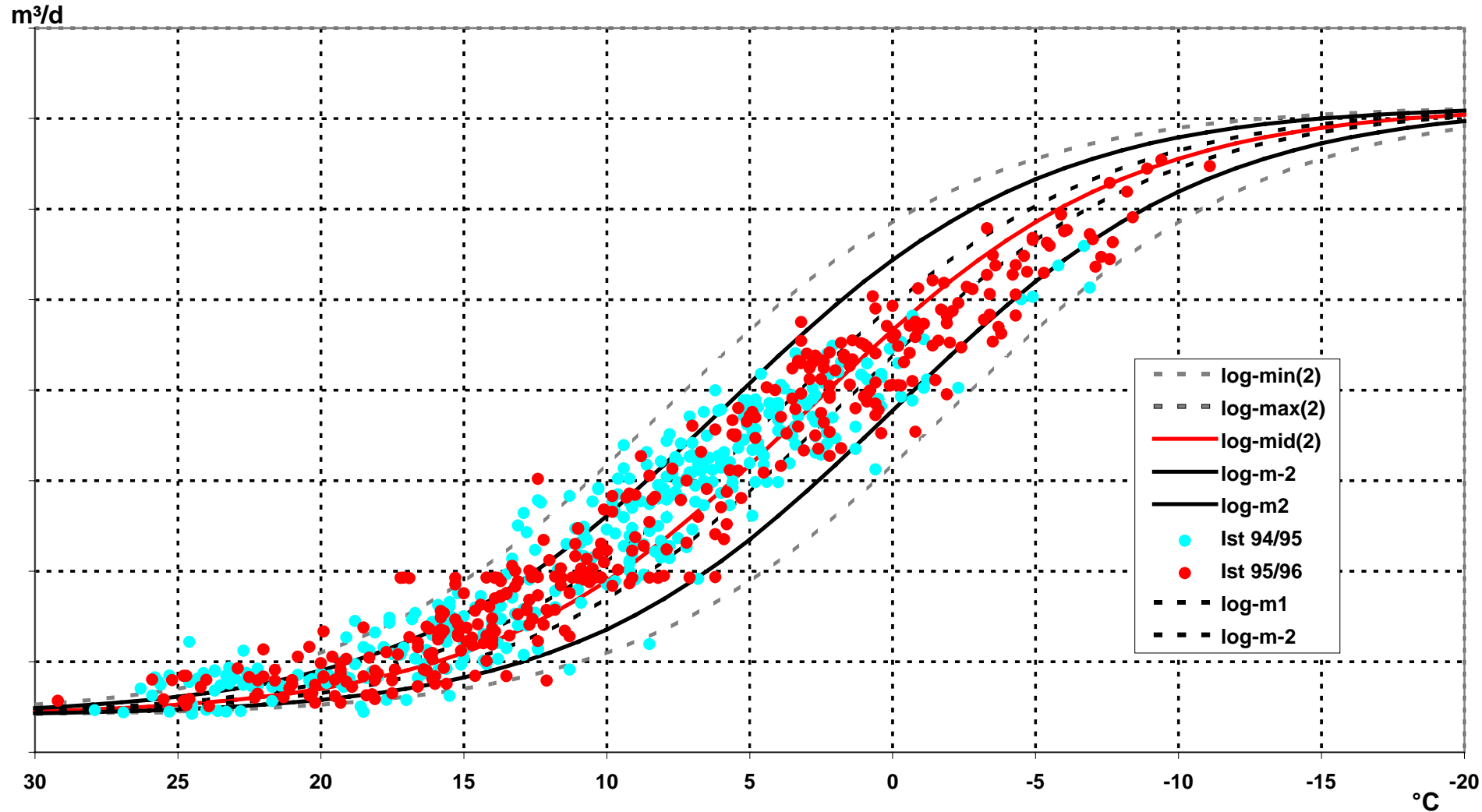
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



