Basic Methodology for Calculating Dynamic Operating Envelopes

Alex Guinman
Energy Queensland

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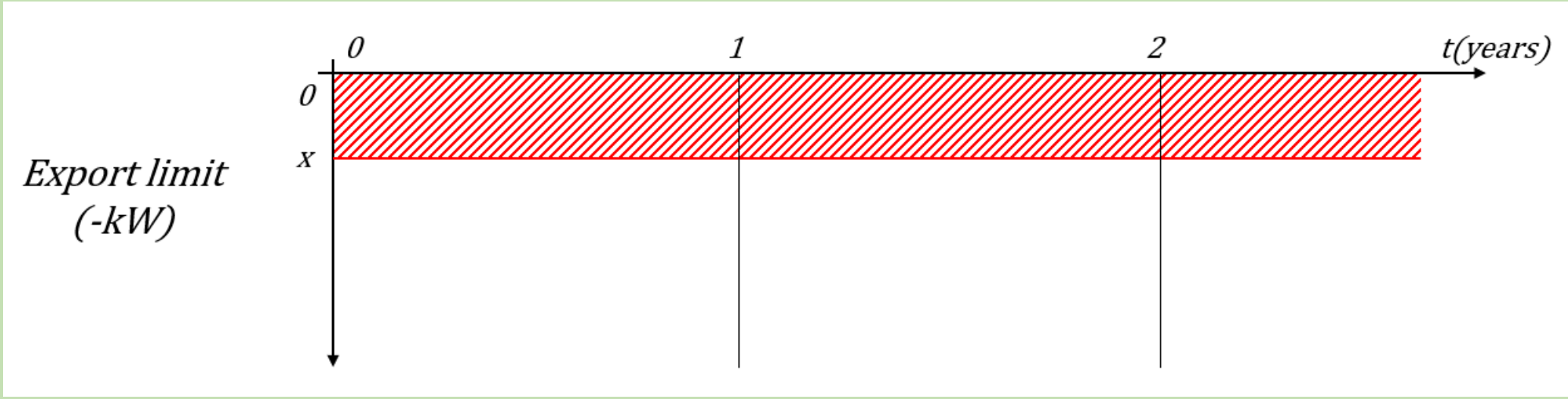
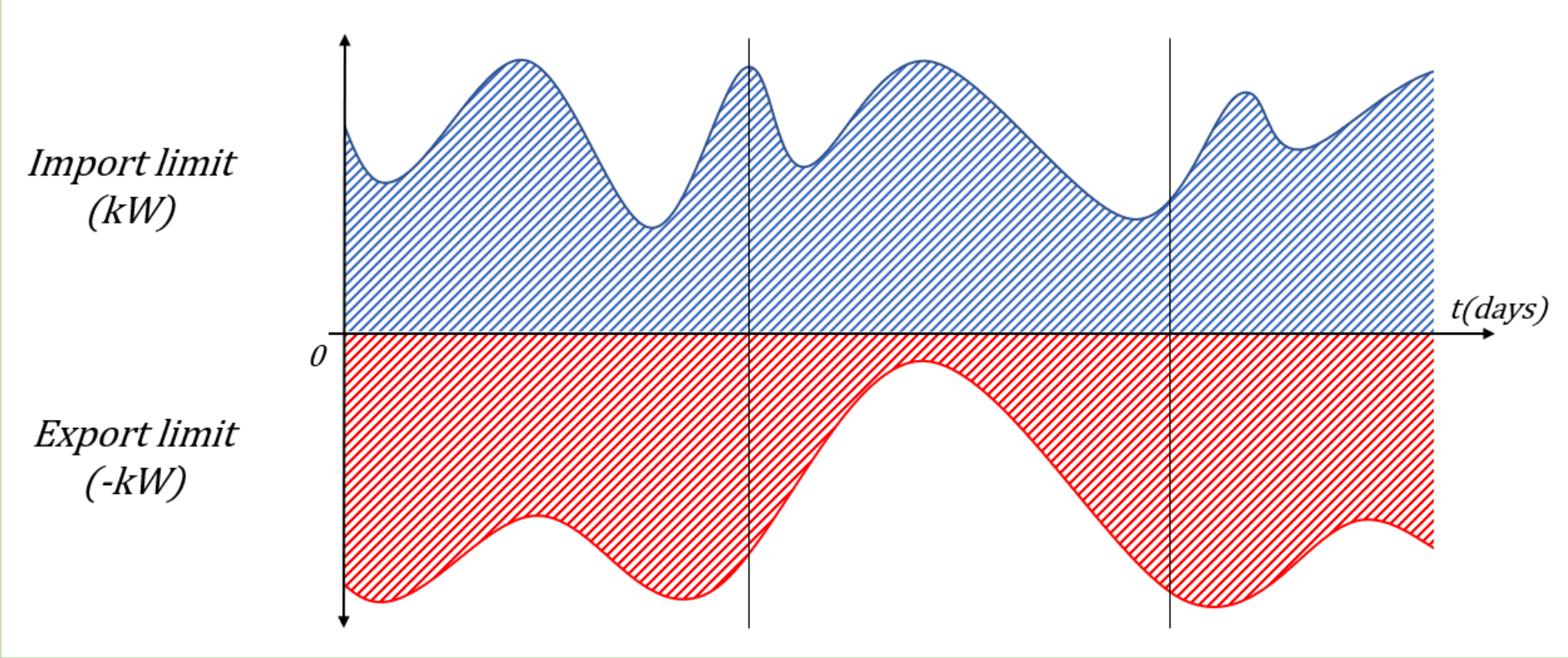
Static Export Limit



