HYDROGEN BOX

Hydrogen as storage alternative

Ori Elbaum, Matej Pavli, Magda Topić, Muhammed Zangariya

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WHY HYDROGEN?

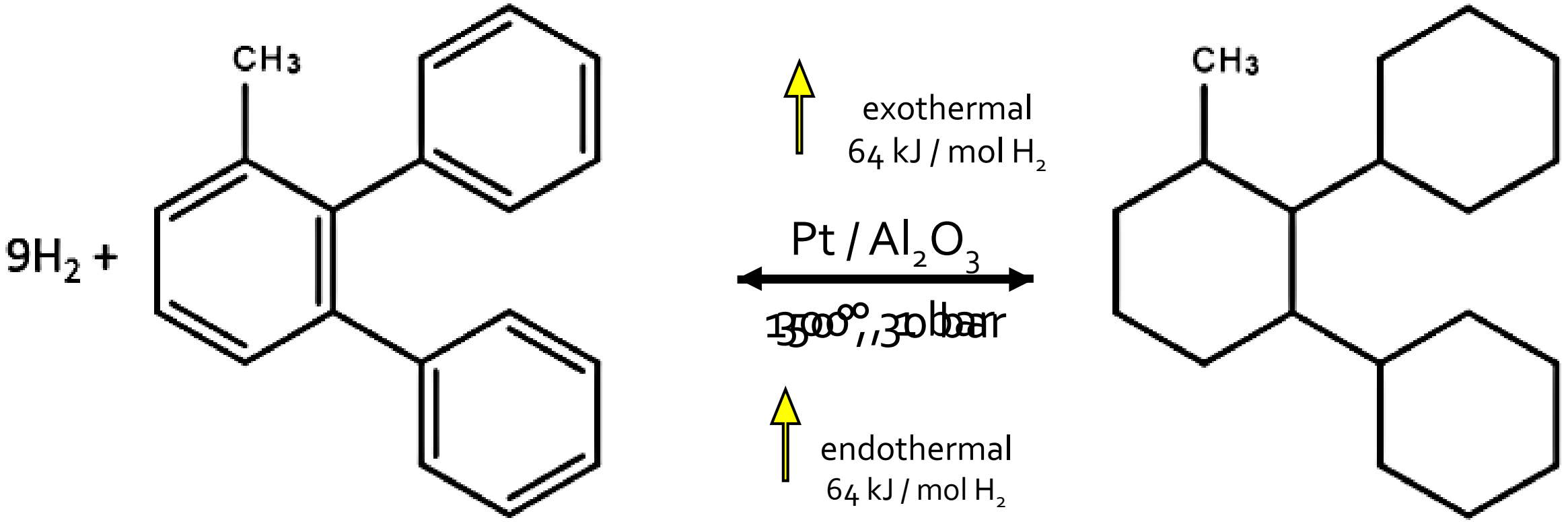
- Stable source of energy
- Highest energy density
- Byproduct: water
- Renewable
- Complicated transport

HOW TO STORE AND TRANSPORT H_2?

SOLUTION

- Liquid Organic Hydrogen Carriers (LOHC)
- hydrogen-rich organic compounds
- liquid energy carriers
- Dibenzyltoluene (DBT)
  - liquid from -39°C to 250°C

