Per Thostrup – 30 years in Biogas – Ms. Ag. Engineer
从事沼气行业的30年历程

- 1978 – 82 Research and technical development (RTD)
  1978 – 82 研究和技术发展（RTD）
- 1882 – 92 Planning of Biogas Plants and RTD
  1882 – 92 沼气厂计划和技术研究
- 1992 – 97 Design of Biogas plants (and RTD)
  1992 – 97 沼气厂设计和发展研究
- 1997 – 02 Build of Biogas Plants
  1997 – 02 沼气厂建造
- 2002 – 09 Operation of Biogas plants
  2002 – 09 沼气厂操作运行
- Present: CEO of www.NordicBioEnergy.dk
  现任www.NordicBioEnergy.dk 的CEO

Coupling between biogas production and use
沼气的生产和使用

- High availability only occurs when produced gas is used
  当生产的沼气得以利用才才算具有很高的实用性
- Biogas storage (big) only partly solve the buffer problem:
  沼气储存仅仅部分解决缓冲问题：
  - Lost electricity production cannot be recovered
    损失的电能是不能够被重复利用的
  - Engine often fall out at full gas storage
    发动机在气体储存满了的时候就会失效
- Better solution is: 更好的解决方案是：
  - Digesters with high value input dosing – can quickly regulate biogas production
    当发酵罐具备承载较高的底物输入量时-能够很快的调整沼气产量
  - Several engines instead of 1 or 2 -1 full back up engine
    几个发动机而不是只有1或2个-一个全程备用的
  - Small biogas storage –
    较小的沼气储存装置
  - Boiler can be avoided – portable boiler for start up.
    锅炉是可以避免的-如果有，也只是启动阶段使用的锅炉

Biogas conditioning – a precondition
沼气预处理-一个先提条件

- Trouble free engine operation only when:

  无障碍发动机操作只有在以下条件下才能够实现：

  – Particle free biogas else scaling in the gas inlet system – mail function of security- filter and valve
    在气体输入系统中，沼气粒子缩放自由-安全输送功能-过滤和阀门
  – Low content of H2S and halogens (Cl and F)
    H2S和卤化物(Cl and F)含量较少
  – Moisture content <70%
    湿度<70%
  – Temteraure max 45*C
    温度最高在45℃
  – Prepressure constant and in the range 70 to 120 mb
    稳定压力在70-120 mb之间

