

Determination Of Commercial Viability Of Flowbatteries

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INTRODUCTION

Present developments in flowbatteries have received attention from several utilities. One of them is Remu, a Dutch utility. In the light of liberalisation, re-regulation and privatisation, Remu has increased its attention to cost reduction while maintaining or even increasing its performance. This paper discusses the possible role of electricity storage with respect to reducing cost and increasing performance.

REMU

REMU is a customer-driven national service provider, which wants to relieve customers of all their energy-based concerns, cost-effectively and with a high standard of quality.

Table 1 Customer base of REMU

| | |
|--------------|-------------------|
| Electricity: | 500.000 customers |
| Gas: | 370.000 customers |
| Heat: | 40.000 customers |

REMU is located in the centre of the Netherlands:

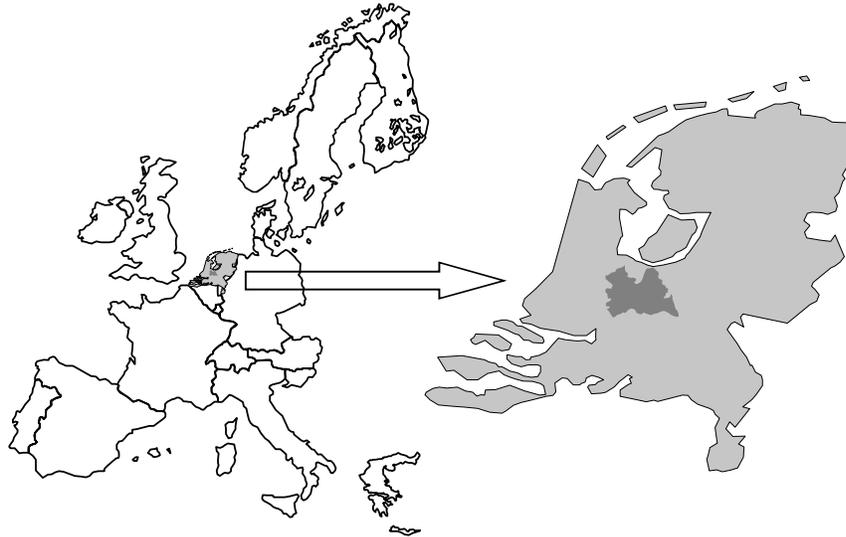


Figure 1 Remu's position within Europe and the Netherlands

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² Kema TDC, Arnhem, The Netherlands.

POTENTIAL APPLICATIONS

REMU has performed a feasibility analysis to determine the commercial viability of flowbatteries for four applications:

1. UPS for large industrial/financial companies
2. Defer grid reinforcements in areas with large amount of photovoltaics
3. Arbitrage (day-ahead market of electricity)
4. Balancing (market for control and reserve power)

REQUIREMENTS

The following requirements have been identified by REMU:

- The battery system has to be suitable for use in existing networks
- The battery system should not reduce the reliability of the grid
- The battery system should allow for differentiation on supply quality
- The system should either increase the income or decrease the costs
- The battery system should preferably be operated on a commercial basis. This means that the battery is not necessarily owned and operated by the grid company
- The financial benefits of the battery system should remain with the investor; it is essential that the profits remain outside reach of the regulator.

RESULTS

The applications have been evaluated for their cost-benefit. A NPV calculation is used. From these, it can be concluded that it is EUR 500.000 (or 10 %) cheaper to use flowbatteries instead of Diesel Gensets for a 3MW/8hour UPS application. Combining the Arbitrage and the Balancing application, a modern flowbattery with a size of 5MW is capable of reaching breakeven in itself.

In REMU's case, it is not beneficial to install batteries to defer larger transformers that are needed for high penetration of PV systems (cost-benefit ratios of 15-25)

CONCLUSIONS

Initial evaluation shows that Remu has potential for a number of cost-effective storage systems. The application could be a combination of both UPS for industrial applications (Financial companies) and trading application (Arbitrage and balancing).

Siting of a combined system (both UPS and trading applications) is currently subject for further study

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Commercial Viability Of Flow Batteries

EESAT 2002 San Francisco
Henk Kroon, REMU
Gerard Thijssen, KEMA

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REMU:

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Contents / Summary

- Need for cost reduction / quality improvement
- Pre-feasibility analysis for use of storage
 - Quick and Dirty
 - Positive results
- UPS application (alternative for dynamic diesel)
- Trading application (arbitrage and balancing)
- Initiate more detailed feasibility analysis

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Technical activities/ studies 2001

- 1 Unified Power Flow Controller/STATCOM
 - Defer reinforcement of High Voltage lines
 - Improve quality of supply
- 2 Storage of electricity
 - Introduce distributed generation (PV)
 - Minimize unbalance
 - Tariff trading / UPS / premium quality
- 3 High Voltage DC
 - Defer reinforcement of High Voltage lines

