

Flexible Interconnection

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What is Flexible Interconnection

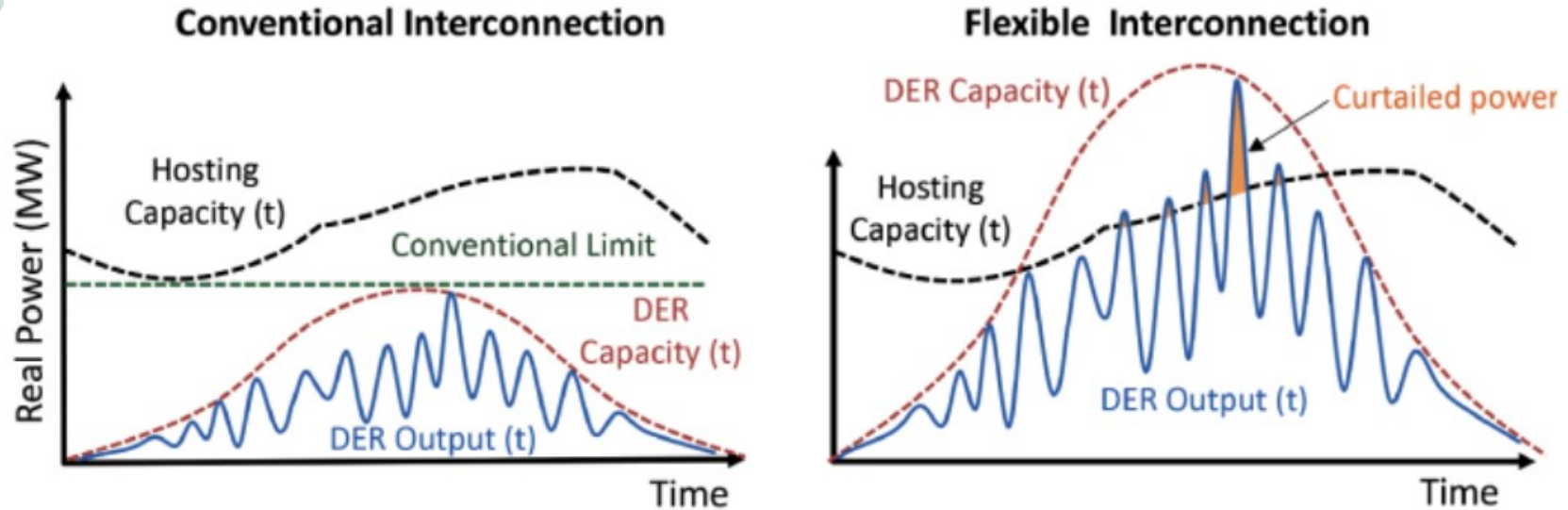
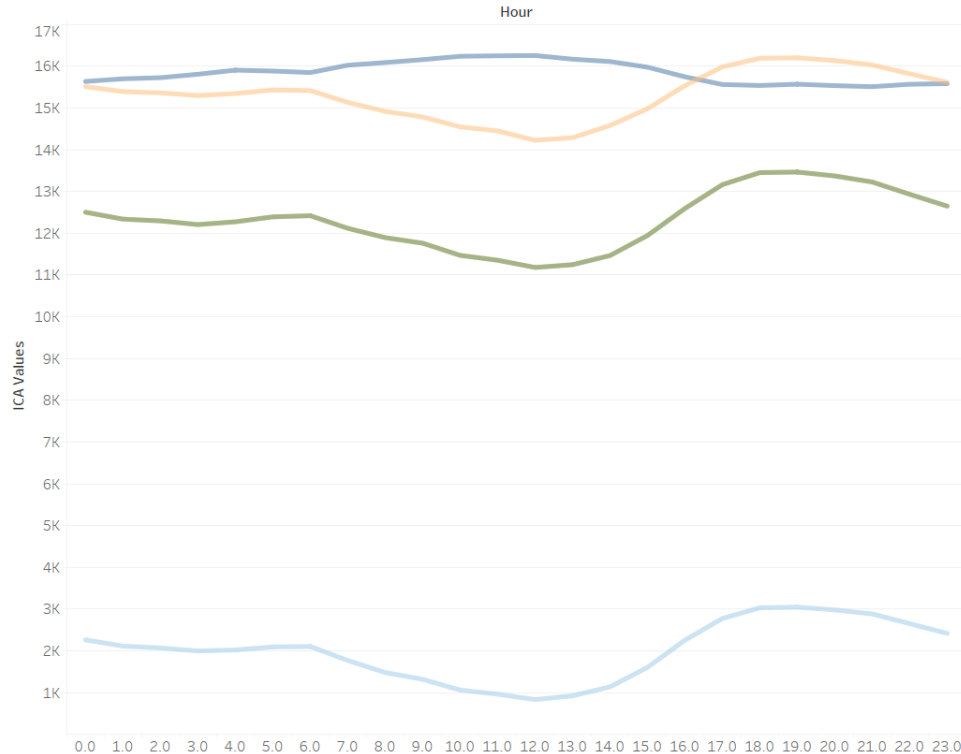


