ADVANCED ENERGY STORAGE CONFERENCE 2025

PART 2

AARHUS
4 DECEMBER 2025

DANISH TECHNOLOGICAL INSTITUTE

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Electrical Energy Storage in Energy Communities

Jens Lindbjerg, Rødkærsbro Energifællesskab &
Katharina Brarup Ingwersen, Danish Technological Institute

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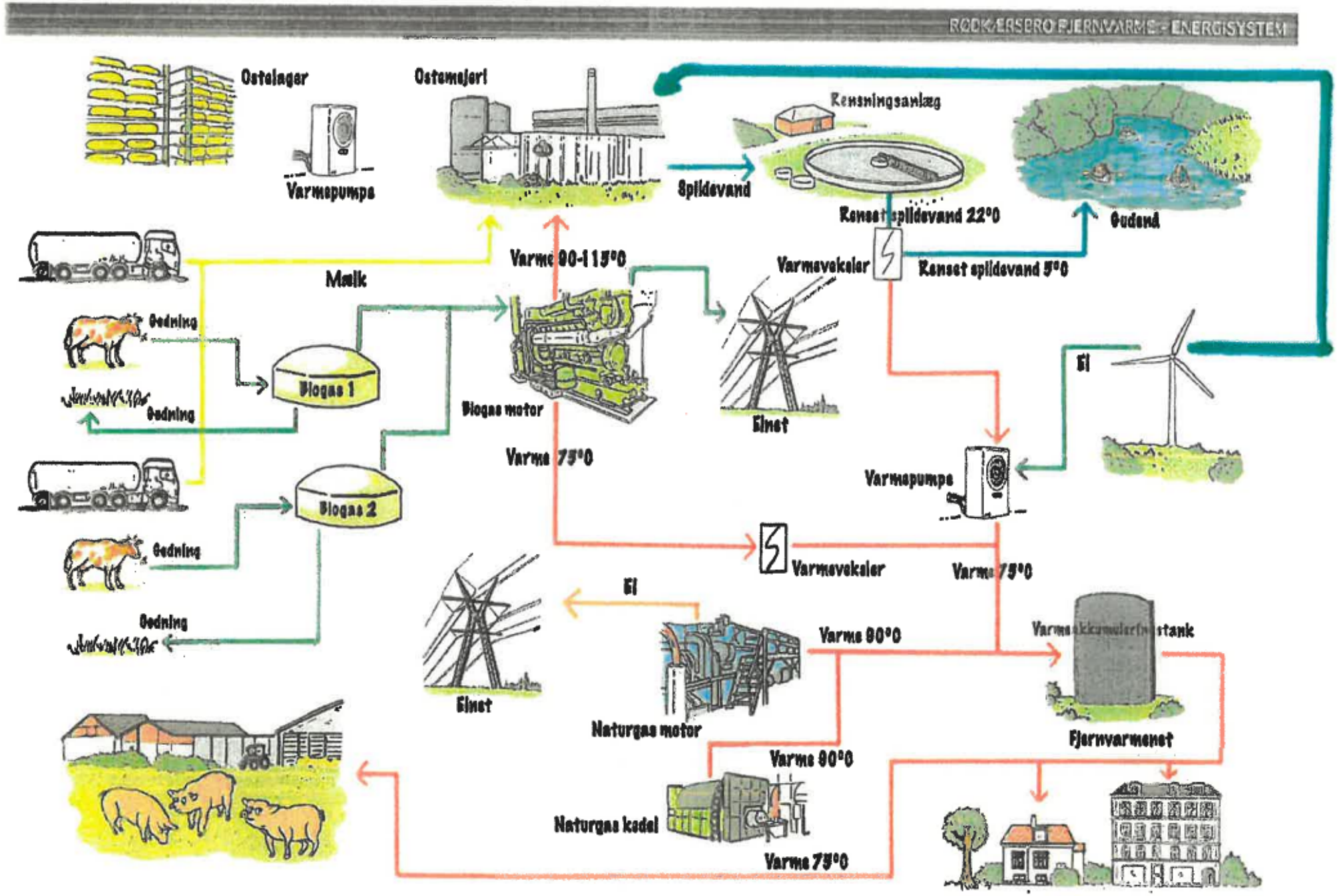
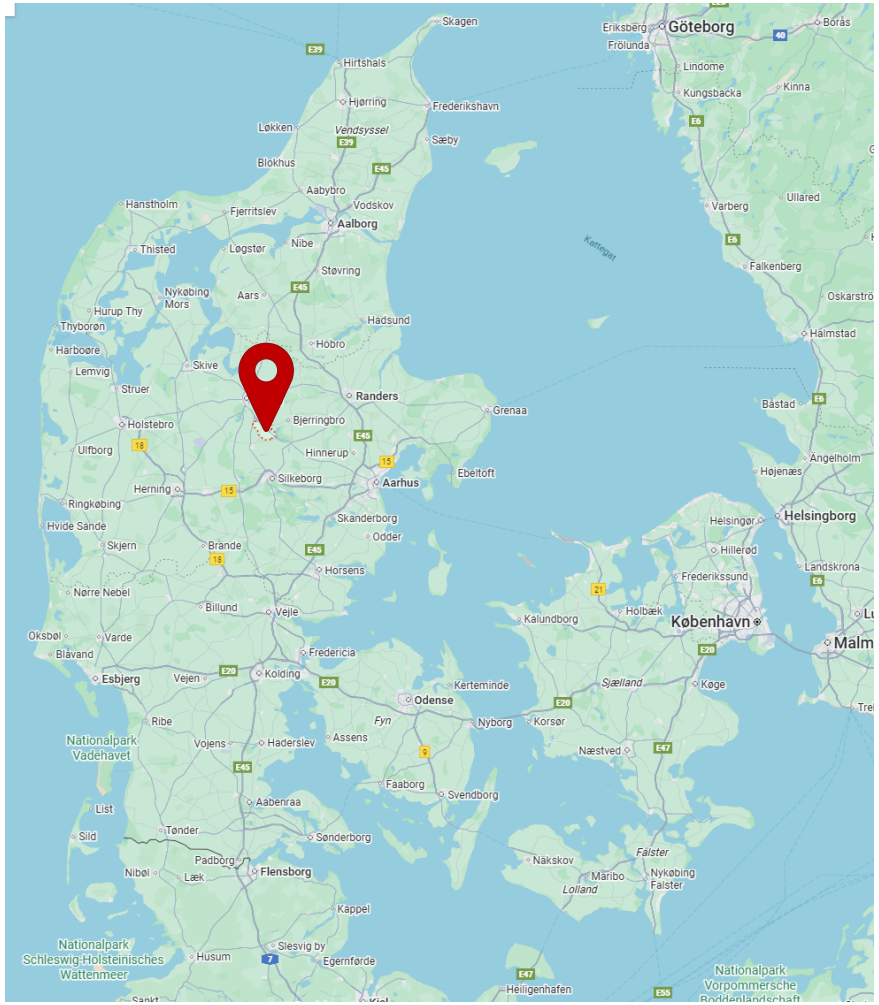
Energy Storage in Energy Communities

