CONTRIBUTED TALK — THURSDAY 11:00

Finance-Informed Learning and Pricing of *Energy Derivatives*

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WHERE THIS COMES FROM

- Asset management at Swiss financial institutions — trustees requiring auditable workflows.
- PhD implementing DRL portfolio policies forced every theoretical ambiguity into a concrete engineering decision.
- That collision crystallised the PMF — formalised with Doga Alkan.

THE QUESTION

How do you evaluate any portfolio strategy — heuristic, optimisation-based, or learned — on equal footing, under realistic costs and constraints?

THIS TALK

An approach that works for equities and multi-asset portfolios. Extending it to energy derivatives surfaces a set of unresolved primitives — this talk maps them.

PORTFOLIO MANAGEMENT FRAMEWORK

A common comparison class. A consistent set of mechanics.

ADMISSIBLE STRATEGY CLASS $\mathscr{W}$

A strategy $S \in \mathscr{W}$ is admissible if it satisfies four conditions simultaneously:

- C1 **Grid alignment** — decisions only at $t \in \Gamma$
- C2 **Budget feasibility** — $\Sigma\, w_{i,t} = 1$ always
- C3 **Cash management** — $h_{0,t} \geq 0$ at all times
- C4 **Cost integration** — proportional TC_t accounted for

Each $S^{(j)}: \mathscr{X} \to \{w \in \mathbb{R}^{N+1} \mid 1^T w = 1\}$ maps feature matrix X_t to weights. All strategies in $\mathscr{W}$ are scored under the same performance, risk, and cost metrics.

Baseline environment (A1, A2): zero slippage — trades execute at observed price; zero market impact — volume does not move prices. These establish a neutral comparison ground. Both are modular and relaxable.

GRID $\Gamma = \{t_0, \ldots, t_T\}$

Discrete-time observation set, daily or coarser. Every strategy acts only at $t \in \Gamma$ — no look-ahead by construction.

COMPOSITION

Prices $v_t \in \mathbb{R}^{N+1}_{++}$, holdings h_t, value $P_t = h_t^T v_t$. Asset 0 is cash with $v_{0,t} \equiv 1$ — no interest accrual; isolates reallocation dynamics.

