A Cluster-Based load Model for a Resilient and Sustainable Community

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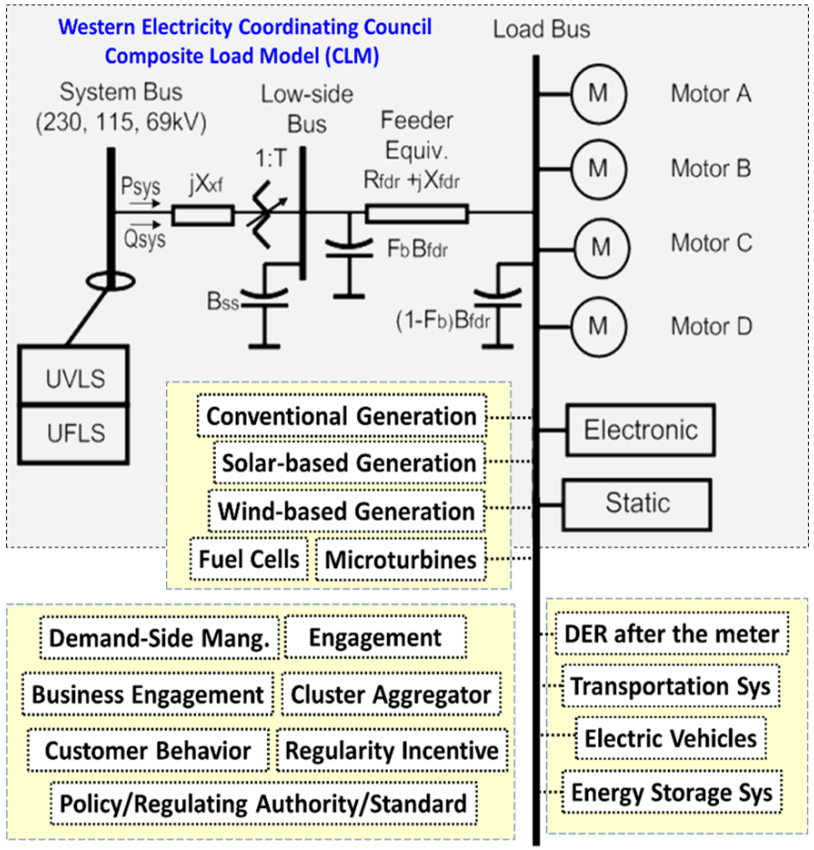
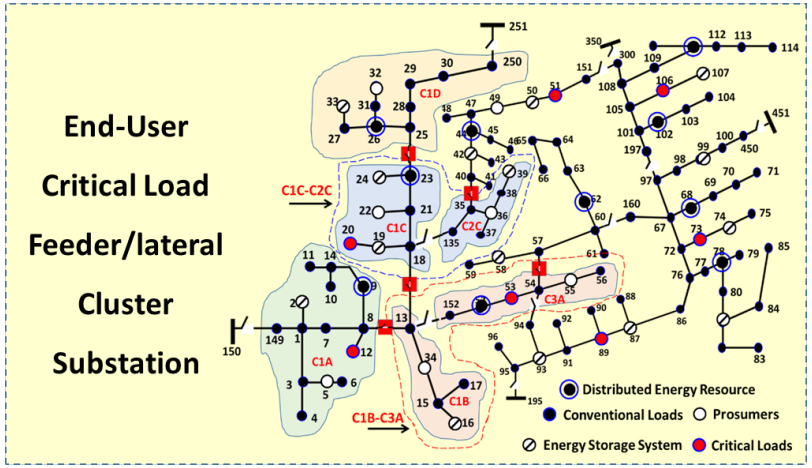
Initiative de modélisation énergétique – Outiller le Canada pour réussir la transition

Outline

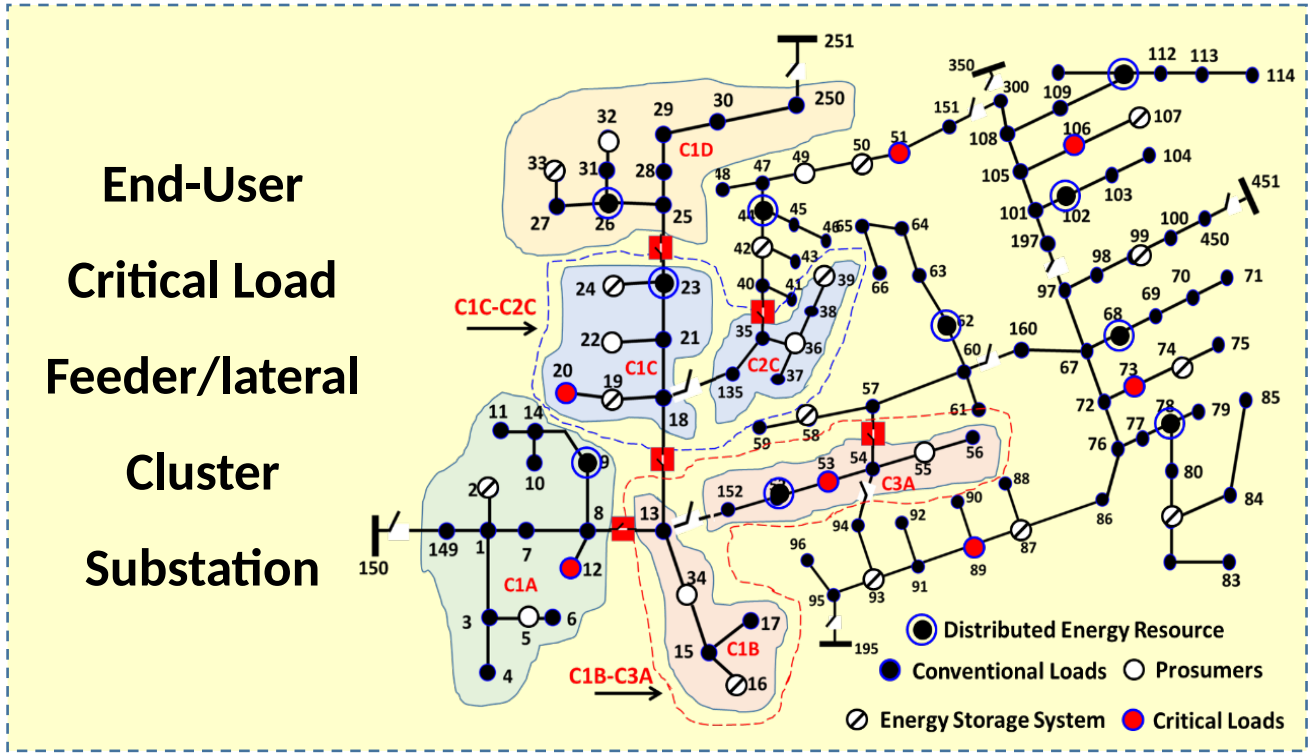
- Why a Cluster-Based Model - Objectives & Drive?
- What are main user-set inputs of the model?
- What question(s) is the model capable of addressing?
- What outputs are used to address those questions?
- What type of decision making does the model inform?
- How does it relate to other models?