Dynamic Operating Envelope



Basic Methodology

- Where you can't use more accurate methodologies such as:
  - Advanced (based on state estimation)
  - Model Free (based on machine learning)

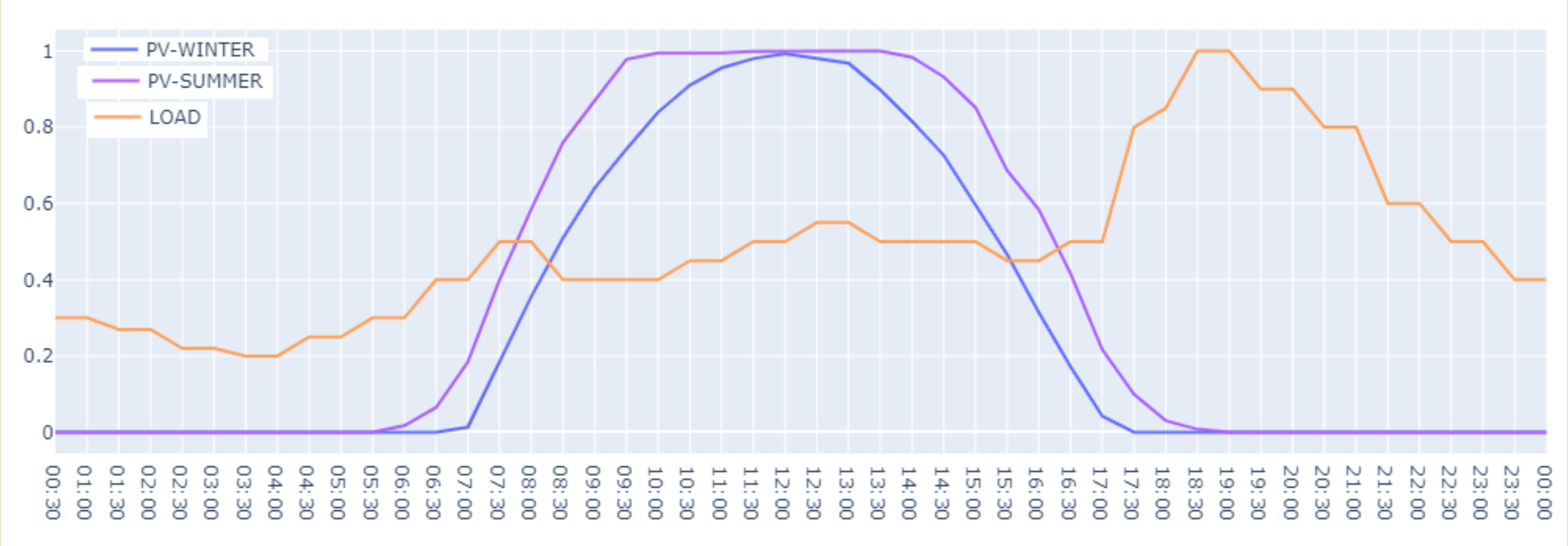
- Due to:
  - Poor network model data
  - Lack of telemetry data (or comms issue)
  - Compute / scaling requirements
  - External DOE calculation system failure (fallback methodology)