Figure 1. Conventional Interconnection Versus Flexible Interconnection (Source: EPRI)

Flexible limits in Interconnection

- Static export limit (UL 3141 PCS, 32 Relay)
- Scheduled limit (UL 3141 v.2 PCS, Relay+RTAC)
- Limit max active power command (UL 1741 SB inverters)
 - Or other inverter control solution
- Volt-watt (UL 1741 SB inverters)

Hosting Capacity Analysis - Day



ICA Study

- Generation - Operational Flexibility
- Generation - Thermal
- Generation - Voltage Variation
- Generation - Steady State Voltage
- Uniform Generation Static Grid

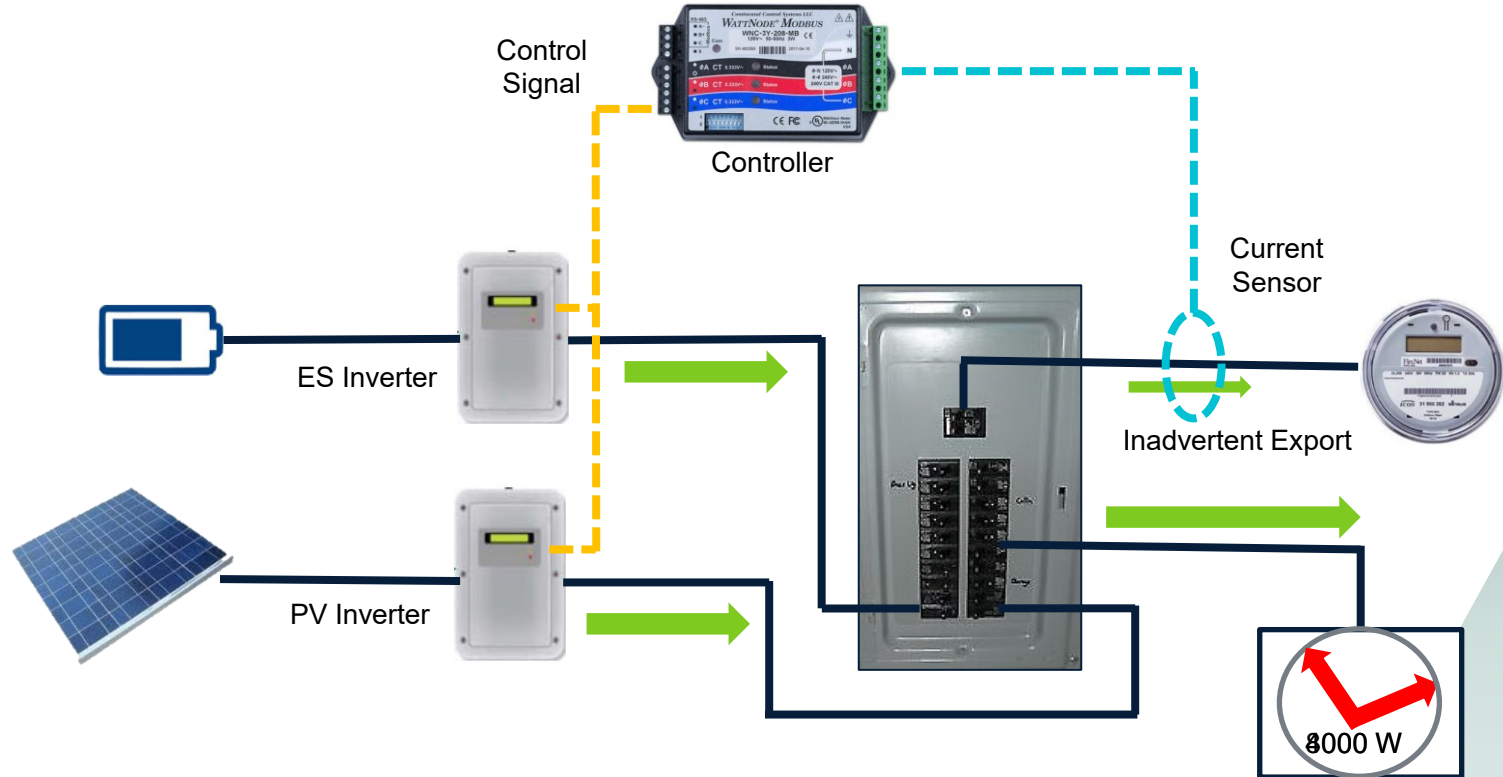
Hosting Capacity Analysis - Year

Monthly - Uniform Generation Static Grid

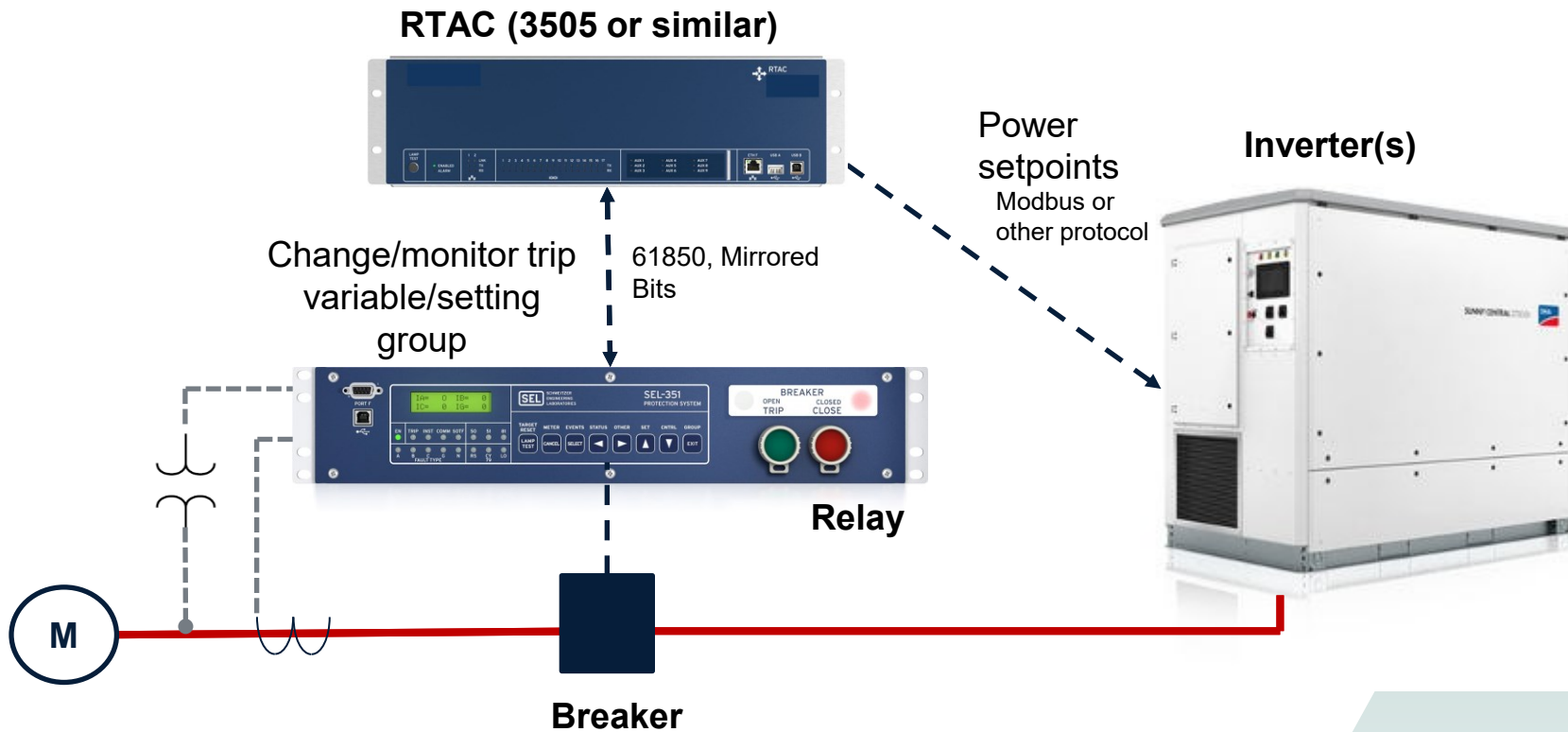


Export Limitation Options

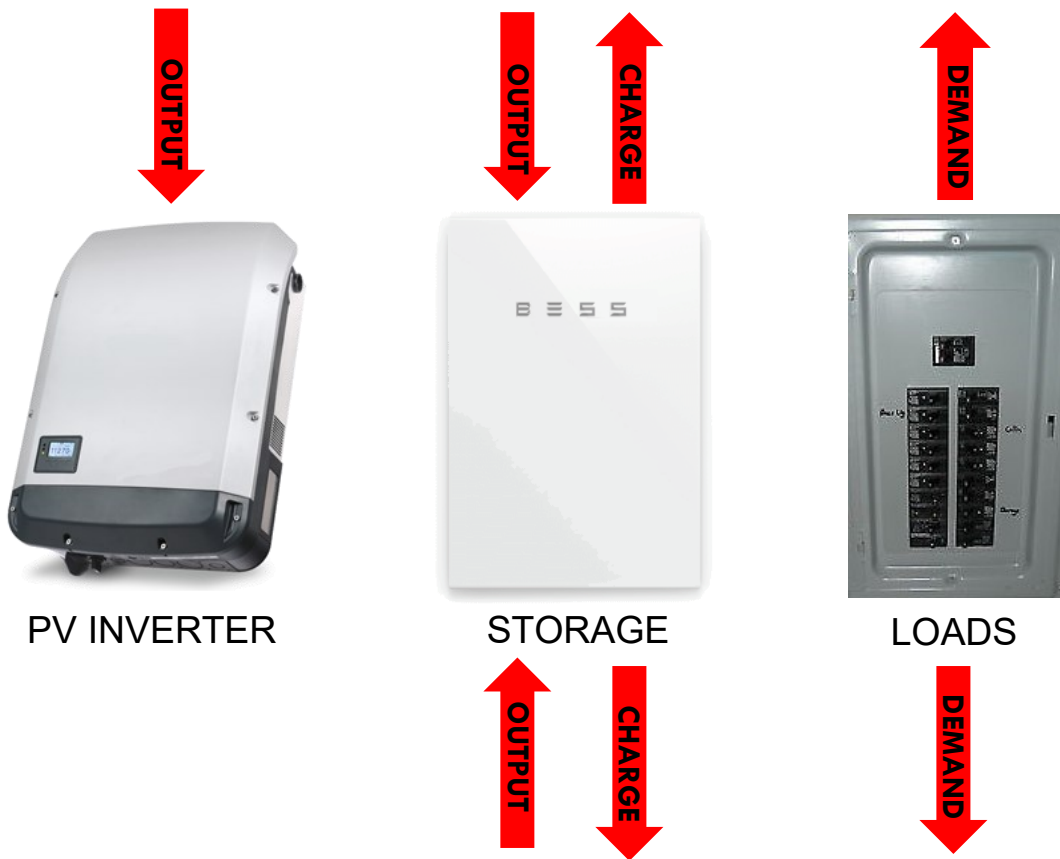
How a PCS Works (Sample Configuration)



