← Back to **Reviewers Console** (/group?id=NeurIPS.cc/2025/Position_Paper_Track/Reviewers#assigned-submissions)

Modern Power Systems Need Tailored AI for Energy Forecasting

PDF (/pdf?id=Lb69UQ7hMk)

NeurIPS 2025 Position Paper Track Submission156 Authors

09 May 2025 (modified: 28 Oct 2025) Submitted to NeurIPS 2025 Position Paper Track
Position Paper Track, Area Chairs, Reviewers, Authors Revisions (/revisions?id=Lb69UQ7hMk)

Keywords: Power System, energy forecasting, time series, interdisciplinary study

Abstract:
Modern power systems are undergoing profound transformations driven by decarbonization, decentralization, and digitalization, which introduce significant complexities and challenges for energy forecasting. Although existing AI techniques have shown success in general time series forecasting (TSF), they overlook the unique characteristics and requirements of power systems. This position paper highlights the critical need for tailored solutions to enhance the accuracy and robustness of energy forecasting. We propose novel directions from three key perspectives: (1) **Decarbonization**: Physics-informed and probabilistic forecasting methods to account for the uncertainty brought by renewable energy, with a focus on extreme weather scenarios. (2) **Decentralization**: Cost-oriented and distributed forecasting approaches, along with edge intelligence techniques, to facilitate stakeholders' decision-making and enable efficient edge-device-based forecasting. (3) **Digitalization**: Hierarchical, explainable, and interactive forecasting frameworks to leverage multi-granular data resources while ensuring the usability and interpretability of energy forecasting systems. We aim to bridge the gap between AI advancements and the evolving needs of power systems, calling for increased focus on interdisciplinary research to develop practical and effective energy forecasting techniques.

Submission Number: 156

Filter by reply type... | Filter by author... | Search keywords... | Sort: Newest First

Everyone | Program Chairs | Submission156 Area... | Submission156... | Submission156... | Submission156 Authors | Submission156... | Submission156... | ✖

4 / 4 replies shown

Add: **Official Comment**

Paper Decision

Decision by Program Chairs 25 Sept 2025, 20:51 (modified: 17 Oct 2025, 12:38) Everyone
Revisions (/revisions?id=z5ybiaK8T0)

Decision: Reject

Add: **Official Comment**

Official Review of Submission156 by Reviewer 5XL3

Official Review by Reviewer 5XL3 08 Aug 2025, 17:36 (modified: 15 Aug 2025, 14:46)

Program Chairs, Area Chairs, Reviewers Submitted, Reviewer 5XL3, Authors

Revisions (/revisions?id=NAbJKzmmBj)

Ethics: NO or VERY MINOR ethics concerns only

Details Of Ethics Concerns:

No human subjects, datasets, or deployable models are released. Minor risks worth acknowledging: (i) privacy from fine-grained meter/DER data and cross-entity collaboration. The paper itself notes that energy data are sensitive and that some privacy-preserving techniques are only partial fixes, which raises governance/consent questions if future work aggregates customer data, (ii) incorrect forecasts can propagate to operations/markets and affect grid stability and costs, which the paper frames as high-stakes (blackout/instability), (iii) representativeness and distribution shift under decarbonization/extreme weather. Future empirical work should report calibration and stress tests across climates and rare events, and (iv) if LLM use is adopted as interfaces or predictors, hallucination/accountability must be managed with verifiable back-ends and auditability.

I'm not requesting an ethics review as these are low-level concerns appropriate for author response/revision. The paper should (a) state a privacy posture (e.g., DP + secure aggregation + access control) for any future data sharing, (b) commit to compute/energy disclosure if training large models or edge deployments are evaluated later, and (c) specify operator-in-the-loop guardrails and verification for any LLM-mediated workflows.

Position: Yes, the paper argues for or against a position related to machine learning.

Summary:

The paper argues that generic time-series forecasting (TSF) is insufficient for modern power systems due to the pressures of decarbonization, decentralization, and digitalization. It motivates the problem by the operational and economic stakes of grid management and structures its position around three directions. The first is (i) physics-informed and probabilistic forecasting, with emphasis on robustness to extreme weather. The second is (ii) cost-aware, distributed, and edge-based forecasting to support decision-making by diverse stakeholders. The third is (iii) hierarchical, explainable, and interactive forecasting methods. The work surveys the current TSF literature and its applications in power systems and highlighting limitations of these approaches. It then calls for interdisciplinary methods that integrate grid physics, market dynamics, and multi-level decision processes into AI-driven forecasting.