- The proposed methodology is intended as a starting point for industry discussion - it is likely to be improved and refined over the next several years

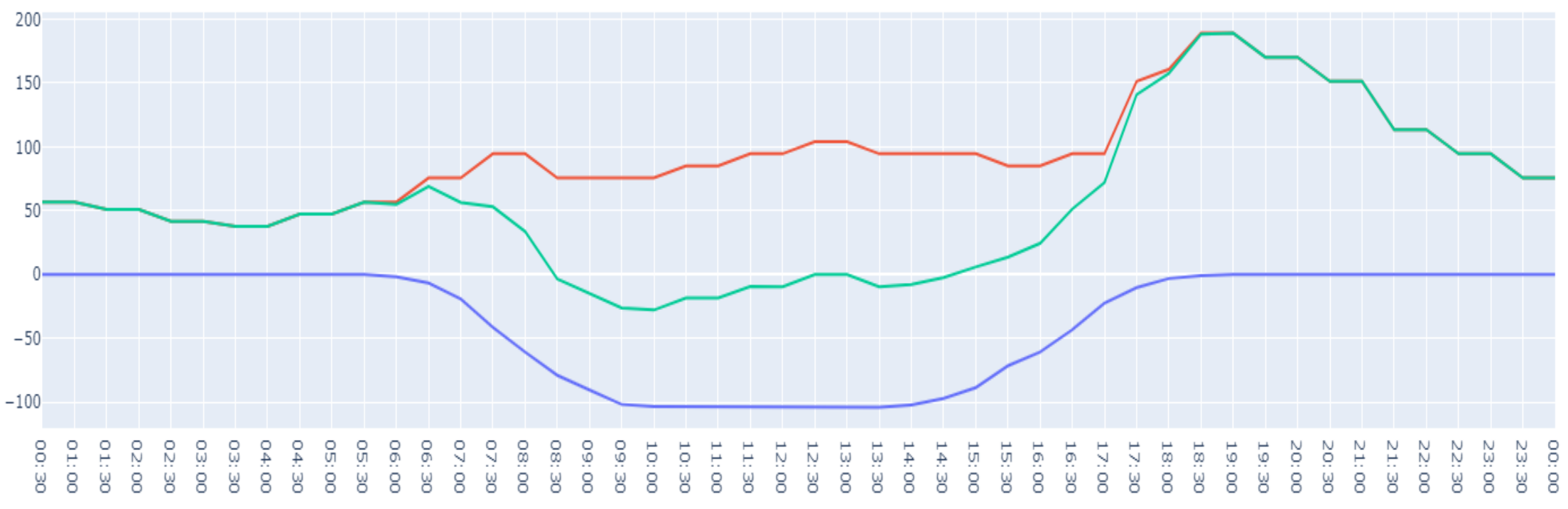
What determines the constraint?

- Thermal constraints
  - Transformer nameplate rating
  - Conductor ratings
- Voltage constraints
  - On the MV and at transformer
  - End of LV Line
- Protection constraints
  - Transformer fuse
  - Service fuse
  - Recloser overcurrent settings
- Upstream constraints
  - Feeder, Zone Sub or Transmission
- Contractual Constraints
  - Min and max limits in connection agreement