Danish Technological Institute

Advanced Energy Storage 2025


RØDKÆRSBRO FJERNVARME - ENERGISYSTEM
Ostelager
Varmepumpe
Ostemejeri
Spildevand
Rensningsanlæg
Renset spildevand 22°C
Udsend
Renset spildevand 5°C
Varmevekslar
Varme 90-115°C
Mælk
Gødning
Biogas 1
Biogas motor
Varme 75°C
Elnet
El
Varmepumpe
Gødning
Biogas 2
Gødning
Varmevekslar
Varme 75°C
El
Elnet
Varme 90°C
Naturgas motor
Fjernvarmenet
Varme 90°C
Naturgas kedel
Varme 75°C

Rødkærsbro Energy Community (REF)



- REF's missions is to promote green transition and delivering sustainable energy solutions to the local community in Rødkærsbro and the surrounding area.

Rødkærsbro: The Local Energy Challenge

- Rødkærsbro: 1.750 inhabitants, small Danish community
- Dominated by dairy company (equal to 84% of local demand)
- Existing renewable capacity: **12.6 MW** (Tolstrup wind park)
- Local production: **32.4 GWh/year**
- Local consumption: **39.1 GWh/year**

- <u>Challenge:</u> Local production equals 83% of the need, but only 46% of the locally produced electricity is used.

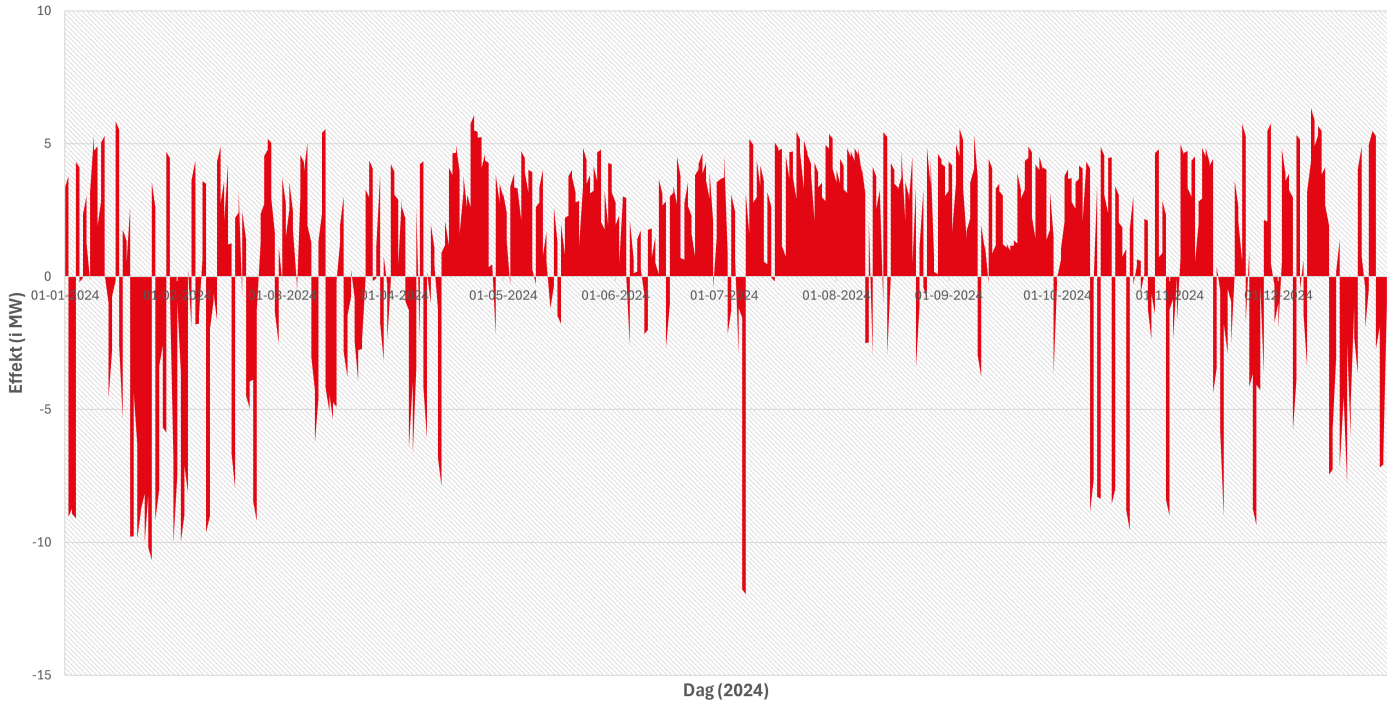


Figure 10: Load histogram at 60 Kilovolt Transformer Station in Rødkærsbro from 2024.