Biogas conversion into Electricity and Heat – Go-gen units
沼气转化为电能和热能-Co-gen单元

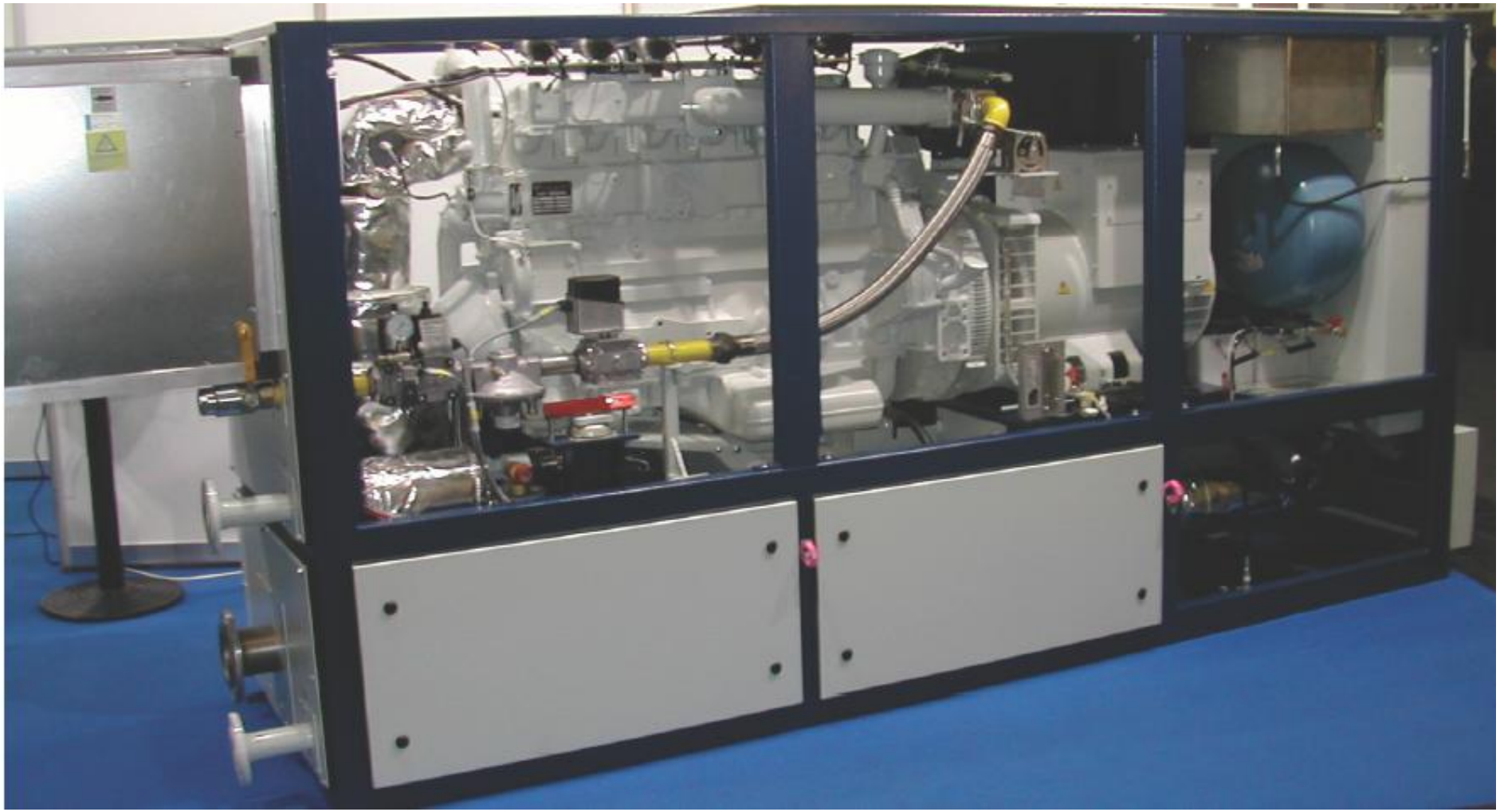
- Gas engines – large ←→ several small (pictures)→43%
  气体发动机-较大的←→ 一些小的（见图） →43%
- Dual fuel diesel engines: small engines (pictures)→45%
  双燃料柴油发动机：小发动机（见图）→45%
- Gasturnines: Capstone and the like (pictures) →33%
  气体涡轮机：定点像图中所示→33%
- Small steam boiler + steam turbine→28%
  小的蒸汽锅炉+蒸汽涡轮机→28%
- Go-gens in comming: Go-gens 正在发展中：
  - Oranic Rankine Cycle, ORC machimes
    有机兰金刻度的涡轮，ORC机器
  - Sterling Engines
    搅拌式发动机
  - Mixed steam power plant (→ 60%, lesa-maschinen.de) in RTD
    混合式蒸汽发电厂（→60%， lesa-maschinen.de）正在研究和发展中