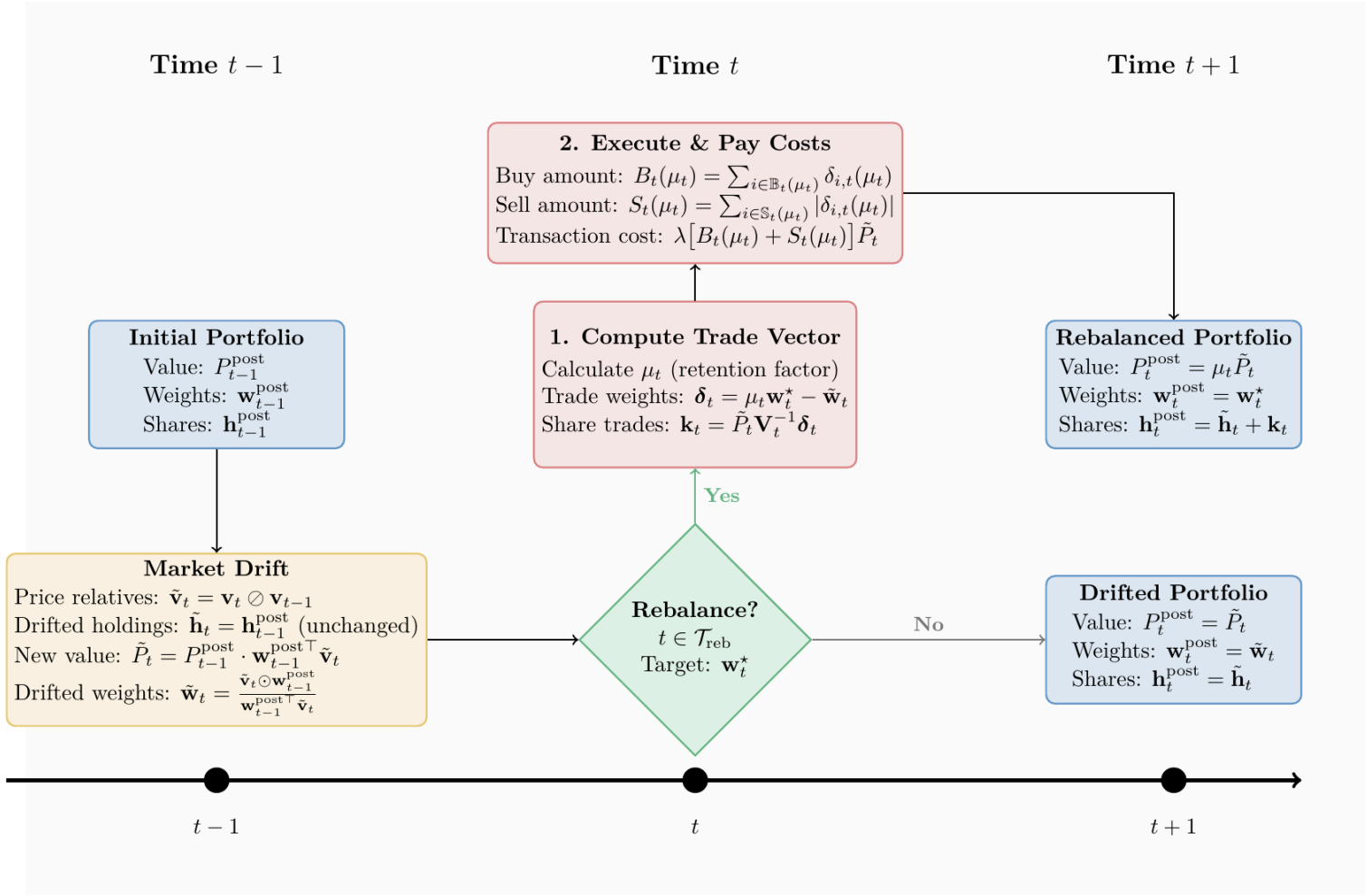
BUDGET & SOLVENCY

Weights $w_{i,t} = h_{i,t} v_{i,t} / P_t$, full budget $\Sigma w_{i,t} = 1$, cash non-negative $h_{0,t} \geq 0$, solvency $P_t > 0$.

TRANSACTION COSTS

Proportional rate $\lambda \in (0,1]$. $TC_t = \lambda(B_t + S_t)$ deducted from cash; rebalancing retains fraction $\mu_t \in (0,1]$ of drifted wealth.

Ayari (2025) · Ayari & Alkan (2025)



SELF-FINANCING $W_t = W_{t-1} + h^{post\ \top}_{t-1}(v_t - v_{t-1}) - TC_t$ — wealth changes only through price movements and trading costs; no external cash.

Guo et al. (2023) · Ayari & Alkan (2025)

EXTENSIONS FROM TRADITIONAL FINANCE WE ARE TACKLING

The base framework is long-only, fractional, liquid. *Real portfolios are not.*

LOT-SIZE CONSTRAINTS

Exact target infeasible under integer lots. PMF defaults to greedy rounding; ILP exact but expensive at scale.

ILLIQUID & APPRAISAL-PRICED ASSETS

No $v_{i,t}$ at every $t \in \Gamma$ — positions frozen, holdings stale until a valuation is available.

CASH IN- & OUTFLOWS

Subscriptions and redemptions rescale P_t outside the trading step — pre-rebalancing adjustment before standard logic runs.

NON-TRADE CASH FLOWS

Dividends, coupons, margin settlements hit $h_{0,t}$ outside TC_t — pre-rebalancing cash check required.

SHORT SELLING

Margin requirements, borrow costs, leverage limits — excluded from the baseline PMF by design.

The PMF's modular structure accommodates these without altering the core mechanics.

Other known extensions: interest on cash · multi-currency · multi-portfolio recursion.