Energy System Analysis and Metrics

- Energy System Analysis
  - Map all energy flows
  - Identify temporal patterns and mismatches
  - Optimise first production before sizing storage

- Key Metrics:
  - Self-consumption rate
  - Grid independence (autarky level)
  - LCOE and LCOS economics

$$LCOS_{EESS}^{j} := \frac{CapEx^{j} + OpEx^{j} + FinEx^{j}}{N_{Cycl} + E_{Nom}^{j} + DoD^{j}}$$

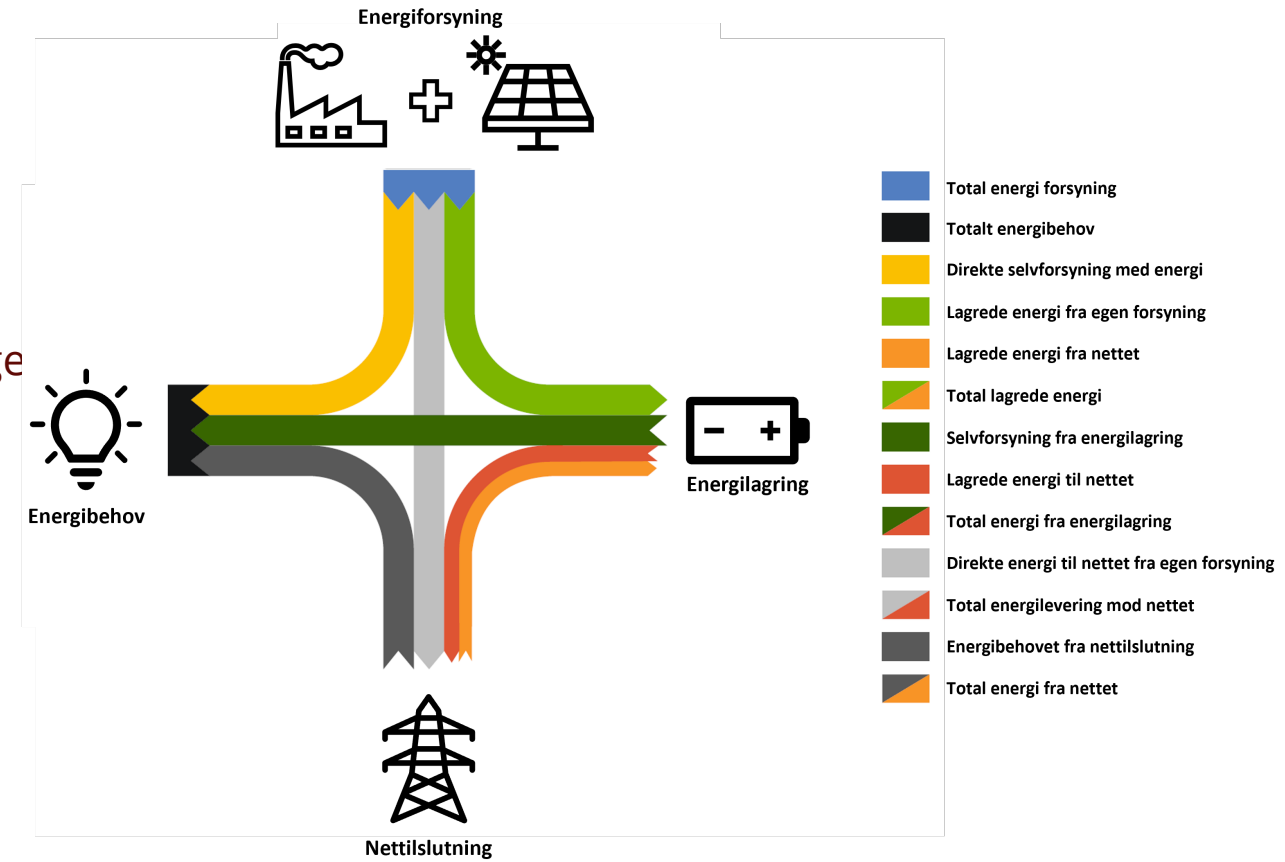


Figure 1: Different energy flows during integration of energy storage in an energy system.

REF: Todays System and Storage

- Current Status (Without Storage):
  - Self-consumption: 45.9%
  - Grid independency: 21.8%
  - Wasted renewable energy: 11.3 GWh/year
- With 4 MW / 4 MWh Battery:
  - Self-consumption: 62%
  - Grid independency: 27%

Rule of thumb: **60% self-consumption**

Tabel 4: Ændring i egetforbrug og autarkigrad med forskellige energilagringskapaciteter i 2024.

