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Frigg: Soft-linking energy system and demand response models

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supply = demand

now.

supply = demand

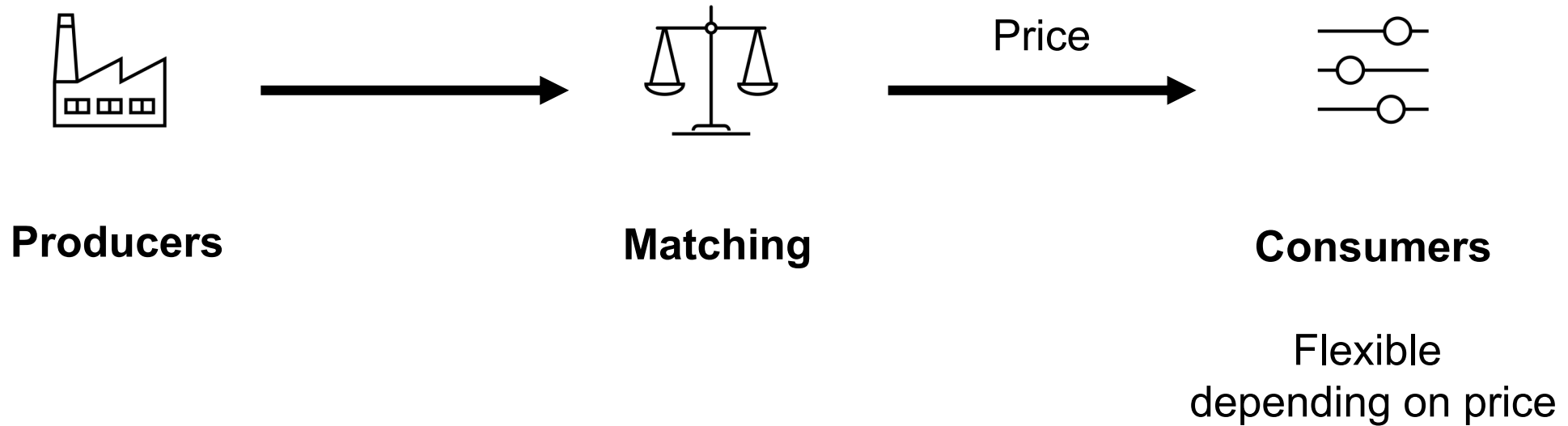


soon.

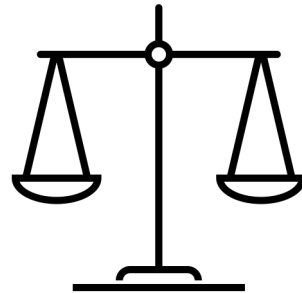
supply = demand



Low-carbon district heating system



Frigg finds the cost reduction potential of demand response.



The cost reduction potential of demand-response is reached when the dynamic price-making leads to a minimisation of system costs.

Input

Heat Demand

1-1-2050 00:00	150 MWh
1-1-2050 01:00	152 MWh
1-1-2050 02:00	187 MWh
...	...

Production Capacities

	Biomass Boiler	NG CHP	Solar Thermal
1-1-2050 00:00	100 MW	80 MW	20 MW
1-1-2050 01:00	100 MW	80 MW	22 MW
1-1-2050 02:00	100 MW	80 MW	25 MW
...

Production Costs

	Biomass Boiler	NG CHP	Solar Thermal
1-1-2050 00:00	40 EUR/MWh	30 EUR/MWh	0 EUR/MWh
1-1-2050 01:00	40 EUR/MWh	42 EUR/MWh	0 EUR/MWh
1-1-2050 02:00	40 EUR/MWh	50 EUR/MWh	0 EUR/MWh
...

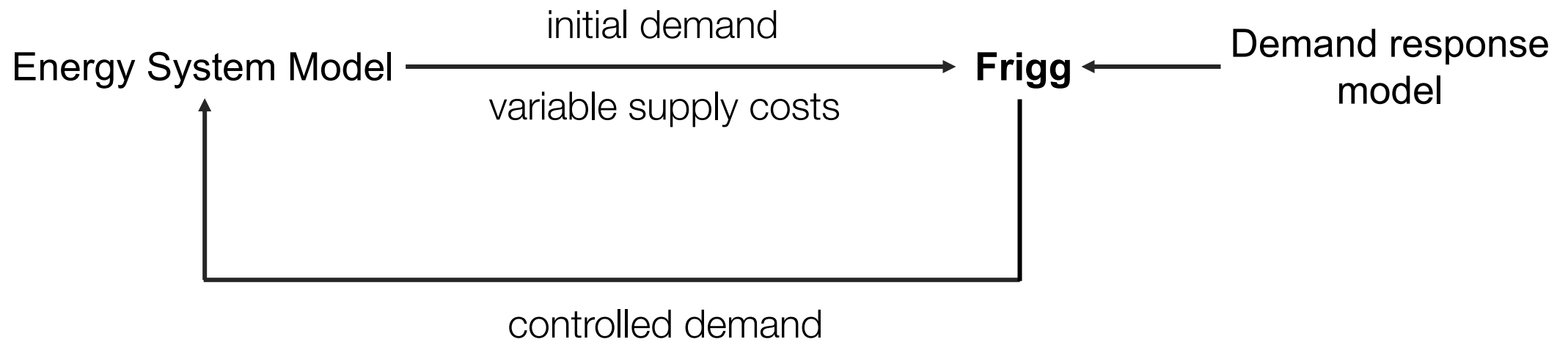
Output

Heat Demand

1-1-2050 00:00	172 MWh
1-1-2050 01:00	130 MWh
1-1-2050 02:00	131 MWh
...	...