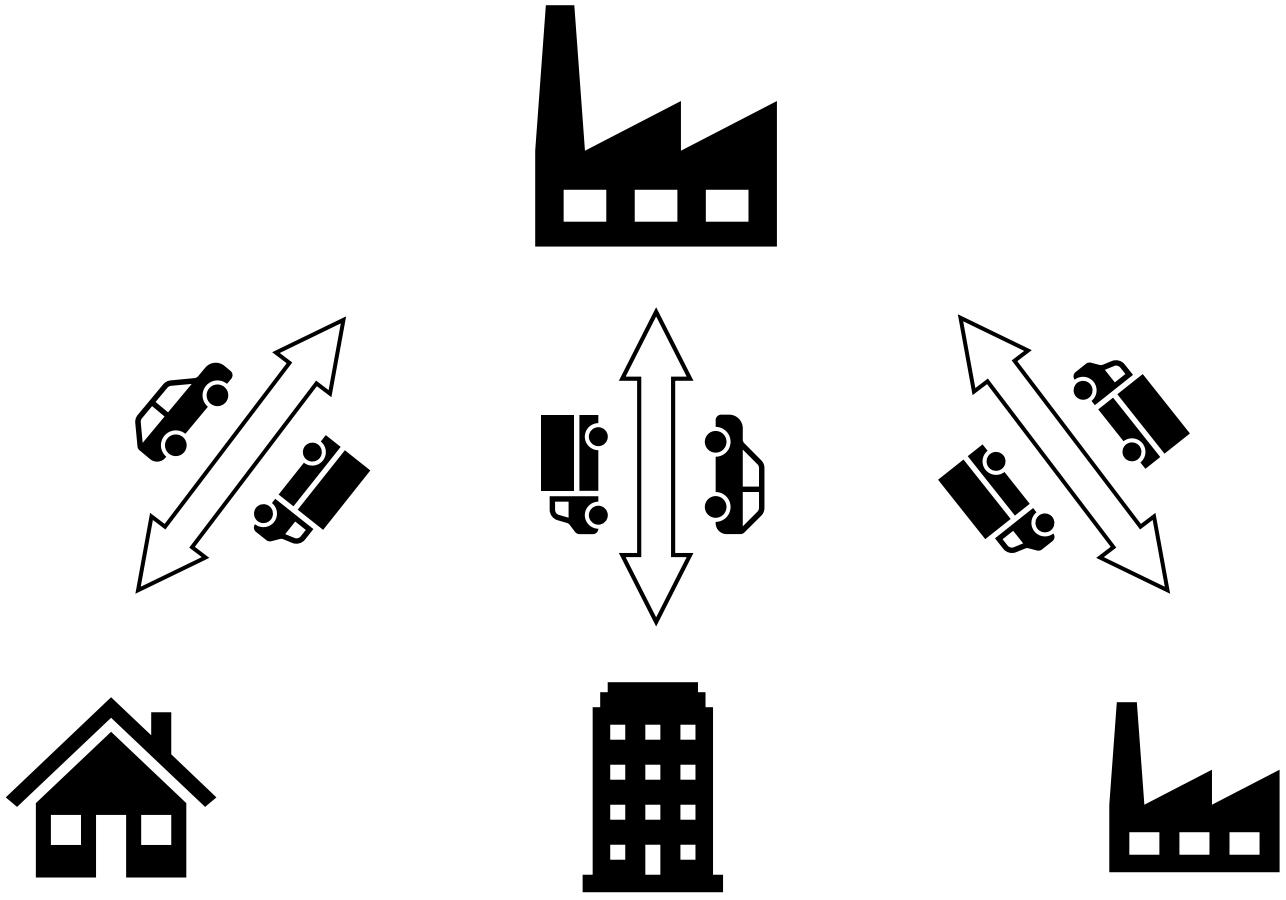
DIBENZYLTOLUENE (DBT)