	Elektrisk Energilagring			
Parameter	*Uden*	*4 MW/4 MWh*	*8 MW/8 MWh*	*12 MW/12 MWh*
Egetforbrug	45,91%	62%	69%	75%
Autarkigrad	21,84%	27%	30%	32%

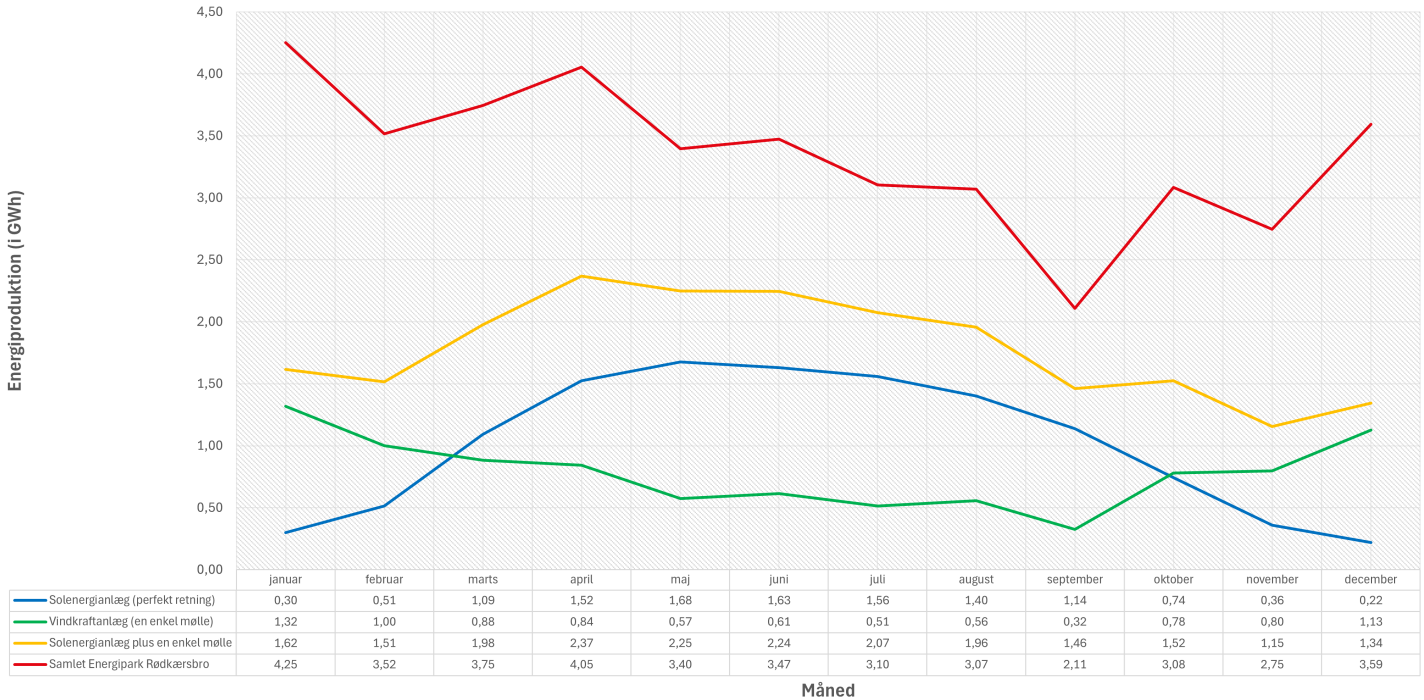
REF: The Future System and Storage

- Planned Expansion of Energy Park:
  - + 3 wind turbines (12.6 MW)
  - + 12 MWp solar PV

- Without storage: Self-consumption drops to 29%
- Target 60% requires: 48 MW / 48 MWh
- Investment: approx. DKK 90 million
- Revenue potential from auxiliary services (DK1): 1.2-1.7M/month

Tabel 5: Ændring i egetforbrug og autarkigrad med forskellige energilagringskapaciteter efter Energiparken Rødkærsbro realiseret (baseret på tal fra 2024).

	Elektrisk Energilagring				
Parameter	*Uden*	*4 MW/4 MWh*	*8 MW/8 MWh*	*12 MW/12 MWh*	*48 MW/48 MWh*
Egetforbrug	29%	34%	37%	40%	61%
Autarkigrad	31%	35%	39%	41%	60%



	januar	februar	marts	april	maj	juni	juli	august	september	oktober	november	december
Solenergianlæg (perfekt retning)	0,30	0,51	1,09	1,52	1,68	1,63	1,56	1,40	1,14	0,74	0,36	0,22
Vindkraftanlæg (en enkel mølle)	1,32	1,00	0,88	0,84	0,57	0,61	0,51	0,56	0,32	0,78	0,80	1,13
Solenergianlæg plus en enkel mølle	1,62	1,51	1,98	2,37	2,25	2,24	2,07	1,96	1,46	1,52	1,15	1,34
Samlet Energipark Rødkærsbro	4,25	3,52	3,75	4,05	3,40	3,47	3,10	3,07	2,11	3,08	2,75	3,59

Figure 8: Simulated energy production from the solar cell modules and wind turbines in Energy Park Rødkærsbro, based on historical data from 2024.