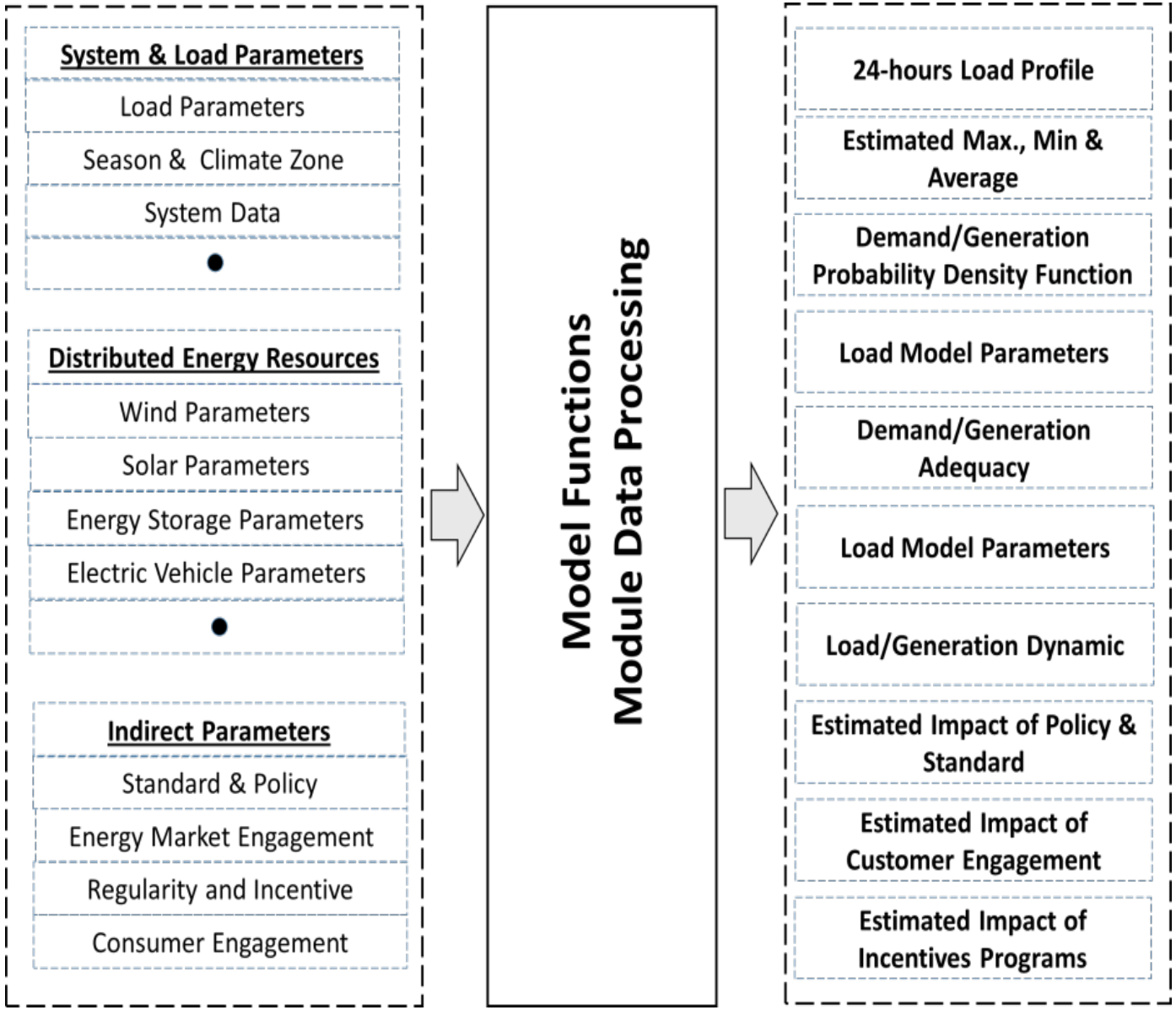
Why Cluster-Based Model ? The Objective & Drive

- Continuous Evolution in Policies, Standards and Energy Market Towards Carbon-Free Resilient Networks.
- Focus on Customer Engagement and Consumer Behavior.
- Focus in the Policy-Makers and Energy Market Beyond Estimating Generation/Demand Metrics.
- Digitization - Advanced Sensors With Real-Time Computational Capability and High-Speed Communication.
- Dramatic Change in the Generation/Demand Infrastructure of the Power System.