Normalised Load Curves

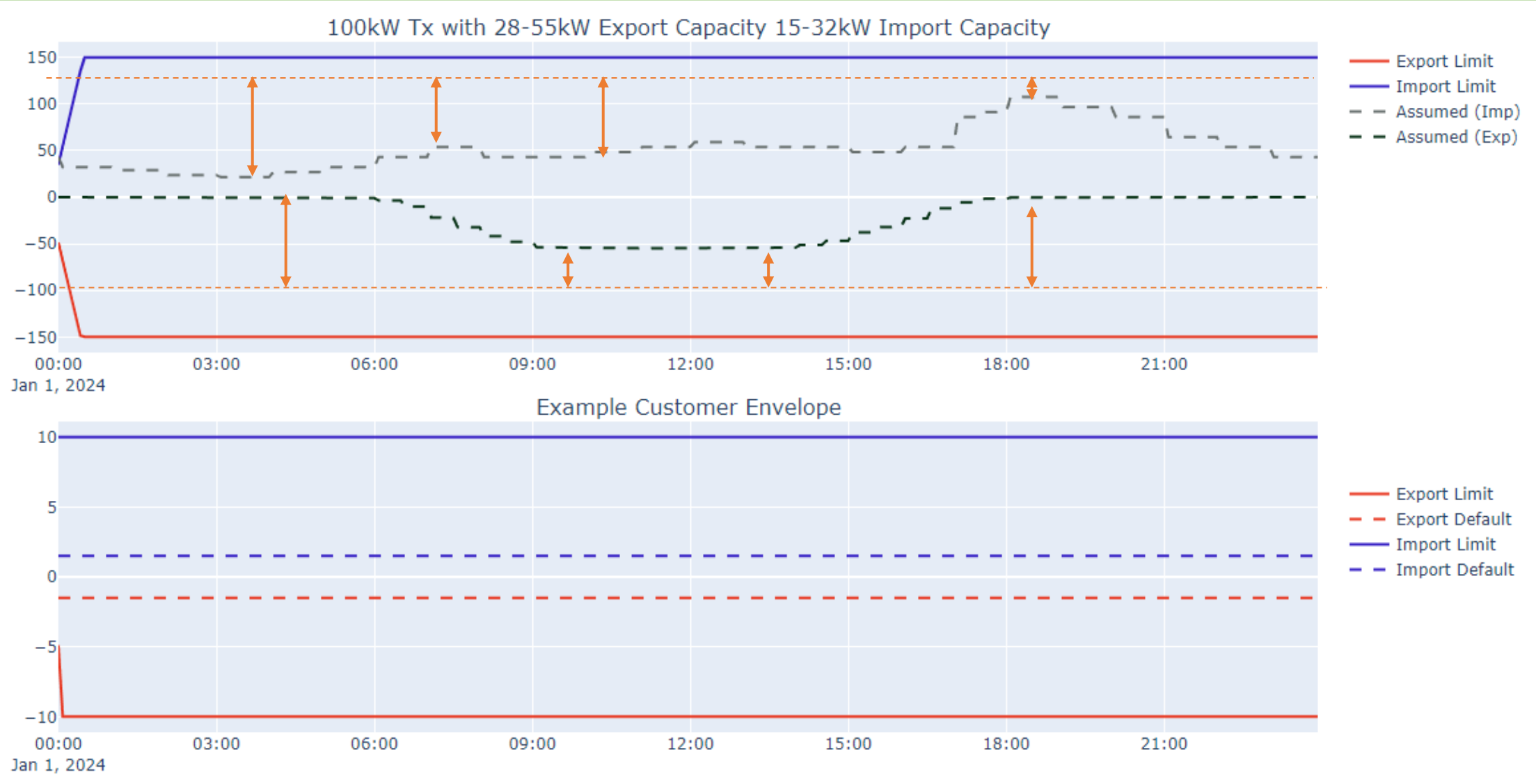


Load Profiles



- Export worst case = PV Curve x Installed Capacity
- Import worst case = Load Curve x Historical Max Demand