Big Biogas engines 大的沼气发动机

400 kW to
3000 kW
400-3000kW

Electric
Efficiency
42-43,5%
发电效率
在42-43.5%

Small Biogas Engine 小的沼气发动机



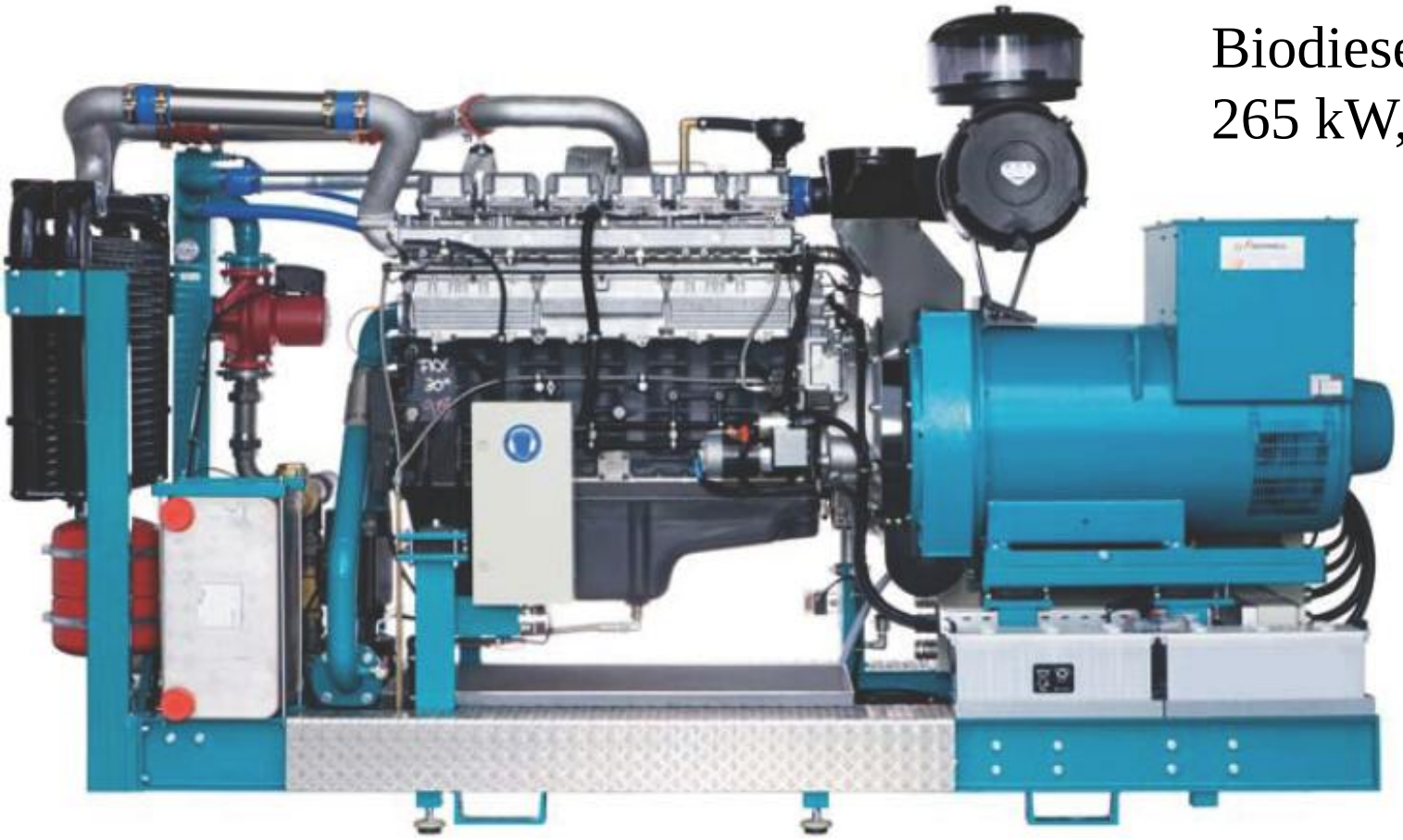
Co-gen package ca. 200 kW Co-gen集装在大概200kW