What are main user-set inputs of the Demand/Generation model?

- **On-line** and/or **Historical** Inputs.
- **Modular-Based** Activations.
- **Stand-Alone** or **Integrated** Part of Other Applications.
- **Flexible** to Accommodate Other or Updated Models.
- Integrated in the **Ecosystem** for **Engineering/Business** Applications.
- Accommodate Indirect Parameters Such as **Customer Behavior** and Engagement, **Policy**, **Incentives** and Standard Implementations.



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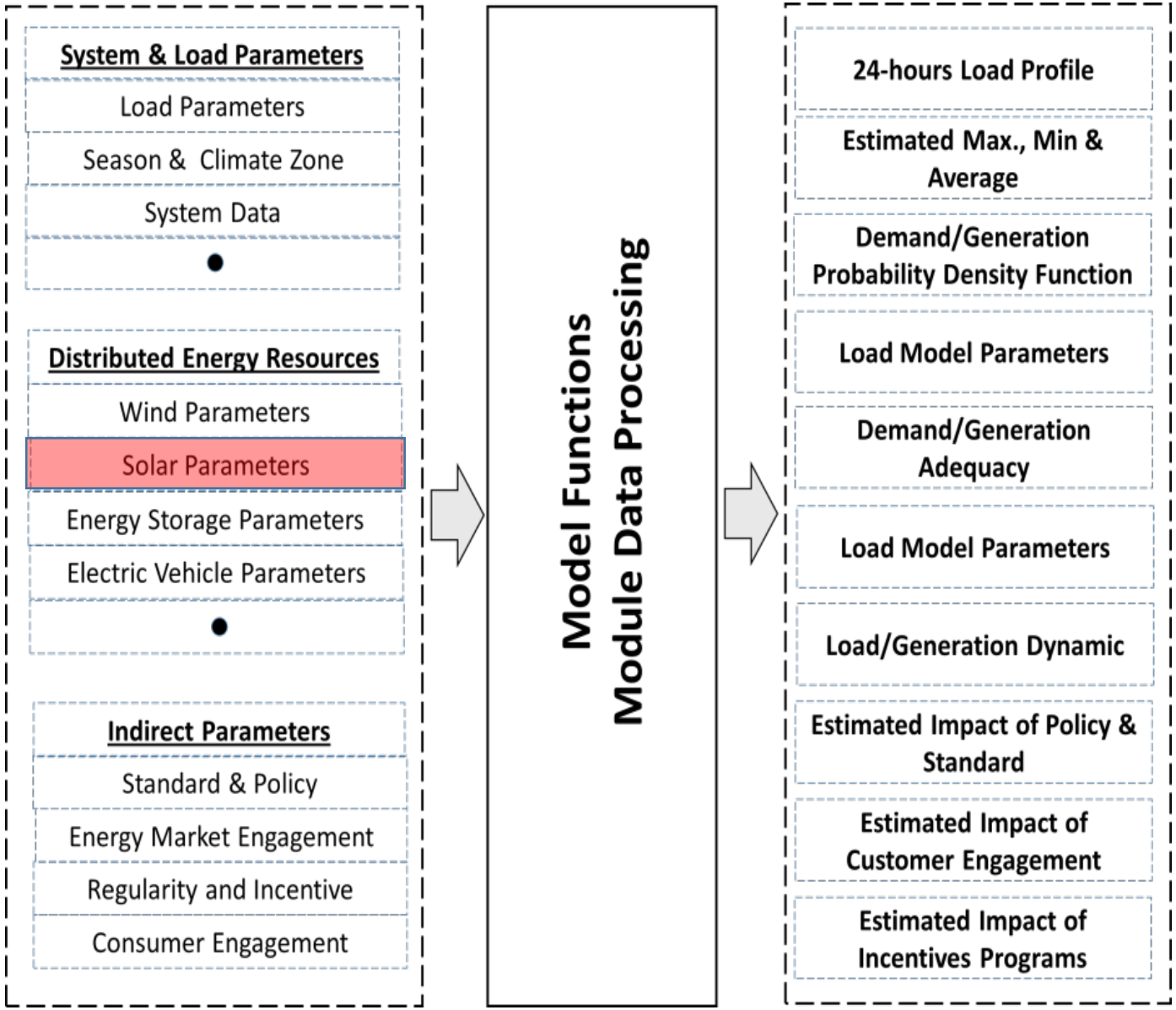