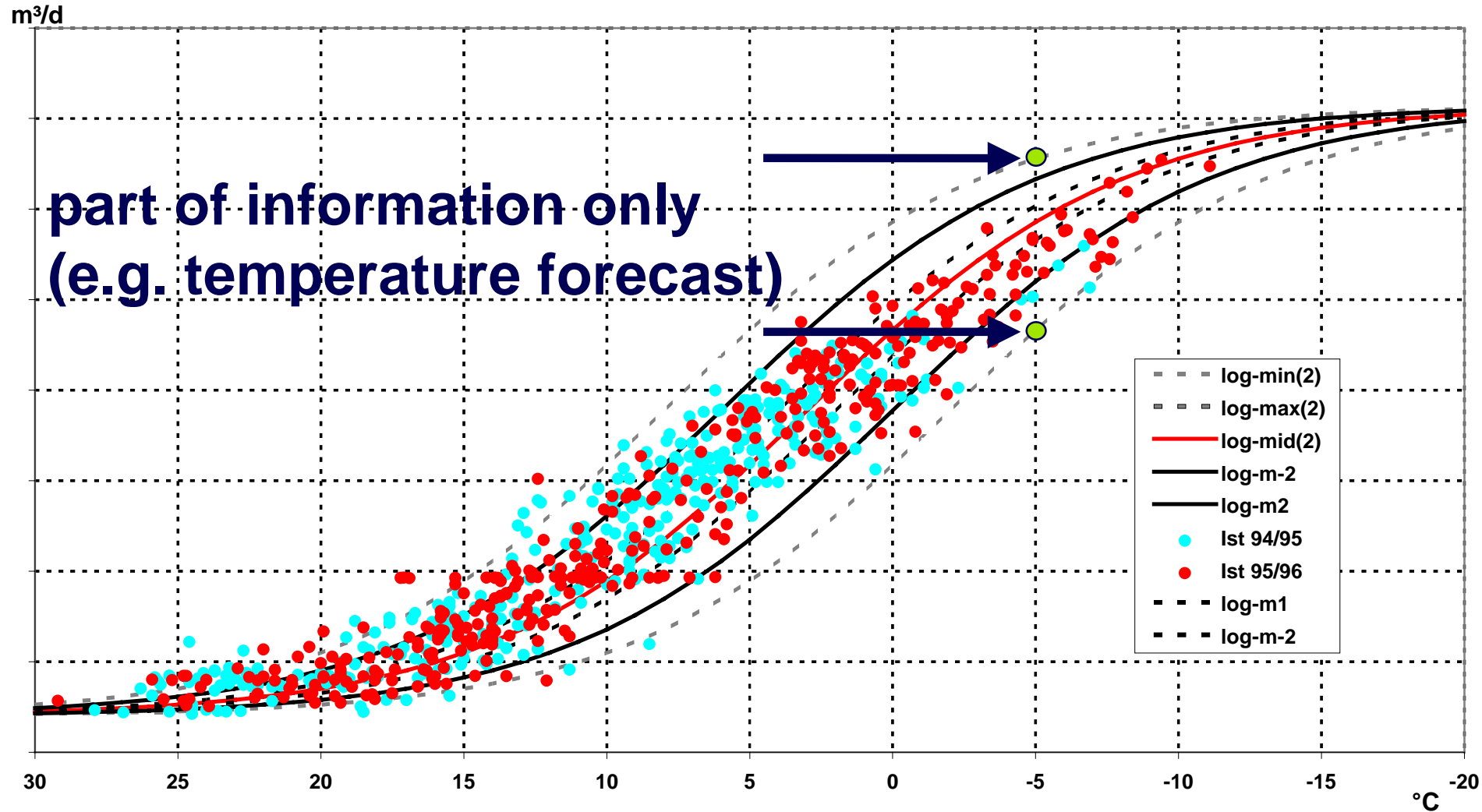
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