Hybrid and Integrated Approach

- Production mix: rebalance wind/solar ratio to match demand profile better
- Flexible demand: electrification of heat supply and thermal storage
- Hybrid storage: combine electrical short-term storage + long-term storage

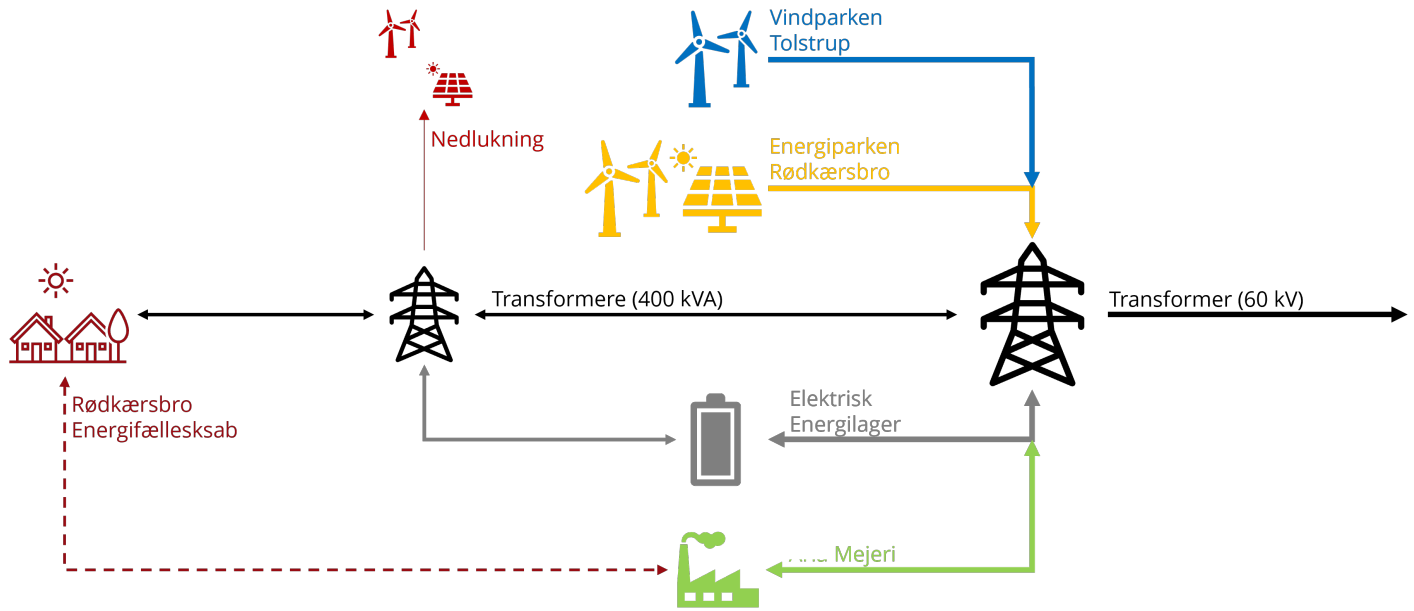


Figure 11: Concept proposal for an optimally integrated energy system for Rødkærsbro Energy Community.

Systems Thinking for Energy Storage

The Energy Systems Approach:

1. **Understand** the complete energy system first
2. **Optimize** production/consumption ratio
3. **Integrate** existing flexibility and assets
4. **Size** storage to fit actual remaining gaps

Rødkærsbro Case:

✓Current system: 4 MWh reaches 60% self-consumption

✓Future system: 48 MWh needed IF no other optmization

✓Hybrid storage: Essential or multi-timescale balancing

✓Community integration reduces storage requirements

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Energy Communities
- a Key Piece in the Green Transition

Henrik Bielefeldt, Energifællesskaber Danmark

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Energifællesskaber
En vigtig brik i den grønne omstilling

What is an energy community?

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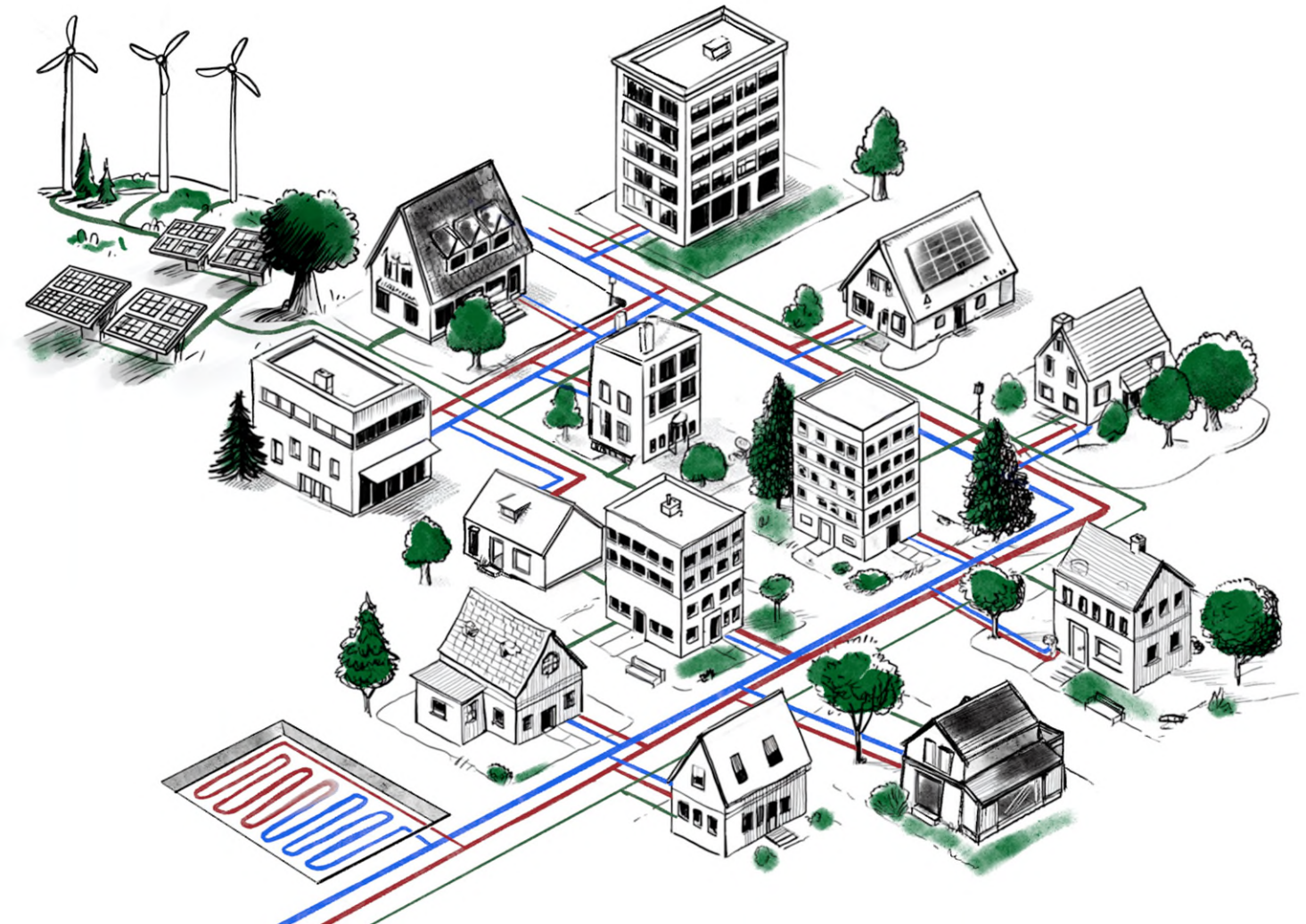