Small Biogas Engine 小的沼气发动机

Co-gen Package 200 kW

CO-gen集装200kW

Dual fuel diesel engine 双燃料柴油发动机



Dual fuel diesel
Biodiesel + Biogas
265 kW, eff: 45%

双燃料柴油

生物柴油+生物气

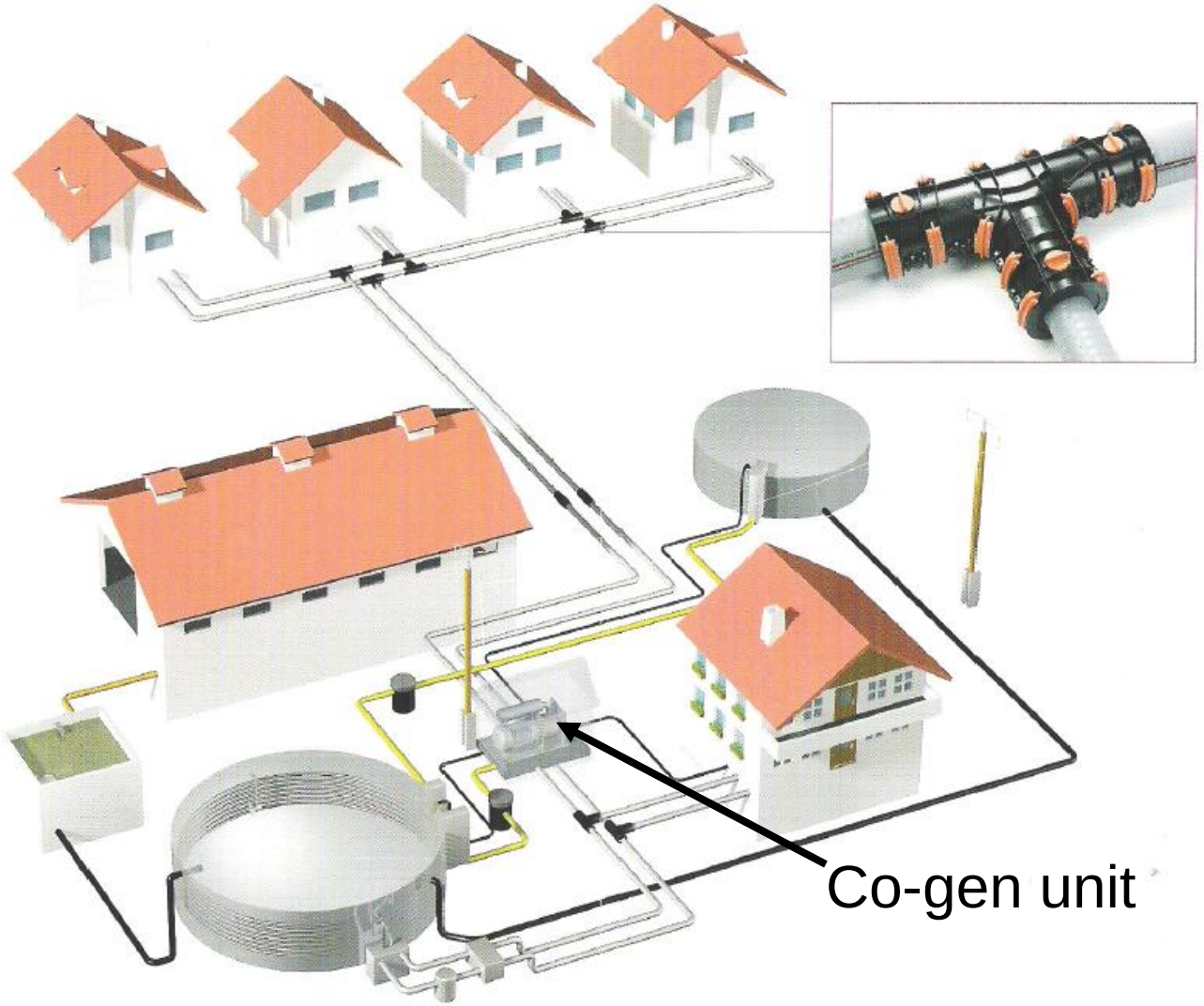
265kW，效率：45%

Use of electricity
电能的使用

- Network experts is asked–depends on country / location
  据专家所述-根据国家和地区不同而不同
- 3 basis concepts for 24 h operation:
  24小时操作的3个基本概念：
  - Sell all elcreicity produced and buy all used
    Most expensive (2 transformers and 2 meters) but most flexible
    出售出所有产生的电能并且购买所有的使用电能, 大多数很贵（2个转换装置并且2米）但是灵活性很强
  - Sell the net electricity produced: produced – own consumption
    Cheaper but only recommeded where there are no rev. Tarif
    向电网卖出生产的电能：生产-自己消费很便宜但是只建议在没有相关规定的地区
  - For own consumtion / Island mode: very seldon possible
    自己消费/内销模式：很少见
- Peak hour generation: 提高发电效率：
  - Generally difficult as storage of biogas i expensive
    一般来讲很困难，因为沼气储存价格昂贵
  - Could be very profitable with a combination of base load and peak hours generation. Requiere more engines, a big biogas storage and a controlled variation in biogas production throughout the day (separate high value feed line)