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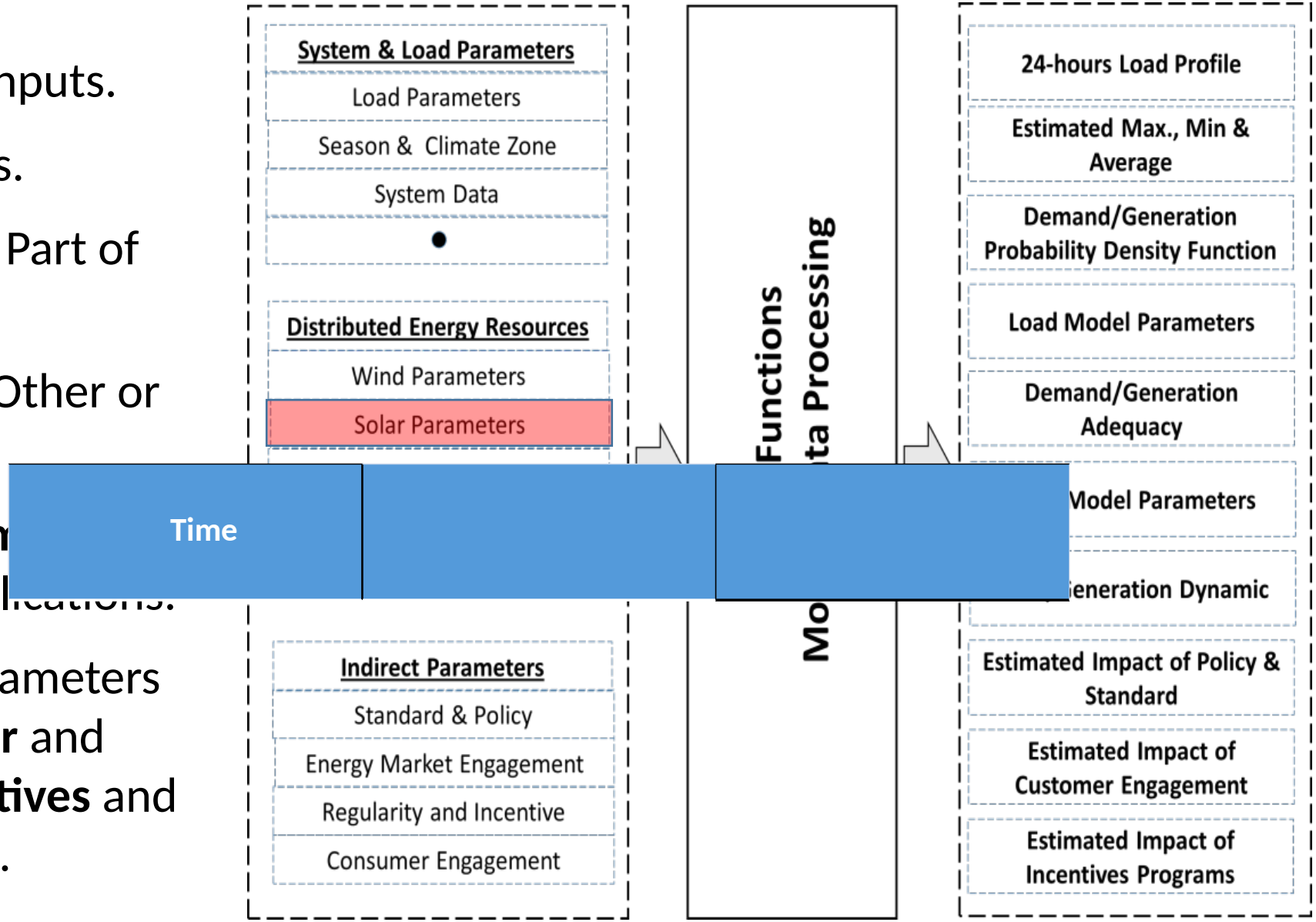