What is an energy community not...

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What is an energy community!

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Part of the solution...

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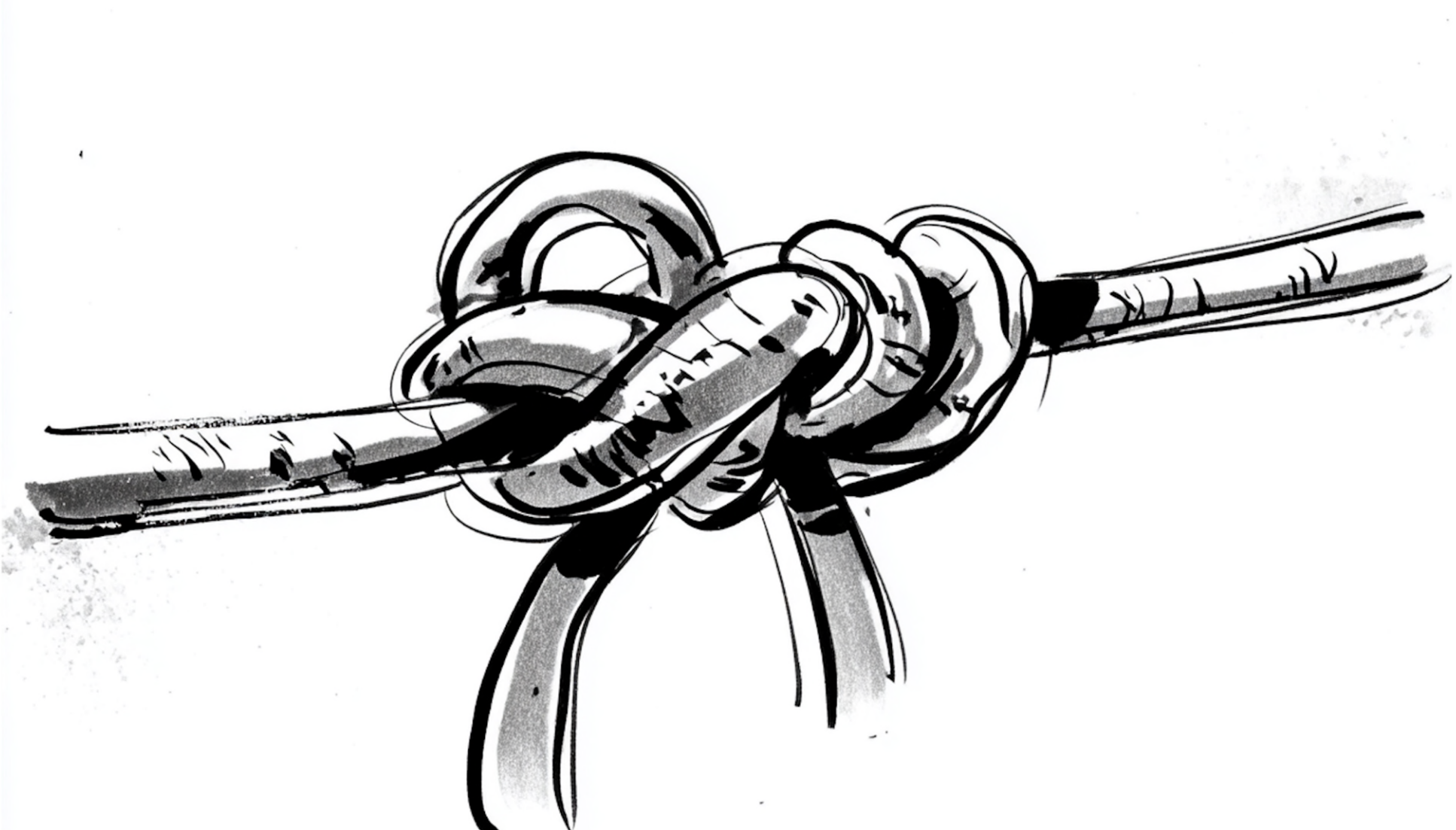
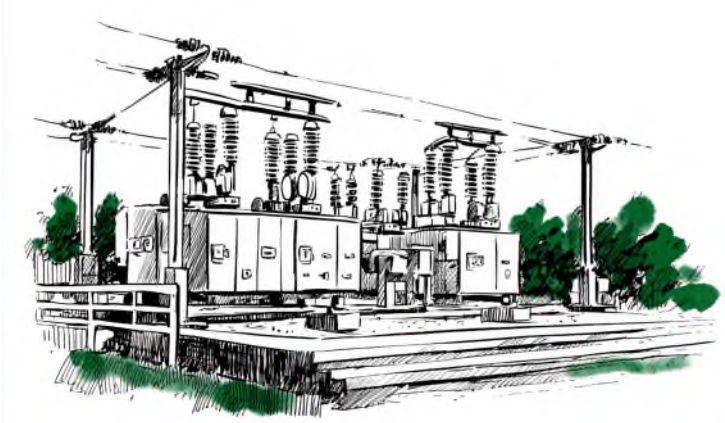
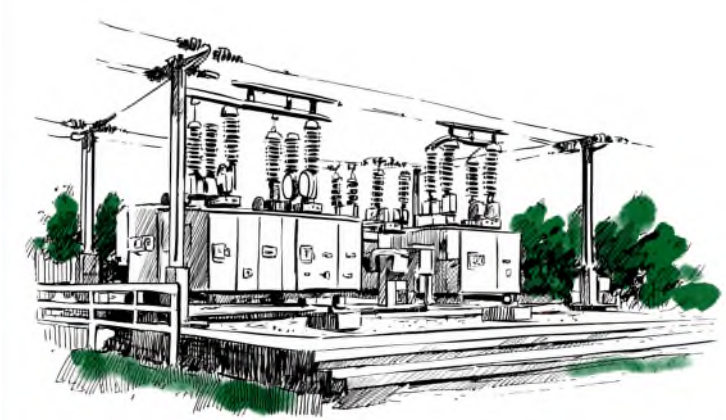