Author Identification: No.
Support: 2: fair
Significance: 3: good
Presentation: 3: good
Context: 3: good
Discussion: 3: possibly
Alternative Position: Yes, and alternative positions are well-considered and named but not addressed

Strengths:

The paper has a clear thesis. It posits that generic TSF is mismatched to modern power systems. The decarbonization/decentralization/digitalization lenses are the right ones and are explained accessibly. The paper synthesizes several relevant directions, including physics-informed learning, probabilistic calibration, decision/cost-aware objectives, distributed/edge settings, hierarchical reconciliation, and operator-facing interpretability/LLM interfaces. It situates them against grid problems (uncertainty, multi-stakeholder ownership, privacy, extreme weather). The writing is organized and readable. The figures help set the scope. The survey touchpoints are broad and current enough to be useful to ML readers entering the area. As a community piece, it can spark discussion across ML + power systems.

Weaknesses:

What I was expecting was a clear, formal problem statement. That is, a mathematical setup that ties the "tailored AI" vision directly to the structure and constraints of energy systems, so that a reader could see exactly how the learning objective changes once grid physics, markets, and decentralization are taken into account. Instead, what the paper gives you are mostly descriptions of challenges and promising directions. They outline physics-informed learning, probabilistic calibration, edge forecasting, hierarchy, interpretability, etc., but these are narrated as high-level features of good solutions, not encoded into a concrete optimization problem.

For example, you were looking for something like:

$$ \min_{\theta} \ \mathbb{E}[C(x^*(\hat{y}(\theta)))] \quad\text{s.t.}\quad x^* \ \text{satisfies OPF constraints}, $$

plus bilevel or fixed-point price–demand models, explicit hierarchical aggregation constraints S, federated/personalized learning terms, and NWP-conditioned uncertainty scoring (CRPS, PIT). That would operationalize the “tailored AI” into a specific, trainable formulation.

What you got instead was a narrative saying “we need decision-coupled models, market-aware learning, hierarchical reconciliation, etc.”

Questions:

1. Specify which TSF assumptions (stationarity, exogeneity, single-agent, i.i.d.) are violated in grids, and map each violation to a required modeling change.
2. Will you adopt a decision-focused training objective with a differentiable OPF/dispatch layer? If not, why?
3. How do you formalize price/demand feedback—bilevel optimization, fixed-point, or simulators with implicit differentiation?
4. For hierarchy, do you advocate end-to-end coherence losses or post-hoc reconciliation, and why?
5. What is your near-term stance on LLMs: interface/agent with verifiable back-ends, or forecaster? What verification/audit mechanisms are assumed?

Agreement: 2: disagree
Rating: 4: Borderline reject: The paper presents a position, but the reasons to reject, e.g., unclear reasoning or limited support for the claims, outweigh reasons to accept.
Confidence: 4: You are confident in your assessment, but not absolutely certain. It is unlikely, but not impossible, that you did not understand some parts of the submission or that you are unfamiliar with some pieces of related work.
Thoroughness: 5: You read the paper and appendices rigorously and checked all of the details carefully, including references and proofs (if present).
Code Of Conduct Acknowledgement: Yes

Add: **Official Comment**

Official Review of Submission156 by Reviewer bZRL

Official Review by Reviewer bZRL 06 Aug 2025, 01:15 (modified: 15 Aug 2025, 14:46)

Program Chairs, Area Chairs, Reviewers Submitted, Reviewer bZRL, Authors

Revisions (/revisions?id=EggoAlekd8)

Ethics: NO or VERY MINOR ethics concerns only
Position: Yes, the paper argues for or against a position related to machine learning.
Summary:
The primary position taken by this paper is to advocate for the development of novel Time Series Forecasting (TSF) methods to improve energy forecasting, which is critical for managing modern electricity grids. The paper shows that the evolution of electricity grids can be viewed through the perspective of 3 areas: decarbonization, decentralization, and digitalization. In this context, it discusses prevailing issues, existing approaches and their limitations, as well as potential research directions specific to each area. Within each area, the paper discusses how each area of evolution has introduced its own unique challenges (for instance, decarbonization has introduced energy sources that have very dynamic supply patterns, making it difficult to make predictions with traditional TSF methods). Finally, the paper’s overall viewpoint is that due to the introduction of numerous internal and external variabilities, existing TSF systems are inadequate for making accurate forecasts and decisions. Therefore, there is a need to develop more practical and robust TSF methods for energy forecasting.

Author Identification: No.

Support: 4: excellent
Significance: 3: good
Presentation: 3: good
Context: 4: excellent
Discussion: 3: possibly
Alternative Position: Yes, and alternative positions are well-considered and addressed by the argument
Strengths:
A significant strength of this paper is its structured approach. It divides its argument into 3 specific areas of evolution, offering a critical analysis and proposing effective solutions for each one. In each of these specific areas, the authors discuss relevant literature as a way to highlight current limitations and to describe potential solutions. Finally, the authors also summarize their position for each area of evolution, which solidifies the overall position and viewpoint of the paper.