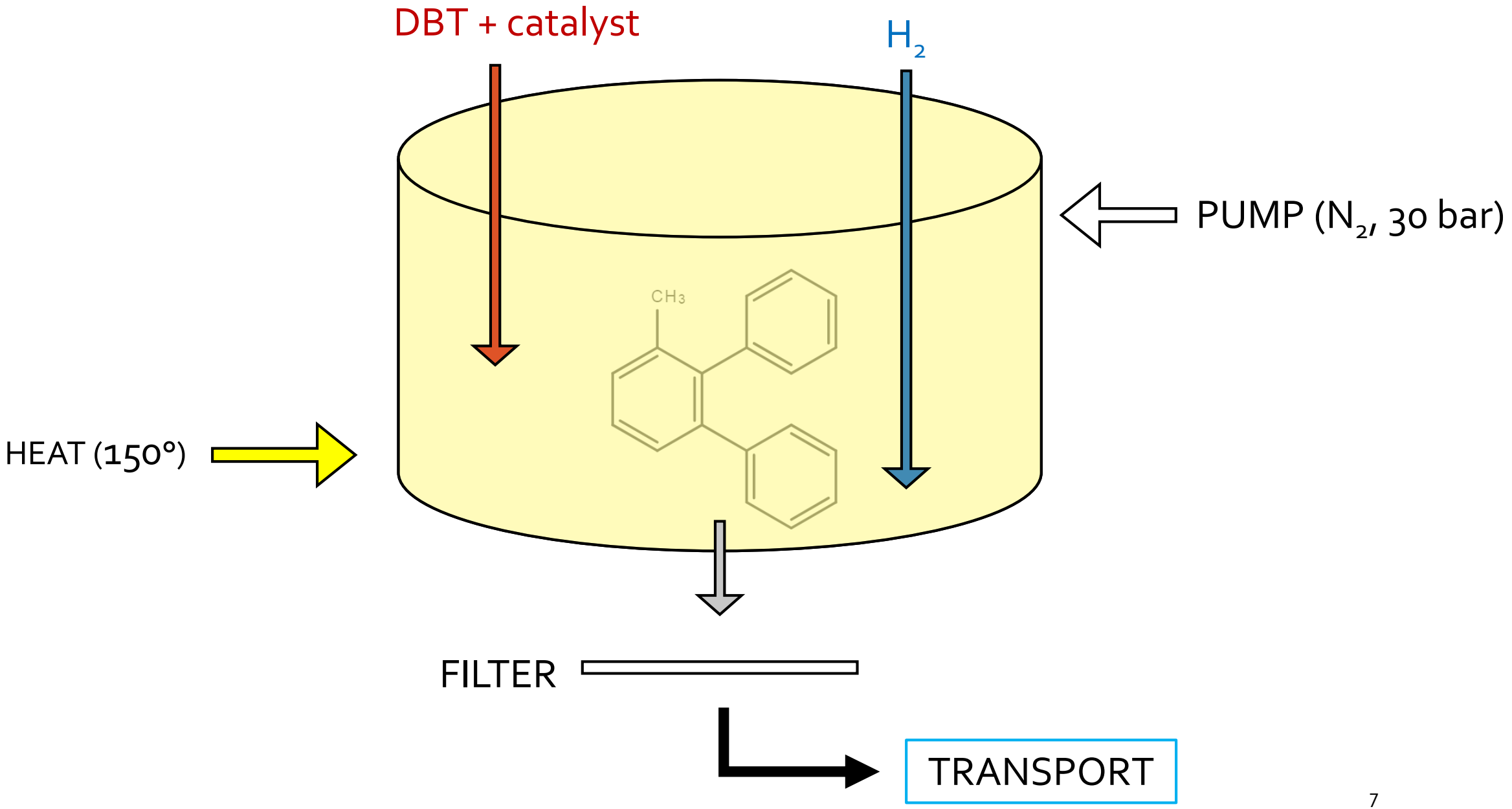


DBT

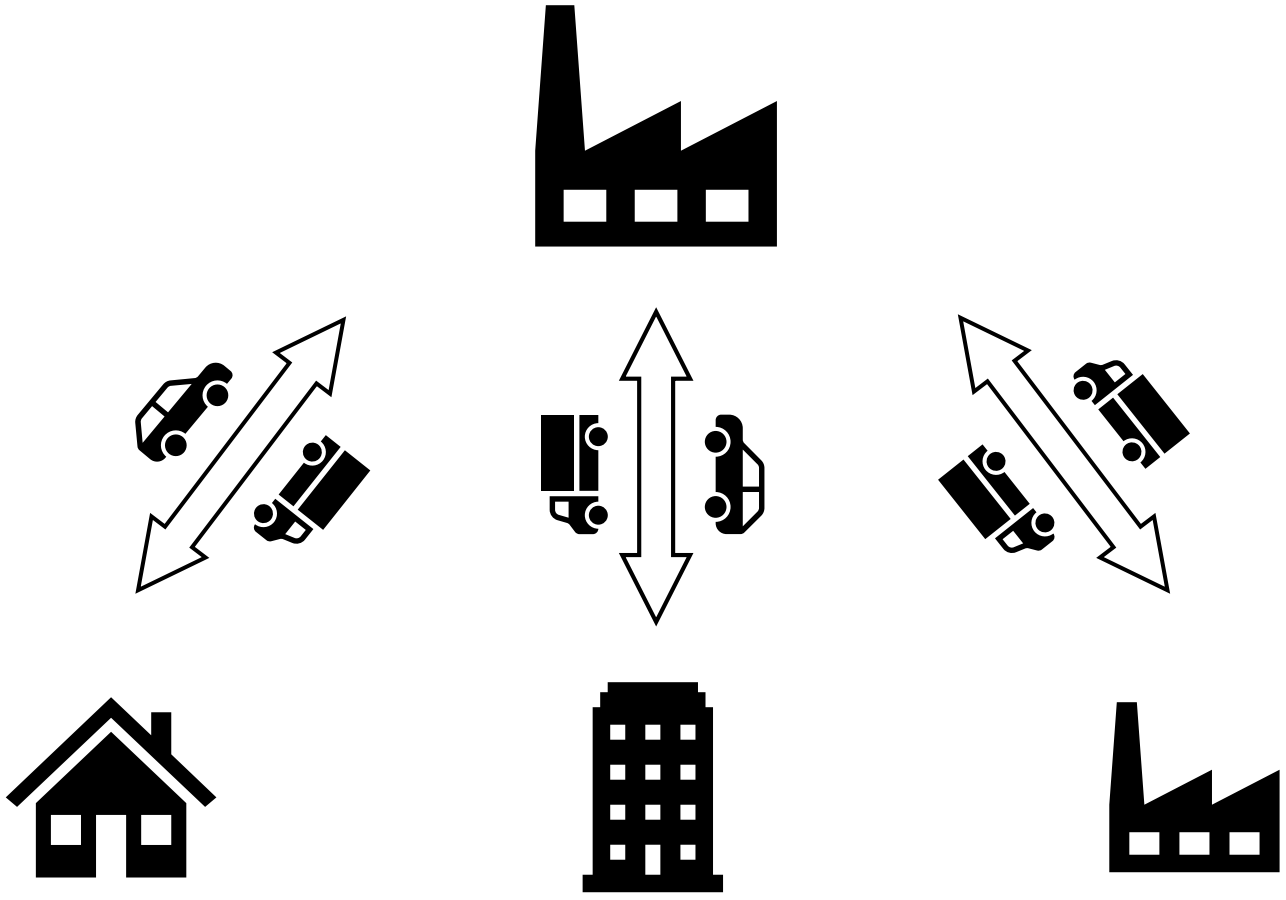
perhydro-DBT

APPLICATION



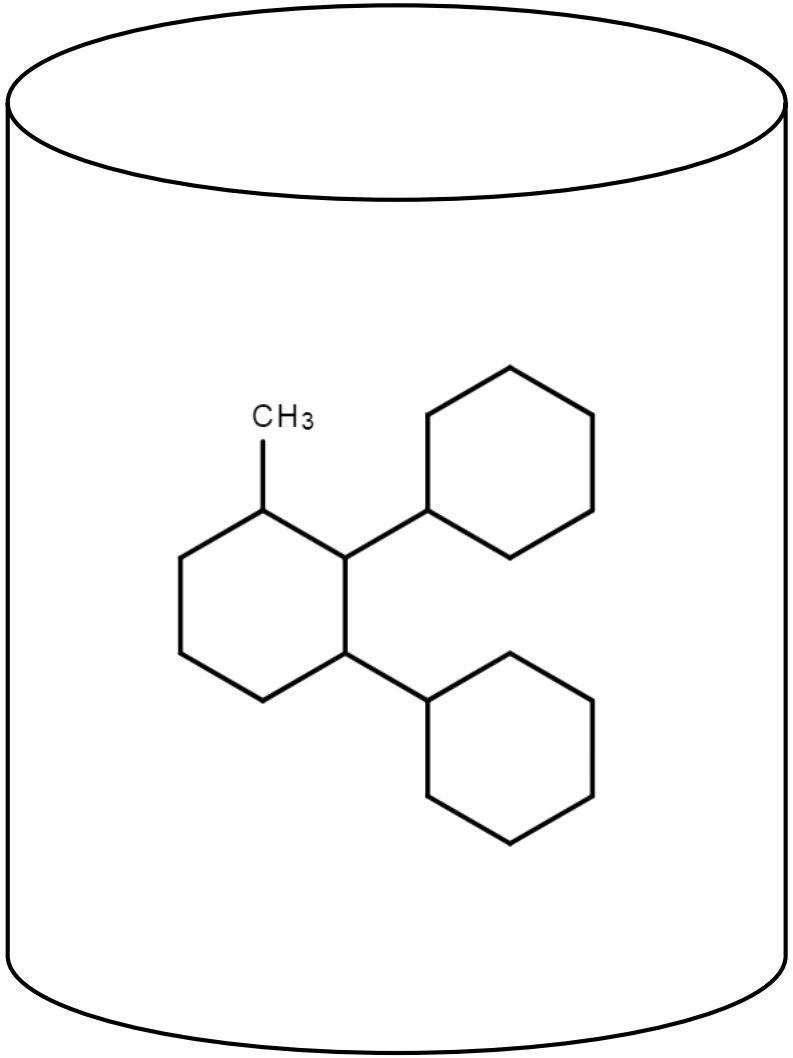

DBT + catalyst
H_2
PUMP (N_2, 30 bar)
HEAT (150°)
CH_3
FILTER
TRANSPORT

APPLICATION

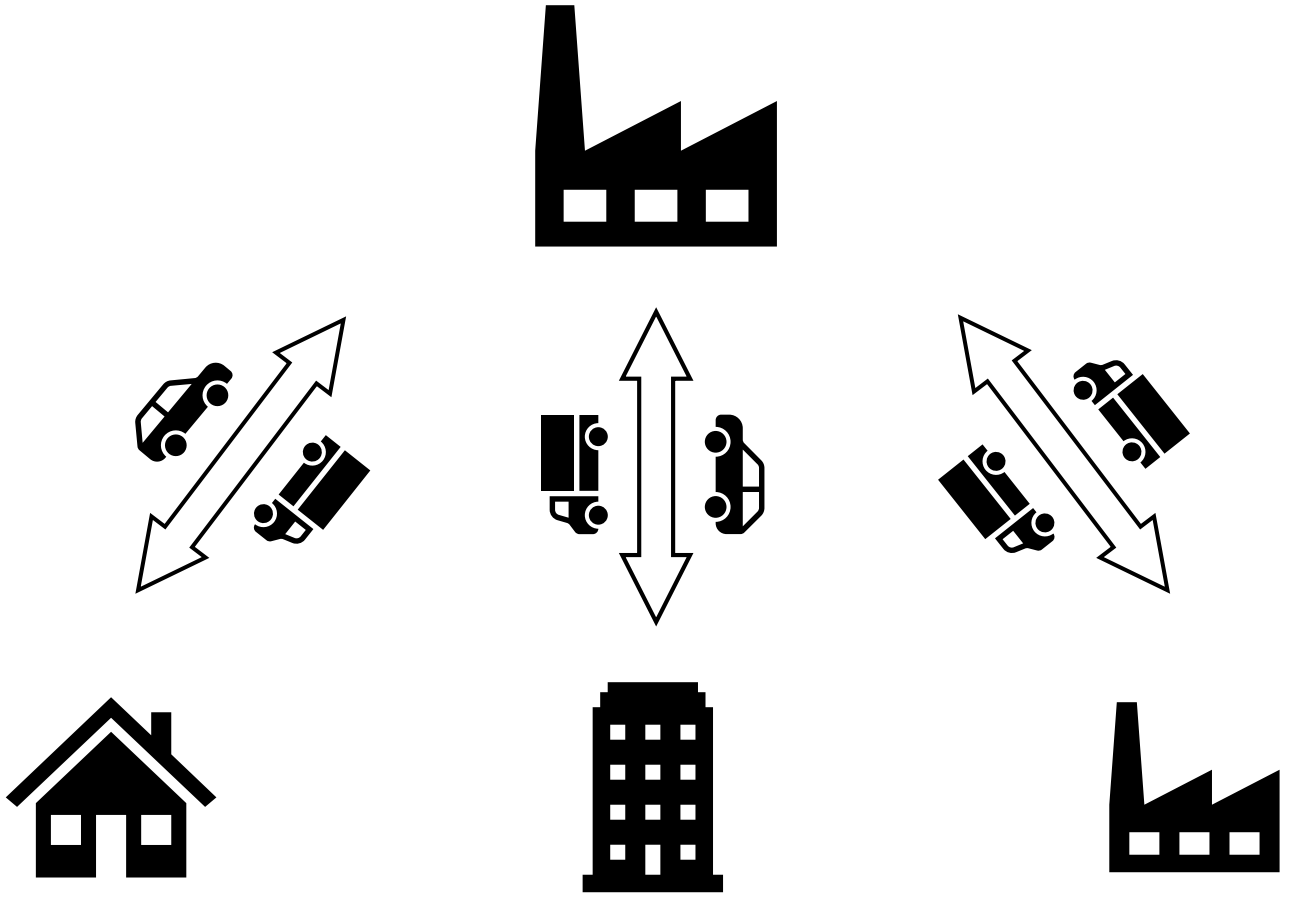


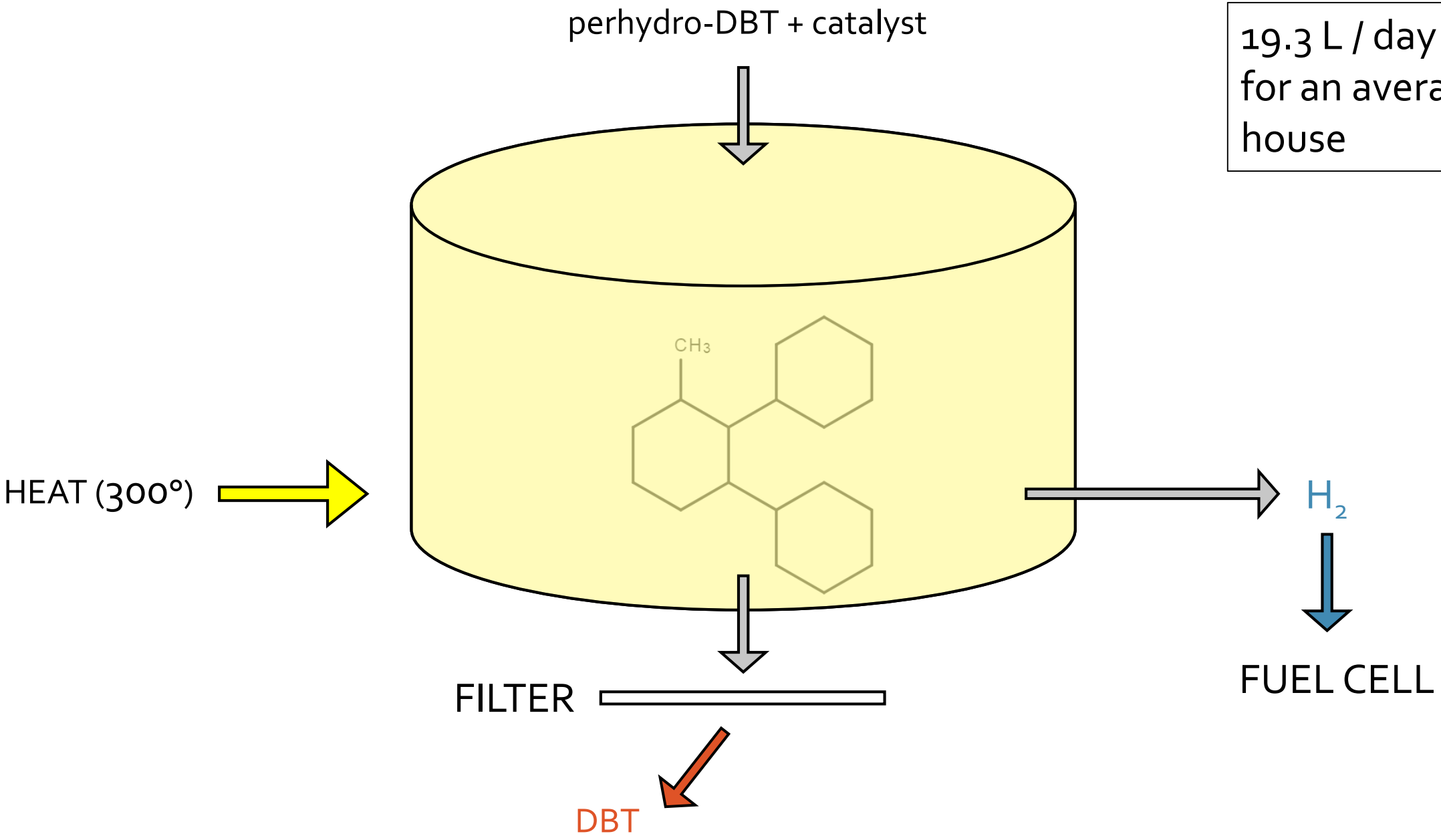