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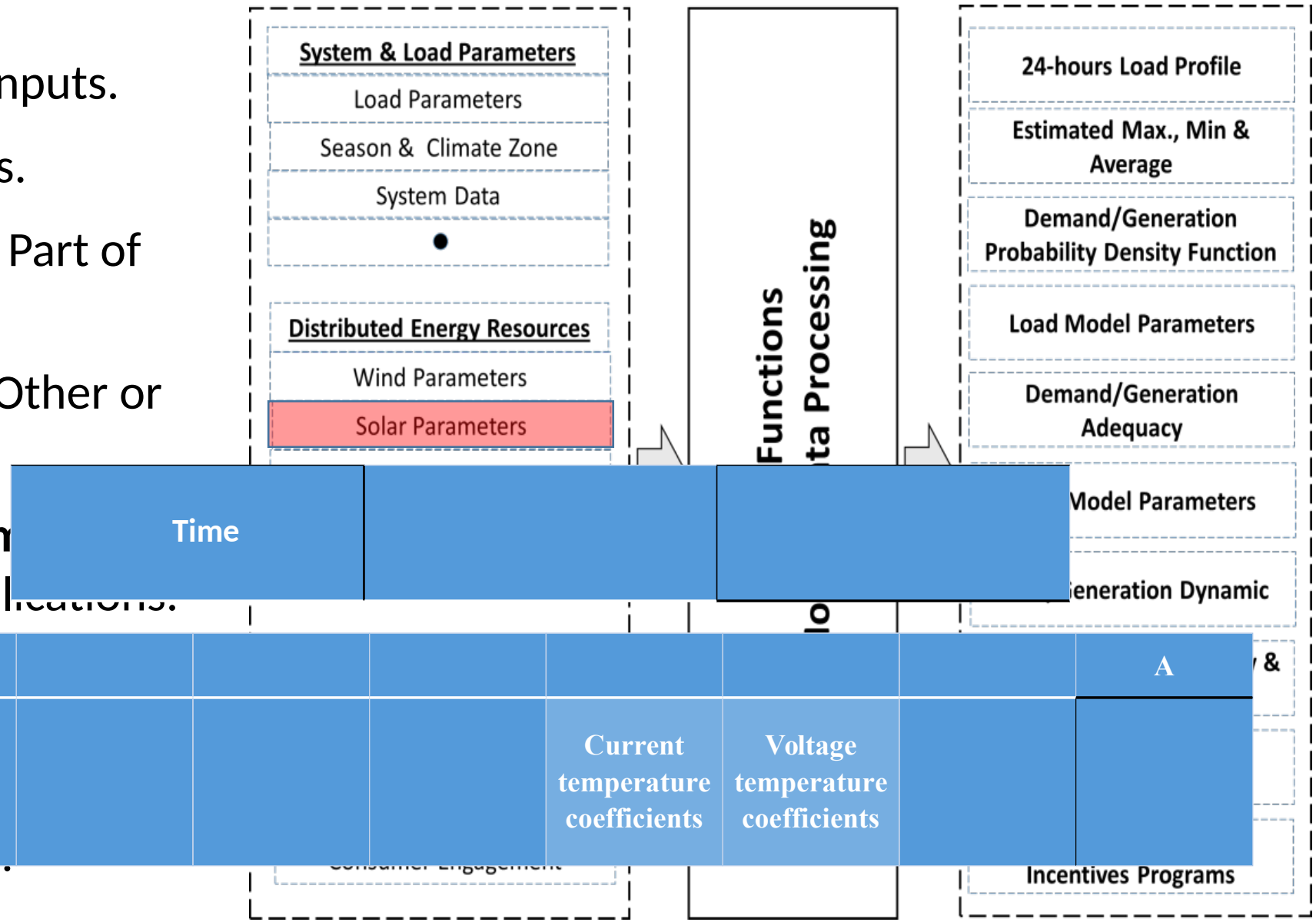