Example (no telemetry) – no constraint



Overallocation

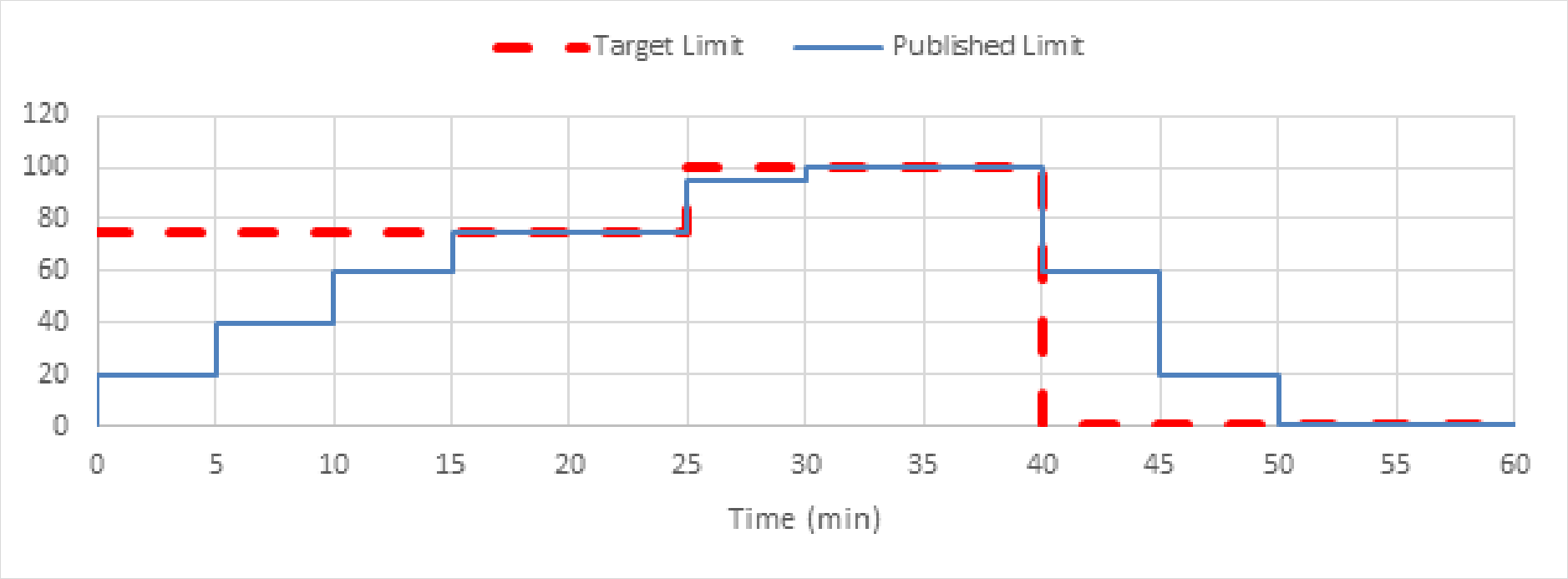
- Overallocation if unused headroom (on next iteration)
  - E.g. Up to 150% of transformer nameplate rating

ANSI Standard C57 series (IEEE, n.d.)