WHERE THE FRAMEWORK RUNS

Running live with financial institutions in Switzerland. *Each engagement sharpens the framework.*

WHAT IT GIVES YOU

- The **mandate defines weights** — the PMF automates what follows: drift monitoring, rebalancing execution, cost accounting, breach reporting. Across both asset and risk management.
- **Run any strategy** against the same ledger — heuristic, optimisation-based, or learned — and get directly comparable results.
- **Cost attribution per trade** — what the model said, what rebalancing cost, what was realised.
- **Privacy-preserving** — plugs into any existing workflow without touching custodian or client data.

WHAT PRODUCTION REFINES

Each engagement delivers concrete solutions to the cases from the previous slide — how lot-size residuals get resolved in practice, how illiquid positions are handled without breaking the ledger, how cash flows outside the trading step are pre-accounted for.

SOME QUESTIONS THAT ARISE FROM PRACTICE

- How do you embed hedging positions?
- How do you handle multi custodian?
- How do different constraints feed back into the rebalancing objective?
- How do you best deliver a best-execution report?

These are some of the questions that drive the framework forward.

APPLYING THE PMF TO ENERGY DERIVATIVES

What does a clean backtest mean for an energy portfolio?

Three primitives need to be fixed before the question is answerable.

WHAT IS THE PRICE?

- For exchange-traded instruments there may be a convention — e.g. negative prices
- In continuous intraday markets there is no closing price — which index applies?
- The convention chosen propagates into every return and weight calculation

WHAT IS THE POSITION?

Annual, quarterly, monthly, daily contracts on the same underlying. Longer contracts roll into shorter ones at settlement — automatically, not a trade. The PMF needs a consistent h_t across the cascade.

WHAT DOES IT COST?

- Imbalance penalties hit $h_{0,t}$ outside the trading step — not known at rebalancing time
- Margin calls require pre-accounting before the solver runs
- Perspective matters: an integrated utility vs. a pure trading desk

These three interact and should be defined for a theory-practice bridge.

Benth, Saltytė Benth & Koekebakker (2008) · EPEX SPOT · EEX

WHICH INTRADAY INDEX IS THE VALUATION BASIS?

EPEX publishes three continuous intraday indices — each technically precise, each designed for a different purpose. *None is explicitly designated as the portfolio valuation convention.*

INDEX	DEFINITION	DESIGNED FOR	AS PORTFOLIO MARK
IDFull	VWAP over full trading session	Overall intraday imbalance vs. day-ahead	Most representative — but known only after session ends MOST REPRESENTATIVE
ID3	VWAP over last 3 hours of trading	DE: 180–30 min before delivery; AT: 180–0 min* Close-to-delivery imbalance; EPEX-designated most liquid window	More actionable — misses early session MOST LIQUID WINDOW
ID1	VWAP over last hour of trading	DE: 60–30 min before delivery; AT: 60–0 min* Last-minute balancing, renewable flexibility	Reflects final market state — high noise for most strategies HIGHEST NOISE

Open methodological question: Different indices produce different realised returns for the same position — different signals, different strategy comparisons, different model conclusions. Which theoretical model are we testing, and against what?

* Index window boundaries differ by market. DE gate closure is 30 min before delivery; AT gate closure is also 30 min, but the AT index calculation window runs to 0 min — i.e. all matched trades up to delivery are included. Verify against traded data if AT is in scope. Methodology per EPEX SPOT Indices, Nov 2025.

WHERE THIS LEADS

Can the PMF standardise backtesting for energy derivatives portfolios?

That is the question we are working towards.

WHY IT MATTERS

Repeatable, auditable infrastructure improves reporting, strategy comparison, and operational processes. Better data means better AI — cleaner signals, more meaningful model comparisons, a well-defined environment for RL.

OPEN QUESTIONS FOR THIS ROOM

- Which intraday index as portfolio mark?
- How to handle negative prices?
- Consistent position across the delivery cascade?
- Imbalance costs — can they enter the objective?
- Integrated utility vs. trading desk — same framework?

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QUANT INFRASTRUCTURE. PLUGGED IN.

Panel follows: Benth · Ziel · Ayari — Moderation: Kunert