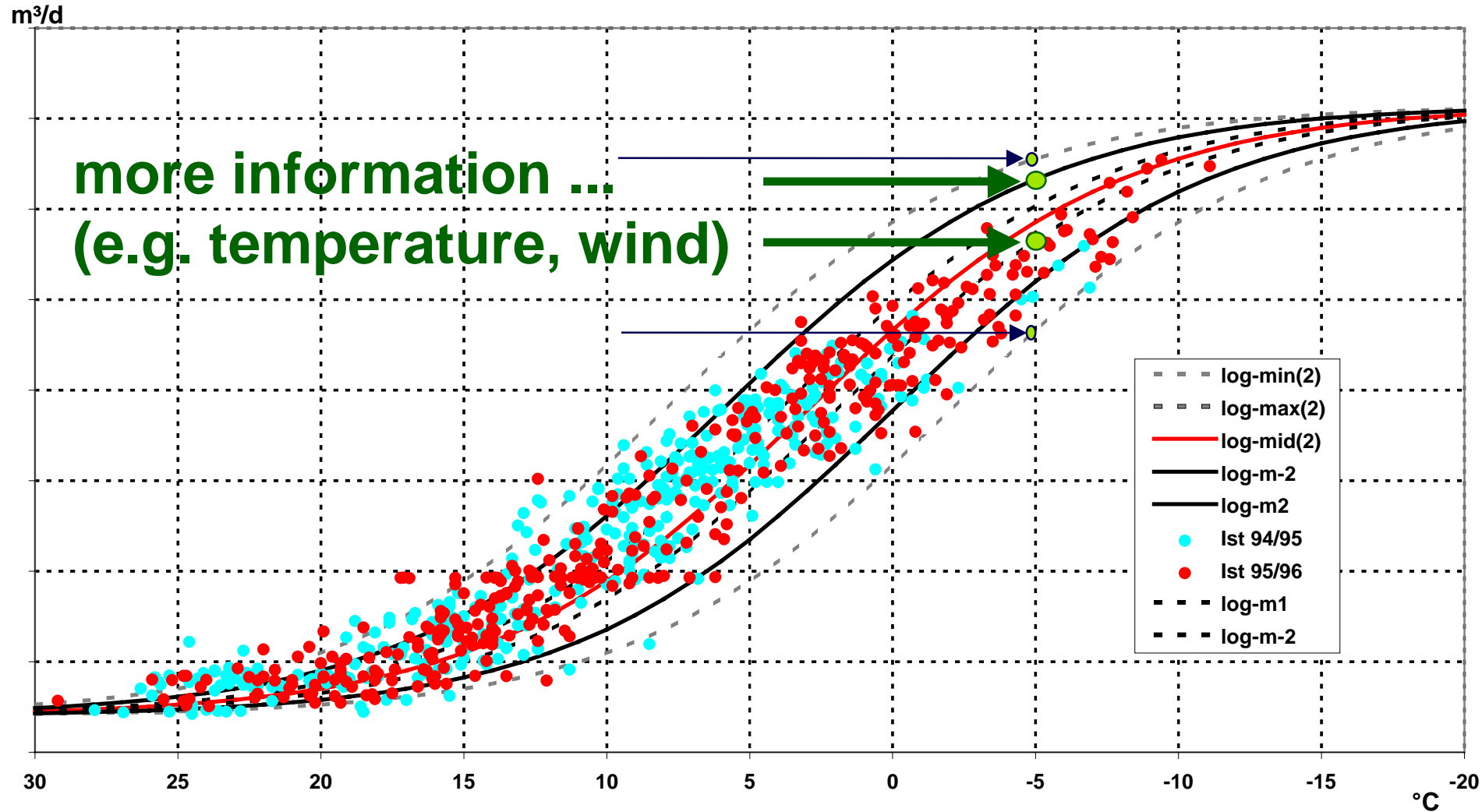
# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature