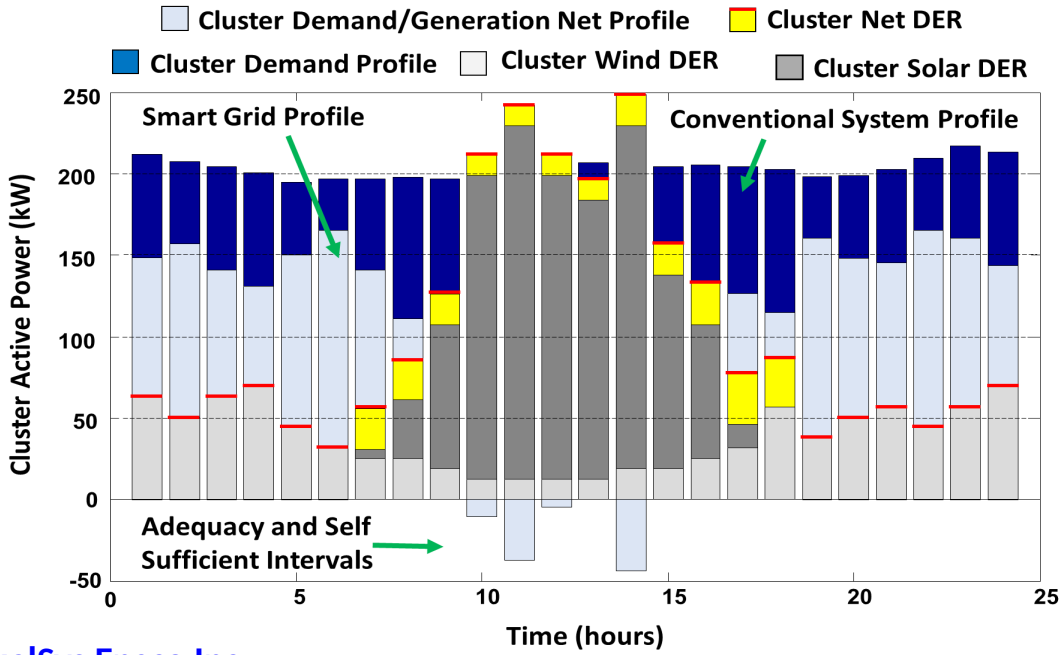
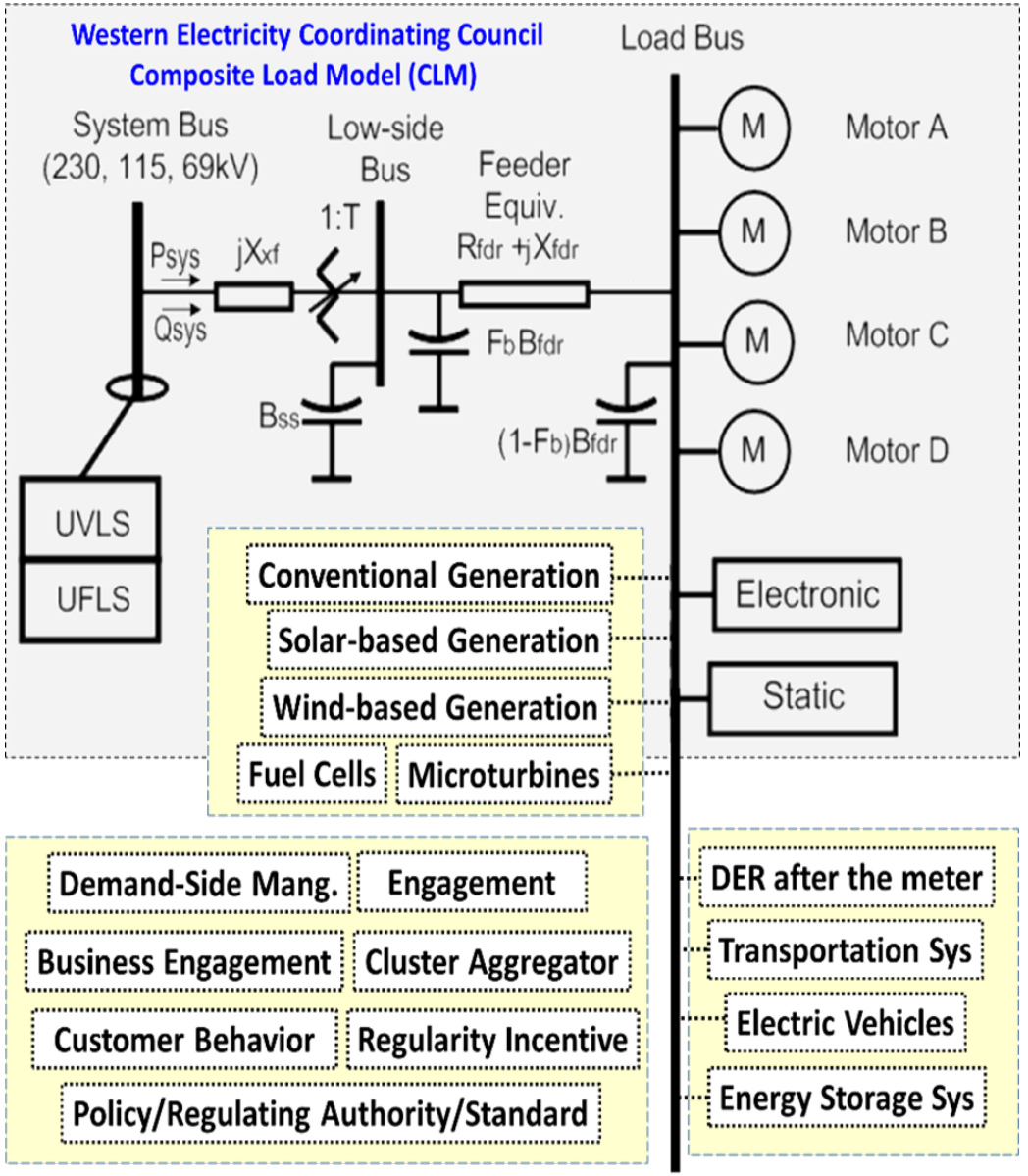