Part of the solution...

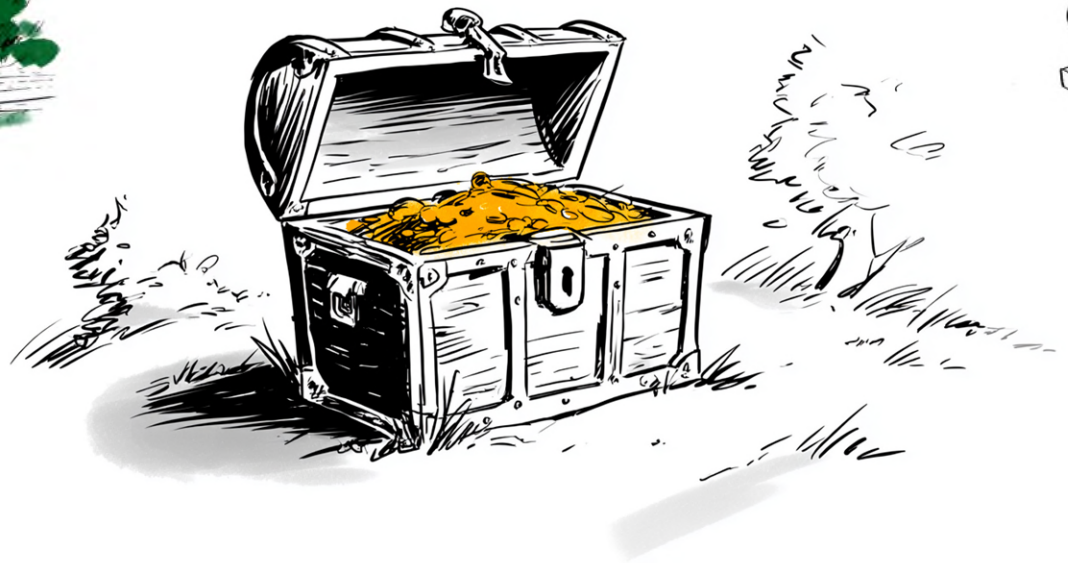


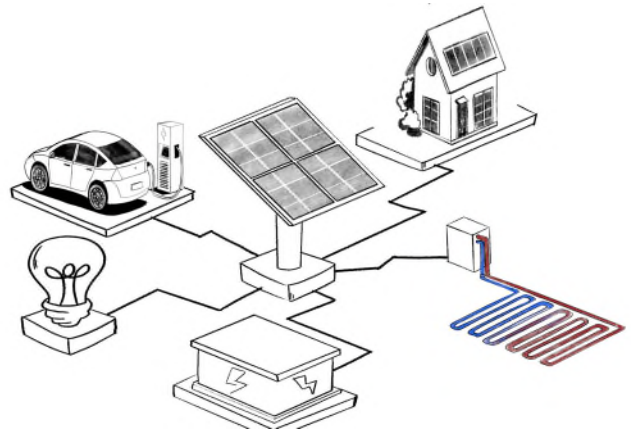
It's not just about distribution – but also local support