DT capacity	Time limit
125%	4 hr
150%	1 hr
200%	30 min

Rate Limiting

E.g. at most 20% increase / 40% decrease on transformer rating

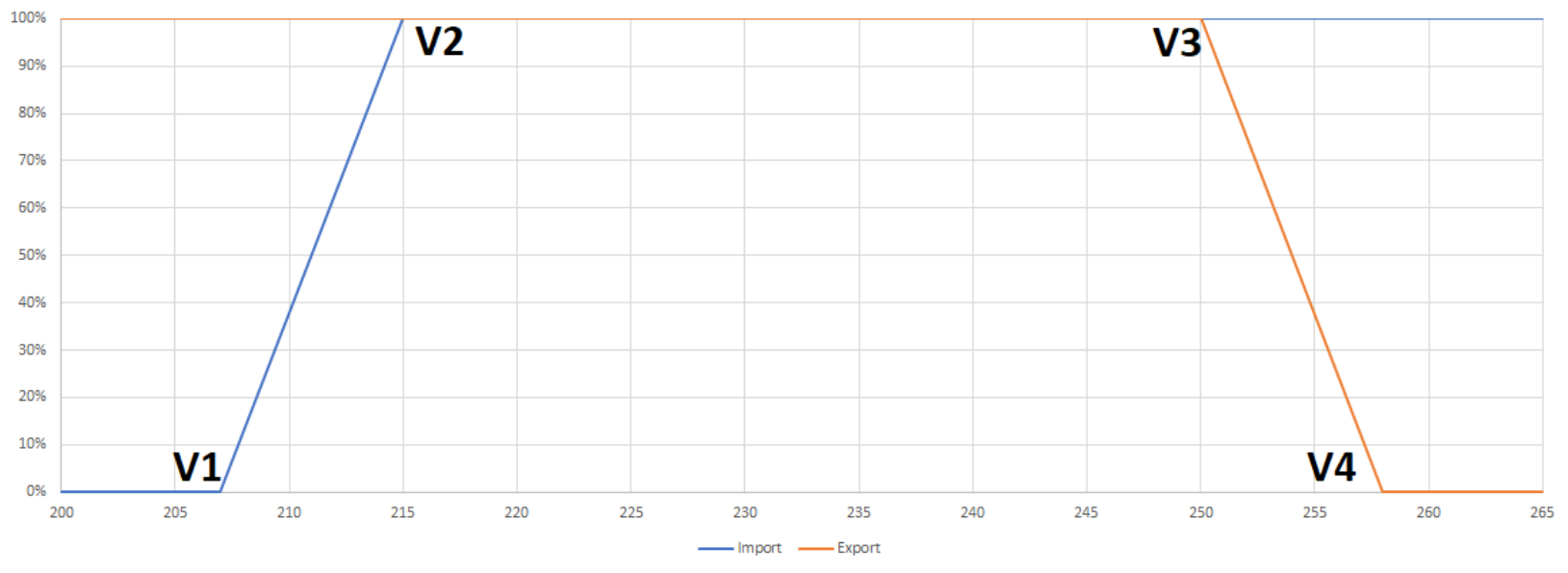


Connection	Approved Export	Equal Allocation			Proportional Allocation (alternative)		
		50 kW Avail.	100 kW Avail.	200 kW Avail.	50 kW Avail.	100 kW Avail.	200 kW Avail.
CP-A (Fixed Legacy)	5.0 -> 5.0 kW	5.0 kW	5.0 kW	5.0 kW	5.0 kW	5.0 kW	5.0 kW
CP-B (Fixed)	1.5 -> 1.5 kW	1.5 kW	1.5 kW	1.5 kW	1.5 kW	1.5 kW	1.5 kW
CP-C (1PH)	1.5 -> 10.0 kW	7.3 kW	10.0 kW	10.0 kW	3.9 kW	7.4 kW	10.0 kW
CP-D (1PH)	1.5 -> 10.0 kW	7.3 kW	10.0 kW	10.0 kW	3.9 kW	7.4 kW	10.0 kW
CP-E (1PH)	1.5 -> 10.0 kW	7.3 kW	10.0 kW	10.0 kW	3.9 kW	7.4 kW	10.0 kW
CP-F (2PH)	1.5 -> 20.0 kW	7.3 kW	20.0 kW	20.0 kW	6.8 kW	14.4 kW	20.0 kW
CP-G (3PH)	1.5 -> 30.0 kW	7.3 kW	21.8 kW	30.0 kW	9.6 kW	21.4 kW	30.0 kW
CP-H (>30)	1.5 -> 50.0 kW	7.3 kW	21.8 kW	50.0 kW	15.3 kW	35.4 kW	50.0 kW
Total	**15.5 -> 136.5 kW**	**50.0 kW**	**100.0 kW**	**136.5 kW**	**50.0 kW**	**100.0 kW**	**136.5 kW**