What question(s) is the model capable of addressing?

Multi-Level Sustainable and Resilient Community:

- Stochastic, Steady-State & Dynamic Loads.
- Self-Adequacy & Self- Sufficient Time Intervals.
- Potential of System Investment.
- Potential of Customer Engagement.
- Policy and Standard Impact.

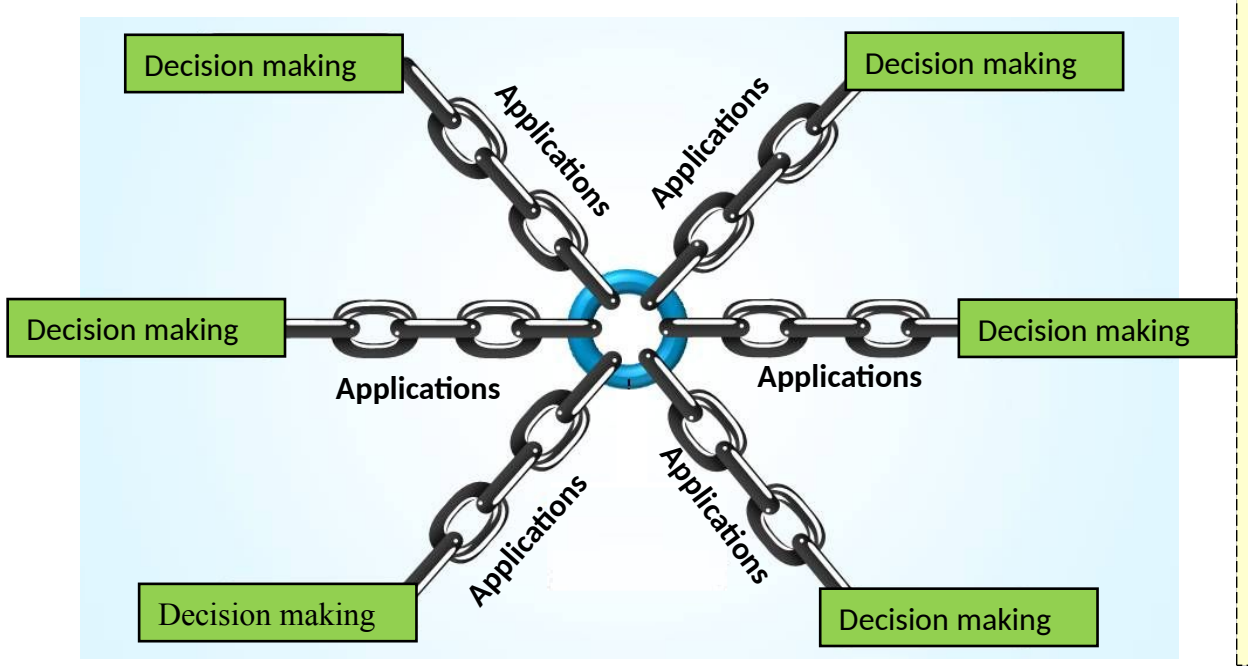




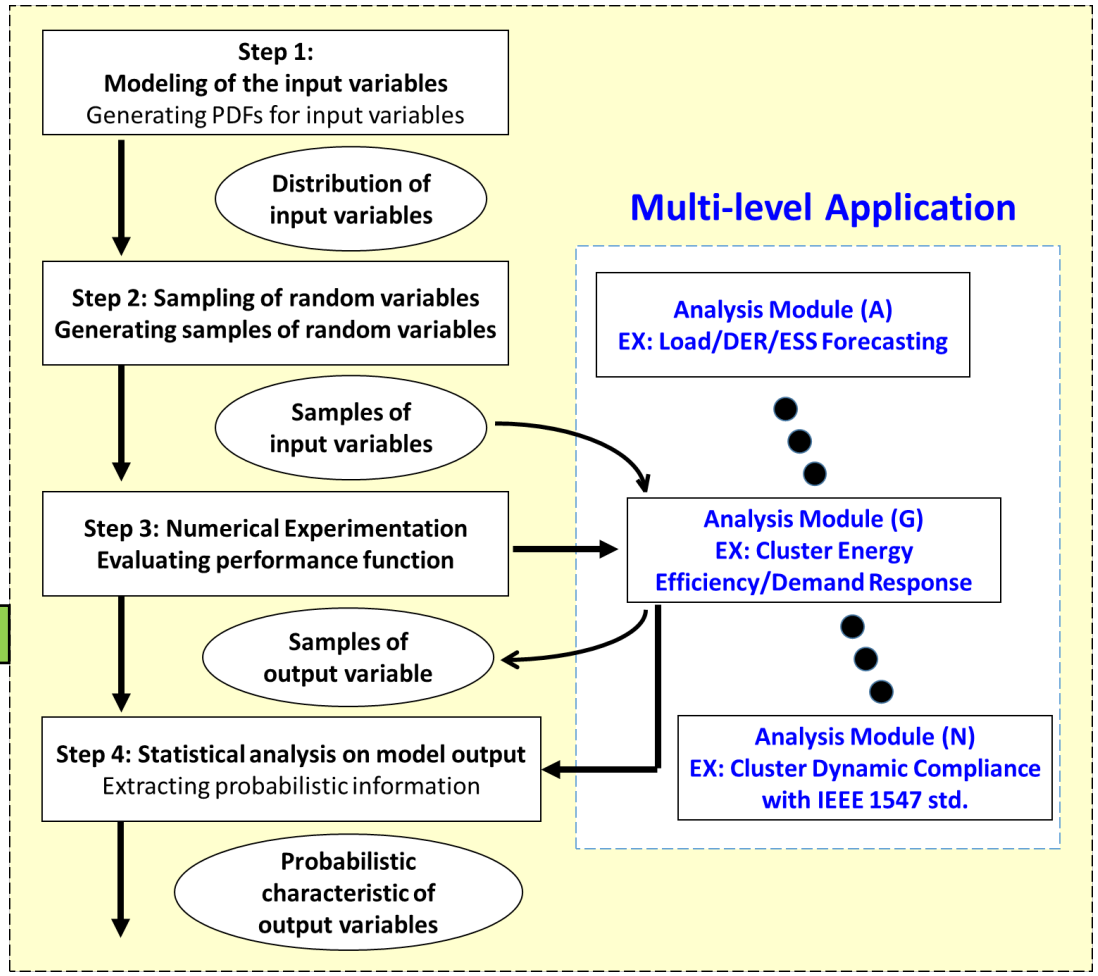
What outputs are used to address those questions?

Multi-Level Demand/Generation Relationship:

- **Probabilistic** and Deterministic **Load Model.**
- Steady-State & Dynamic Load Model.
- On-line & Off-line Model
- Mathematical Model Parameters.
- Indirect Model Parameters.



Multi-Level Based Probabilistic Studies



What outputs are used to address those questions?

Processing Engine

Multi-Level Demand/Generation Relationship:

- Probabilistic and Deterministic Load Model.
- Steady-State & Dynamic Load Model.
- On-line & Off-line Model
- Mathematical Model Parameters.
- Indirect Model Parameters.

Decision Making

- Government-Policy Makers
- Utilities-Policy Makers
- Customers

Samples of Standalone and Integrated Applications

Applications	Single End-Use	Industrial Plant	Critical Load	Cluster Load	Feeder Load	S/S Load
Transactive Energy Market	*	*	*	*	*	*
Resiliency & Reliability	*	*	*	*	*	*
Load/DER/ESS Forecasting		*		*	*	*
Dynamic Overvoltages		*		*	*	*

What type of decision making does the model inform?

1 - Government-Policy Makers:

- Best Energy Mix Strategy.
- Quantify greenhouse gas emission reduction.
- Improving energy efficiency
- Determine the best energy market strategies and rules.
- Regulate electric energy storage and DER penetration.
- Regulate the effect of electric vehicles.

2 - Utilities-Policy Makers:

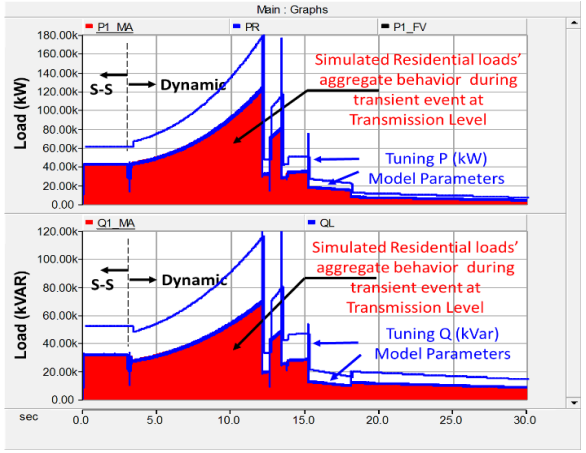
- Establish Resource Planning Policy for Gen/T&D.
- Design More Accurate Operational Incentives.
- Develop New Measures For Infrastructure Investment.
- Develop Multi-Level Reliability Indices and Trends.
- Enhance Certainty Level of DERs/ESSs Penetration.