TRANSPORT

- Cylinder tank
- V = 8 m^3
- Stainless steel



APPLICATION




perhydro-DBT + catalyst
19.3 L / day
for an average
house
CH3
HEAT (300°)
H2
FUEL CELL
FILTER
DBT

COMPARISON

Perhydro - dibenzyltoluene

- Safe
- 100% hydrogen efficiency
- Energy loss ≈ min. 26.4%

Liquid Hydrogen

- Not safe
- 91% hydrogen efficiency
- Energy loss in liquification min. 30%

COST

- DBT ≈ $1-4 / kg
- Big tanks ≈ $15 000
- Small tanks ≈ $5 000
- Catalyst ≈ $368 / 0.1 kg
- Filter ≈ $125-500

∑ ≈ $30 000 + transport

PROS

- efficiency
- safety
- duration of storage
- wide range of applications

CONS

- size
- energy loss
- cost

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Ori Elbaum – ori.elbaum@gmail.com

Matej Pavli – mato.pavli@gmail.com

Magda Topić – tmag1404@gmail.com

Muhammed Zangariya – mzangrea@gmail.com

Efficiency:

$$\eta = 1 - \frac{E_{in}}{E_{out}}$$

$$\eta = 1 - \frac{31.7\,\frac{MJ}{kg}\,H_2}{120\,\frac{MJ}{kg}\,H_2}$$

$$\eta = 73.6\%$$

Average American house

per day: 106 MJ

19.3 L / day
for an average
house

$V = 8\ m^3$

$m = \rho \cdot V = 5874\ kg$

$w\ (H_2) = 0.062$

$m\ (H_2) = m \cdot w\ (H_2) = 366\ kg$

catalyst:
$w = 1{,}6 \cdot 10^{-2}\ \%$
$m = 0.96\ kg$ per a tank

$E = E(H_2/kg) \cdot m\ (H_2) = 4.4 \cdot 10^{10}\ J$