(After Demand-Response)

Frigg's soft-linking structure



Solution approach (Schledorn et al. 2022)

Objective function (supply side)
 $Costs(t) = f(Demand(t))$

Flexibility Function (demand side)
 $Demand(t) = f(price(t))$

Smart price-making
 $p^*(t) = \underset{price}{argmin} Costs(t)$

Least-cost heat demand
given consumer behaviour

Set-up

Small-scale case study on Ejby system

4.2 MW natural-gas-fired CHP unit

6.5 MW natural-gas-fired boiler

4000 sqm solar thermal unit

Case 1

baseline, no demand response

Case 2

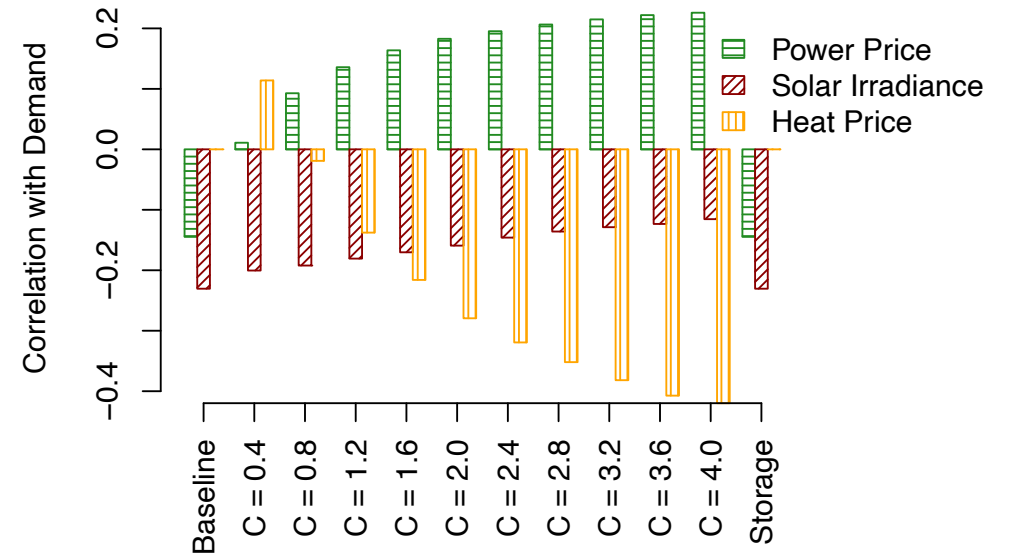
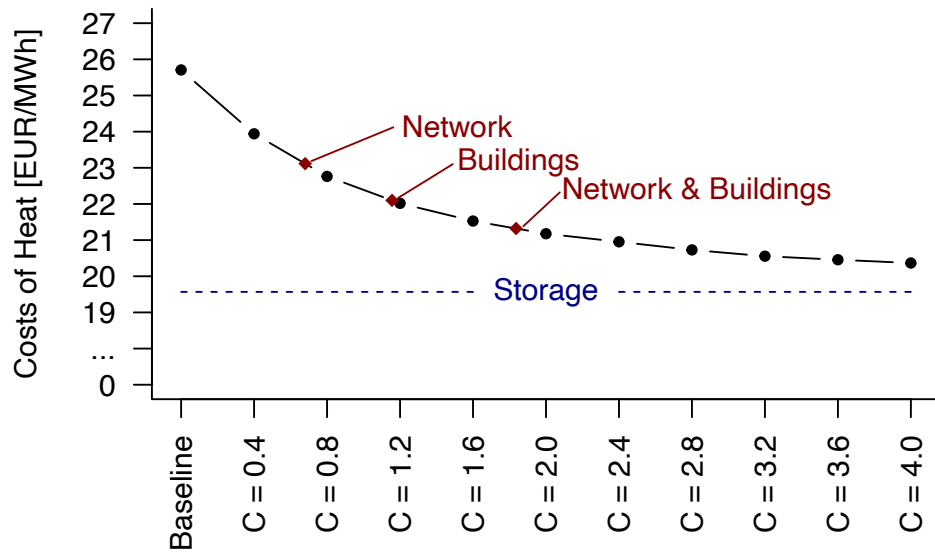
varying capacities C of demand response

Case 3

heat storage, no demand response

Results

Small-scale case study on Ejby system



Thank you!

[Link to Paper: Frigg: soft-linking demand response and energy system models](#)