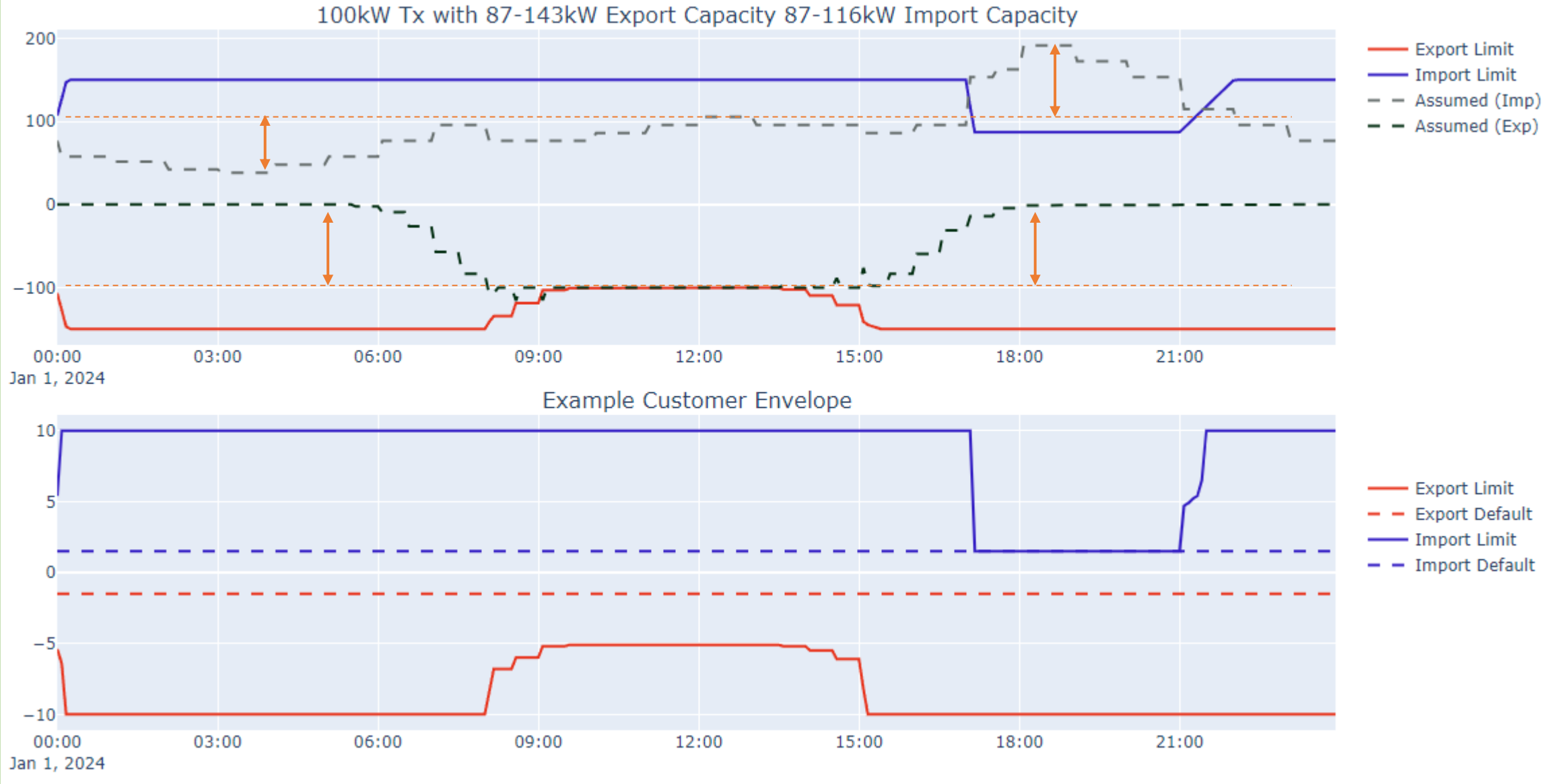
What about voltage?