3 - Customers:

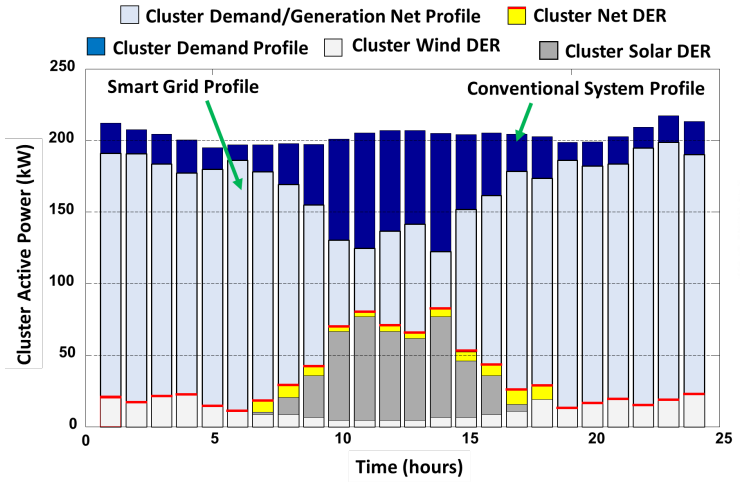
- Enhance Customer Choices & Opportunities.
- Track Accurately Customer Behavior Changes.
- Promote Customer Choice for Adopting Clean Energy Technology.
- Promote Customer Engagement in Energy Market.

How does it differ from other models?

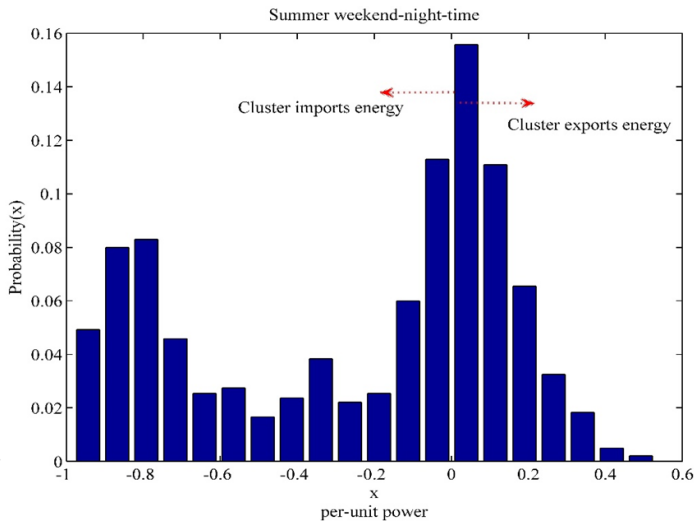
- **Multi-Level Model & Not Only Aggregated**
  - Supports End-User and Aggregator Engagement and Decentralized Operation.
  - Operates as a Standalone or as Integrated Part with Other Modules.
- **Output is Flexible in Nature**
  - Considers Dynamic, Steady-State, or Stochastic Nature.
  - Harmonized with the Ecosystem and Electricity Market.



Dynamic



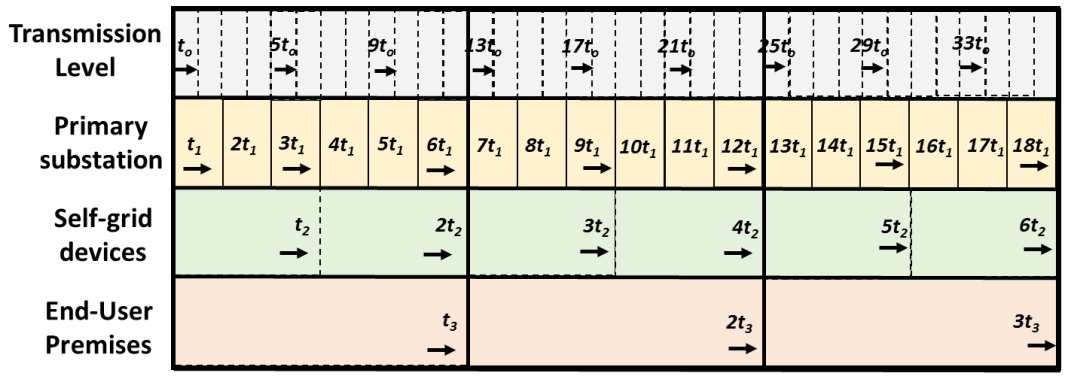
Steady-State



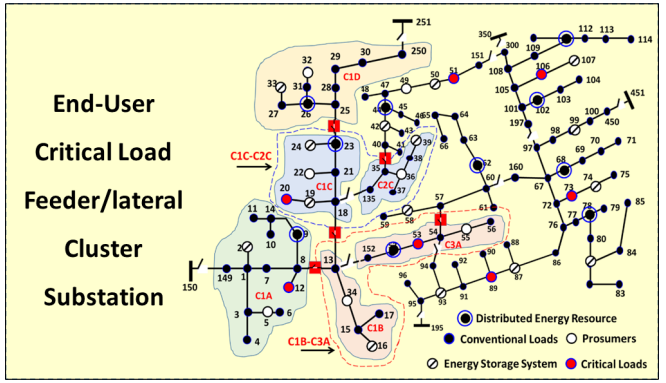
Stochastic

How does it differ from other models?

- **Develops Time-Synchronization Map** of Demand/Generation within Each Cluster.
  - Allows Balancing DERs/ESSs and Load within each Cluster.
  - Develops Survivability Time-Duration Bond for a Resilient System.
- Permits **Scalability that Allows Multiple Parallel Marketplaces** in a Sustainable Community.
- Promotes **Investment in Clean Technology** Deployment.
- Promotes **Behavior-Driven**, Enables **Demand Response-Enabled**, and motivates **Engagement**.
- **Conveys Accurate and Up-to-Date** System's Demand/Generation/Storage Impact for Policy-Makers, Energy Regulators, and Standard-Developers.



Time-Synchronization Map



Active Distribution Network

Questions?