The business model



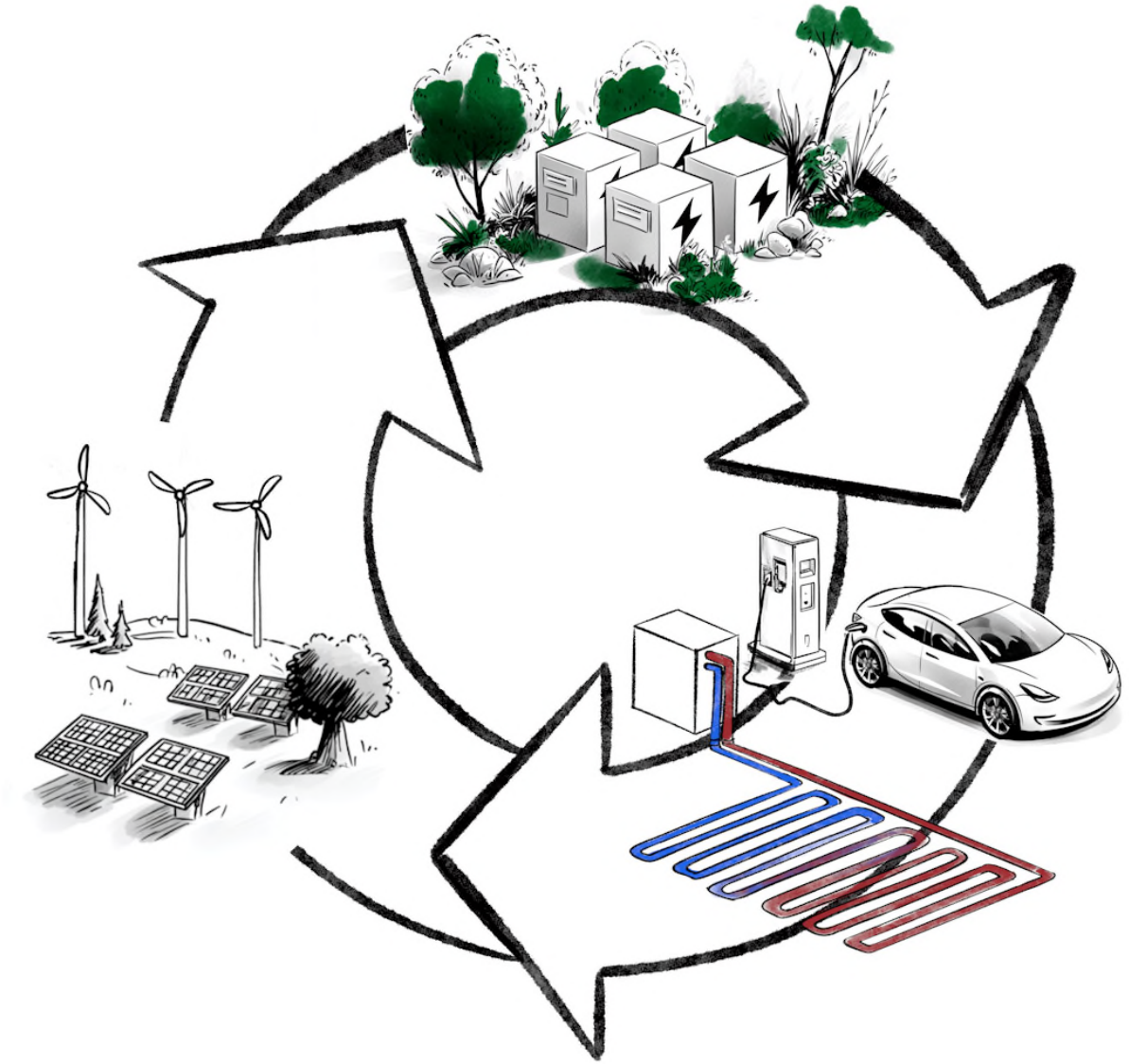
Local tarif





Intelligent consumption and production

An interplay of solutions



An interplay of digital solutions

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An interplay of digital solutions

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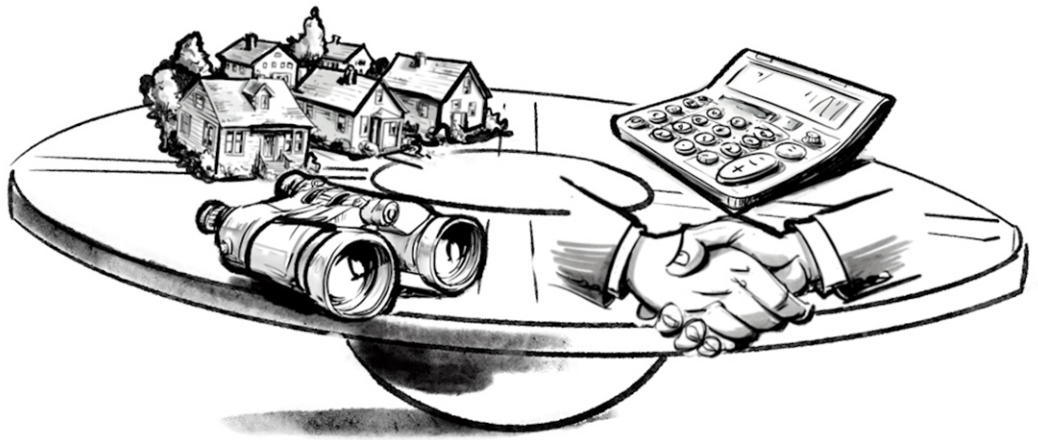

We have only just begun – But we can do it

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Fælledby

- Photovoltaics: 30.000 m² (5 MWp)
- Grid C. Batteries: 4,5 MWh / 3,2 MWp
  (**5-10 hours of buffer)**
- **Smart charging**: 350/700 EVs,
  estimated 25/50 MWh capacity
  (**2-3 days of avr. Buffer with V2G**)
- Windturbines: 3 x 25 kW
- Now: 35% self-suffient (All-Y-Round)
  (**45-50% selfconpt. with V2G-akcive EVs**)

SUSTAIN

For more information, please contact:

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Head of Project Development

Mail: hb@sustain.dk
Phone: 42 43 94 49

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Energifællesskaber Danmark is a nationwide, non-profit interest organization that gathers and strengthens the many forces that want to produce, share and use green energy together.

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