# Applications of Quasitopos Axioms in Optimization

## forecasting energy over temperature

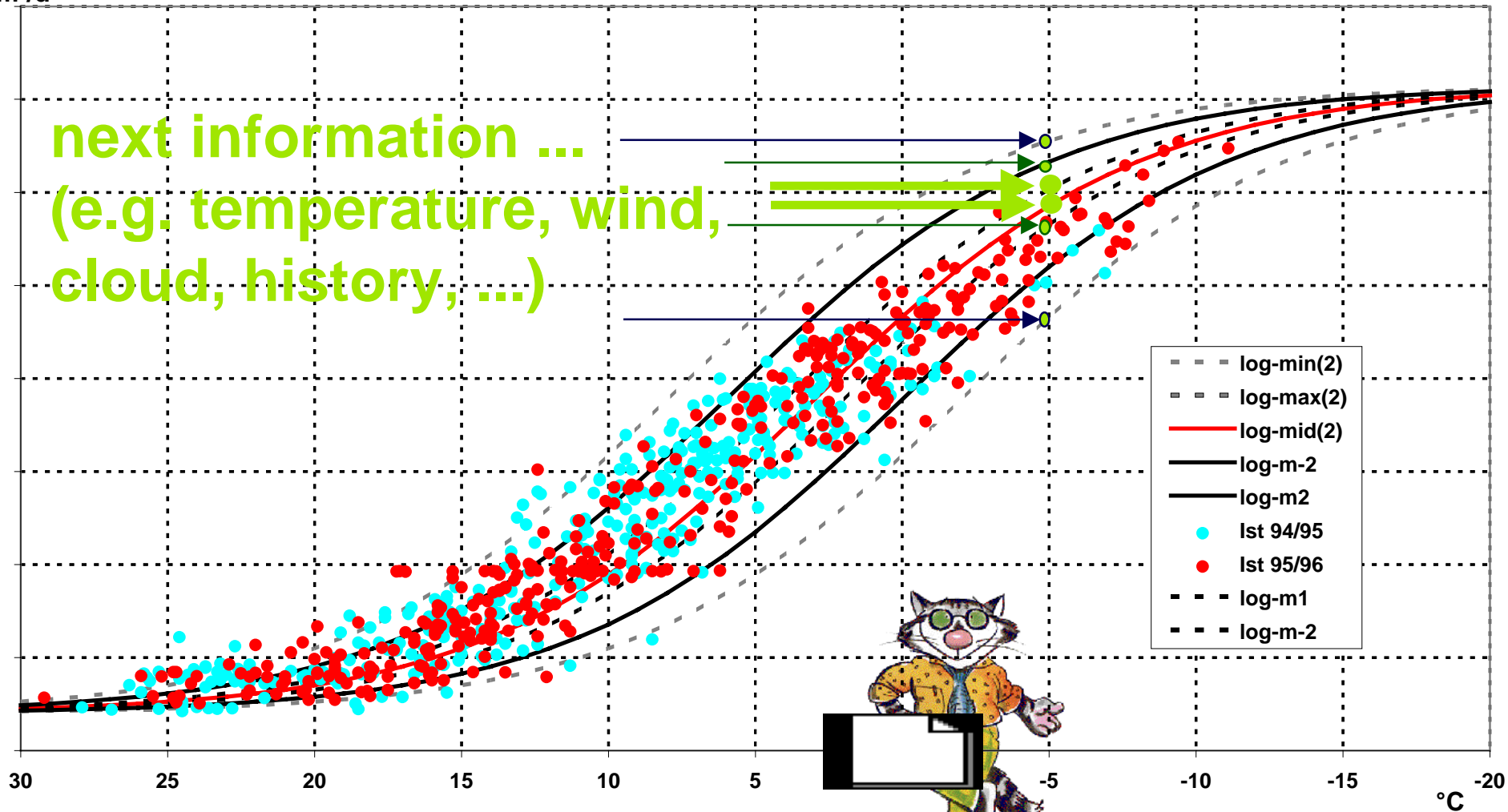


# Applications of Quasitopos Axioms in Optimization

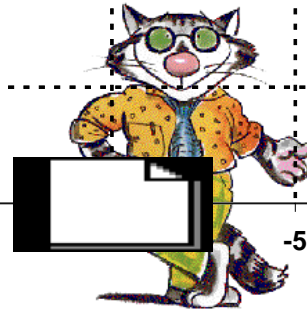
## forecasting energy over temperature

m<sup>3</sup>/d

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



- log-min(2)
- log-max(2)
- log-mid(2)
- log-m2
- Ist 94/95
- Ist 95/96
- log-m1
- log-m2



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