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Requirements to a battery system

- be suitable for use in existing networks.
- not reduce the reliability of the grid
- allow for differentiation on supply quality
- either increase the income or decrease the costs
- preferably be operated on a commercial basis
 - Not necessarily owned and operated by the grid company
- financial benefits should remain outside reach of the regulator

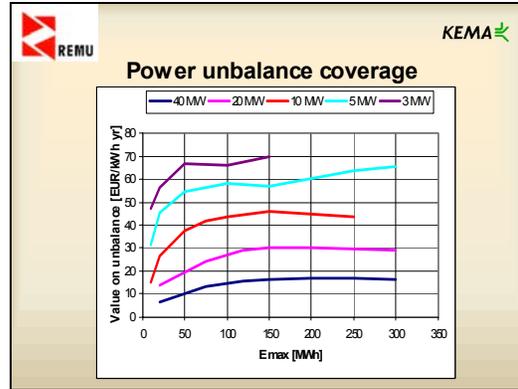
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Applications

- 1 Energy storage for renewable and distributed generation
 - micro chp, windturbines, PV
- 2 Power quality improvement
 - UPS, voltage dip
- 3 Tariff trading
 - peak shaving, buy low/sell high, coverage of power unbalance
- 4 Energy storage for UPFC
 - allowing extension of operating area

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Implementation of Photo-voltaics

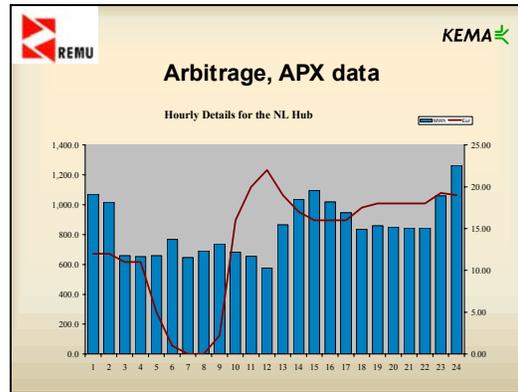
Storage at the MV/LV substation

- Required is 100 kW per substation
- cost-benefit ratio is 25 >> **not cost effective**

Storage at the MV substation

- Required is 1000 kW per substation
- cost-benefit ratio is 15 >> **not cost effective**

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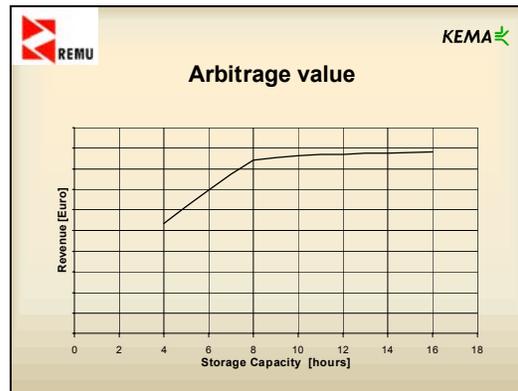
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Power unbalance

- Market for control and reserve power
- settles difference between day-ahead planning and actuals
- auction system

The graph displays power unbalance over a 24-hour period. The y-axis represents power unbalance in MW, ranging from -100 to 100. The x-axis represents time in hours. The plot shows a fluctuating line with several sharp peaks and troughs, indicating significant variations in power unbalance throughout the day.

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UPS

Grid — Flowbattery — Load

Storage tanks

- Presently, use of dynamic diesel gen sets
 - low investment
 - high losses
- Battery is alternative
 - high investment
 - low losses
 - combined application

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Valiation dynamic nobreak

Euro 1000 - 650 / kW (100 kW)
Euro 400 - 300 / kW (1.5 MW)

Annual O&M cost : 2.5 % of investment
Depreciation period: 15 years
No-load losses: 10 % of nominal rating
(Cost no-load losses Euro 0.04538/kWh)

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Example: 3 MW no break

For evaluating the investment the Net Present Value method is chosen. This results in:

NPV of diesel: EUR -5,237,110
NPV of Flowbattery: EUR -4,717,596

It is EUR 500,000 cheaper to use Flowbatteries for a 3MW/8 hours UPS application

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Conclusions

- Combination of different applications is necessary
- Feasibility depends on local circumstances
- Anticipation on reaction of regulator
- Storage can play a rol in future networks, but...
- Business cases based on commercial offers

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Average Outage Durations

ENBU 10kV netten verdeling herstellijden

Legend:

- 0 >= 0.25
- 0.25 >= 0.5
- 0.5 >= 1.0
- 1.0 >= 2.0
- 2.0 >= 4.0
- 4.0 >= 8.0
- 8.0 >= 16.0

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Conclusion / Summary

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