    把基本承载量和提高小时产量结合起来是很可行的。安置更多的发电机，一个大的沼气储存装置，并且控制全天中沼气生产 量的变化（分离的高填充量管道）

Use of Heat – Basis concept

热能利用-基本概念



- Biogas digesters
- Hygienization
- Prestorage
- Pretratment
- Aftertreatment
- Sevice buildings
- Factories
- Living houses
- District heating
- ORC generation

- 沼气发酵装置的清洁处理
- 预储存
- 预处理
- 后处理
- 工作车间
- 工厂
- 居住间
- 区域加热
- ORC生产

Use of Heat – Temperature management
热能利用-温度管理

- Go-gen unit (90/70*C) demands a **low return temperature**, max 70*C and no temperature peak in return water

  Co-gen单元(09/70 ℃)需要一个很低的回流温度，最高70 ℃，并且回流水的温度不能达到极点温度
- By all heat consumers must be secured that return temperature is max. 70*C and no temperature leak

  必须保证所有的热能使用装置的回流温度最高达到70 ℃，并且不达到极点温度
- Dump cooler (air cooled or cooling tower) is only security for acheiving <70*C

  蒸汽冷却装置（冷却的空气或者冷却塔）必须保证温度在70 ℃以下

Use of Heat – Hydraulic management
热能利用-水力管理系统

- Many problems comes from hydraulik problems in the hot water system

  很多问题都出于热水系统中的水力问题
- Each producers and consumer of heat must have free access to the water flow it needs, also when there are more on/off consumer circuits (like digesters)