Weaknesses:
I believe the paper effectively presents its viewpoint, however, it could place more emphasis on how TSF methods can be designed or optimized for different stakeholders. For instance, energy distributors might prioritize optimizing for reduced costs, while environmental agencies might be more interested in increasing the contribution of renewable energy sources to total power generation. While the paper briefly touches on this in the cost-oriented forecasting section, this might be a relevant topic for readers and could have been explored further in the paper.

Questions:
I would definitely encourage the authors to think about how different stakeholders might design or optimize their TSF methods based on their specific concerns

Agreement: 4: agree
Rating: 6: Weak Accept: The paper presents a solid argument about an issue of moderate importance to at least one sub-area of theNeurIPScommunity.
Confidence: 4: You are confident in your assessment, but not absolutely certain. It is unlikely, but not impossible, that you did not understand some parts of the submission or that you are unfamiliar with some pieces of related work.
Thoroughness: 4: You read the paper and appendices and checked most of the details, including references..
Code Of Conduct Acknowledgement: Yes

Add: **Official Comment**

Official Review of Submission156 by Reviewer hbrz

Official Review by Reviewer hbrz (Vivek Kumar Mishra (/profile?id=~Vivek_Kumar_Mishra1))
22 Jul 2025, 07:42 (modified: 15 Aug 2025, 14:46)
Program Chairs, Area Chairs, Reviewers Submitted, Reviewer hbrz, Authors
Revisions (/revisions?id=NU6LTBn2Gj)

Ethics: NO or VERY MINOR ethics concerns only
Position: Yes, the paper argues for or against a position related to machine learning.
Summary:
This position paper argues that modern power systems, shaped by decarbonization, decentralization, and digitalization, need specialized AI for energy forecasting. Regular AI time series forecasting methods don’t fully address the challenges of renewable energy’s variability, distributed systems, or digital data complexity. The paper reviews current forecasting methods, identifies gaps, and suggests new approaches: (1) physics-informed and probabilistic models for decarbonization, (2) cost-oriented and edge-based forecasting for decentralization, and (3) hierarchical and explainable models for digitalization. It emphasizes combining data-driven and physics-based models, addressing privacy, and improving forecasting under extreme weather. The goal is to spark discussion and guide future research for better, trustworthy energy forecasting in the NeurIPS community.

Author Identification: No.
Support: 4: excellent

Significance: 4: excellent
Presentation: 3: good
Context: 4: excellent
Discussion: 4: very likely
Alternative Position: Yes, and alternative positions are well-considered and addressed by the argument
Strengths:
The paper connects AI and energy forecasting really well. It clearly explains why off-the-shelf AI tools aren't enough anymore. It breaks down the key issues in modern power systems and gives a structured plan with examples to fix them. It's ambitious and well-thought-out.

Weaknesses:
The paper could improve by adding real-world case studies or examples to make its ideas more concrete. It's heavy on technical terms, so simplifying some language would help reach a broader audience. It also repeats some points (like decentralization challenges) across sections, which could be streamlined. An alternative position not fully explored is the potential of purely data-driven models with massive datasets, which some argue could outperform hybrid models in certain cases. Another angle could be the cost or feasibility of implementing complex AI models in real-world power systems, especially for smaller grids.

Questions:
Can you share examples of real-world power systems where tailored AI forecasting has been successfully implemented? How do you balance the computational cost of physics-informed models with practical deployment in resource-constrained settings like edge devices? Are there specific datasets or benchmarks you'd recommend for testing these tailored AI methods?

Agreement: 4: agree
Rating: 8: Strong Accept: The paper presents a strong argument about an important issue that ought to be discussed and is of importance to a sub-area within the NeurIPS community.
Confidence: 4: You are confident in your assessment, but not absolutely certain. It is unlikely, but not impossible, that you did not understand some parts of the submission or that you are unfamiliar with some pieces of related work.
Thoroughness: 4: You read the paper and appendices and checked most of the details, including references..
Additional Comments To ACs And PCs:
This is a strong position paper that ties machine learning to a critical real-world problem. It's relevant, well-researched, and likely to inspire discussion in NeurIPS. Could be improved with clearer language and real-world examples, but it's a great fit for the track.

Additional Comments To PCs:
No major issues here. The paper's anonymous, follows NeurIPS guidelines, and makes a compelling case. It's a solid candidate for acceptance unless you're prioritizing papers with more experimental data.

Code Of Conduct Acknowledgement: Yes

Add: **Official Comment**