DOE	V1	V2	V3	V4
Transformer	216	221	248	253
End-of-line	207	215	250	258

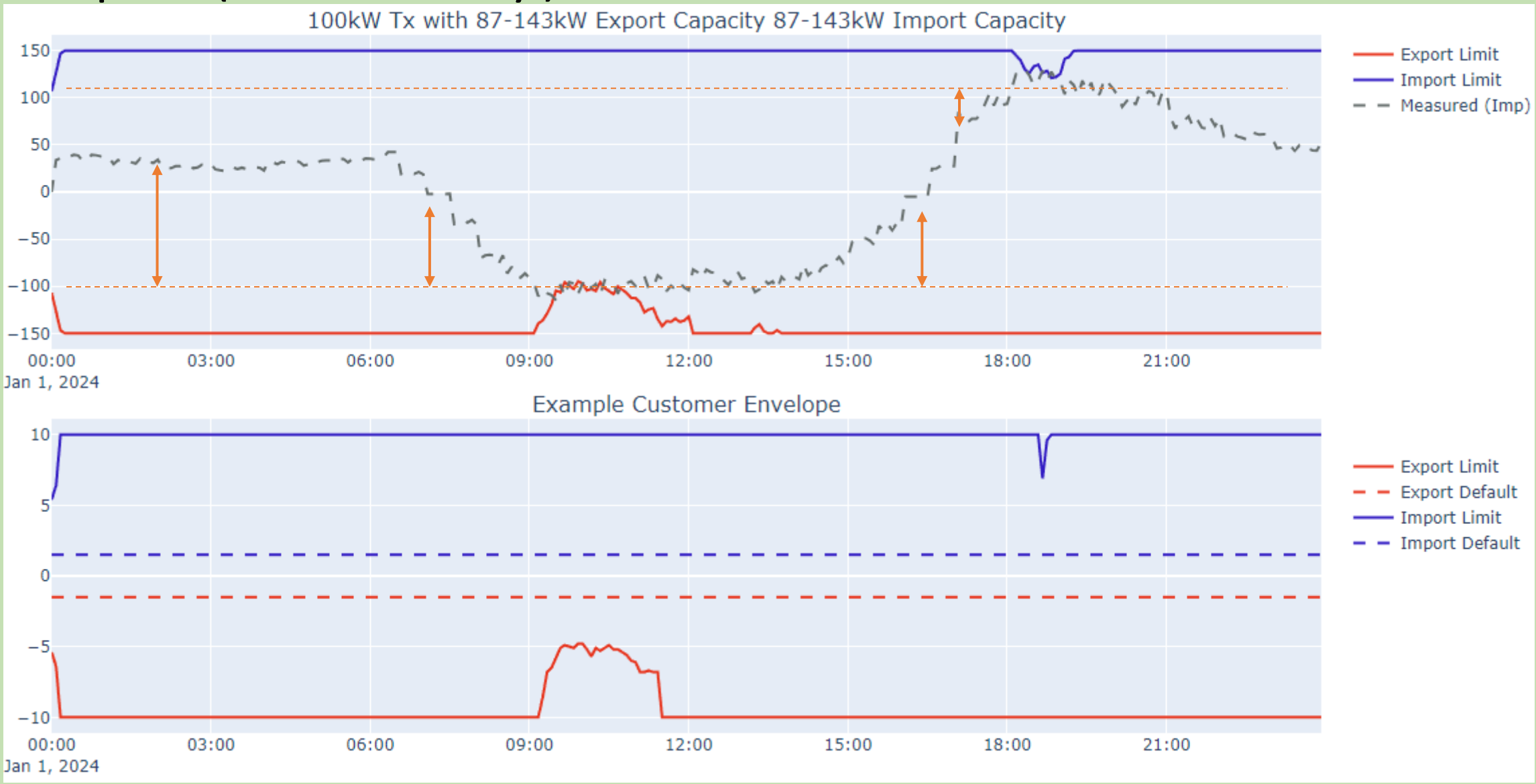
AS4777	V1	V2	V3	V4
volt-var	207	220	240	258
volt-watt	207	215	253	260



Example (no telemetry) - constrained



Example (telemetry) - constrained



When to use basic methodology?

- Network is not constrained (lower compute)
- No network model available
- No telemetry or state estimation available
- For basic forecasting

% of Transformers	No PV	0-75%	75-100%	100%+
1 customer	26.6%	10.0%	0.4%	0.3%
2-25 customers	22.7%	20.1%	1.2%	1.0%
25+ customers	0.7%	15.4%	1.2%	0.4%
Total	50.1%	45.5%	2.8%	1.7%