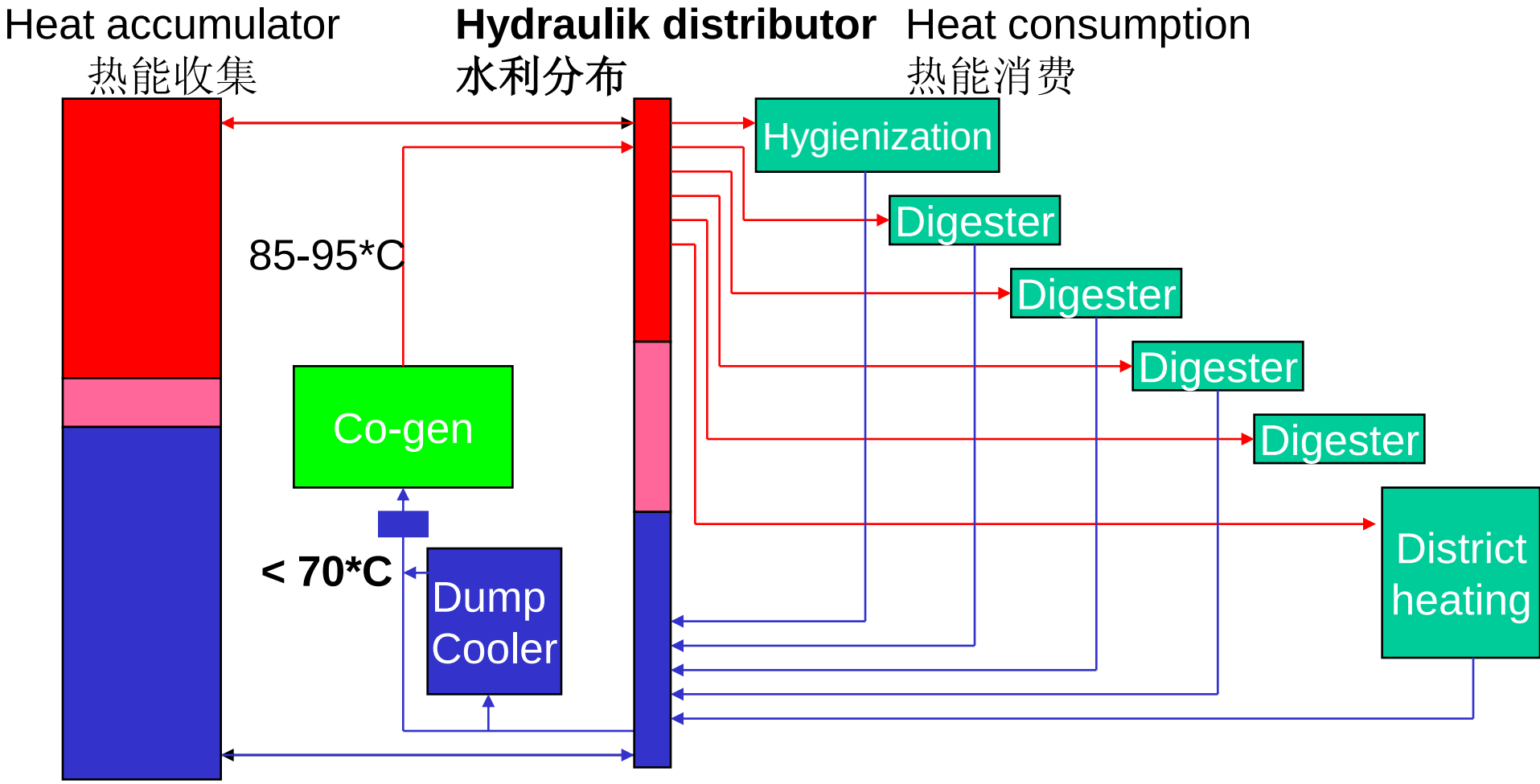
  每个热能的生产装置和消费装置都必须满足水力输送的基本要求，并且配有跟多的开/关电路（像发酵罐一样）
- A **hydraulik distributer unit** is needed – see sketch

  需要一个水力分布单元-见下页
- Proper bleeding system – air outlets must be in place

  合适的流动系统-必须及时排出空气

Use of Heat – Hydraulik distributor

热能利用-水力分布单元



Steam generation and heat for cooling

蒸汽生产和热能冷却

- Steam can be generated from the exhaust (450–500*C)
  可以利用排出的废物产生蒸汽(450–500℃)
- Needs specialized knowledge and experience
  需要特殊的经验和知识
- To sell steam can be a good business – distance!!!
  出售蒸汽是一个很好的行业-还存在距离！！！
- Low pressure steam (110*C / 2 bar) gives half of electricity, ca. 20% but high pressure (20 bar) reduces the amonut down to 10%
  低压蒸汽（110 ℃/2bar）产生一半的电能， 大概20%，但是高压蒸汽（20bar）产生的电能不到10%。
- After steam heat exchanger a normal hot water exchanger can be fitted.
  蒸汽热交换后，一般的热水交换就可以加入进来
- Heat for cooling: next speaker Dr. J. Clemens
  用热能来冷却