Relay+RTAC Configuration

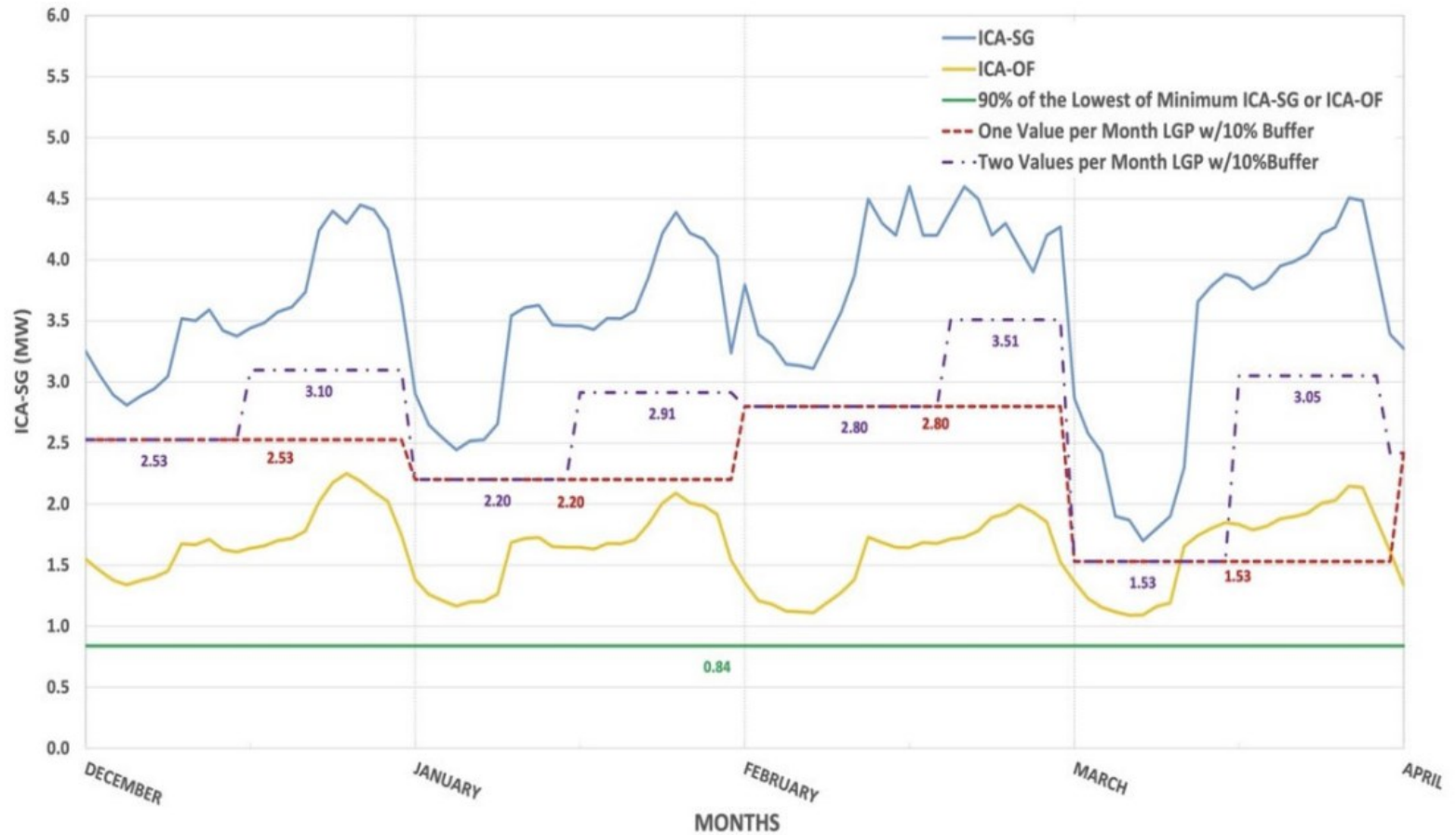


Export – Limiting Flexibility

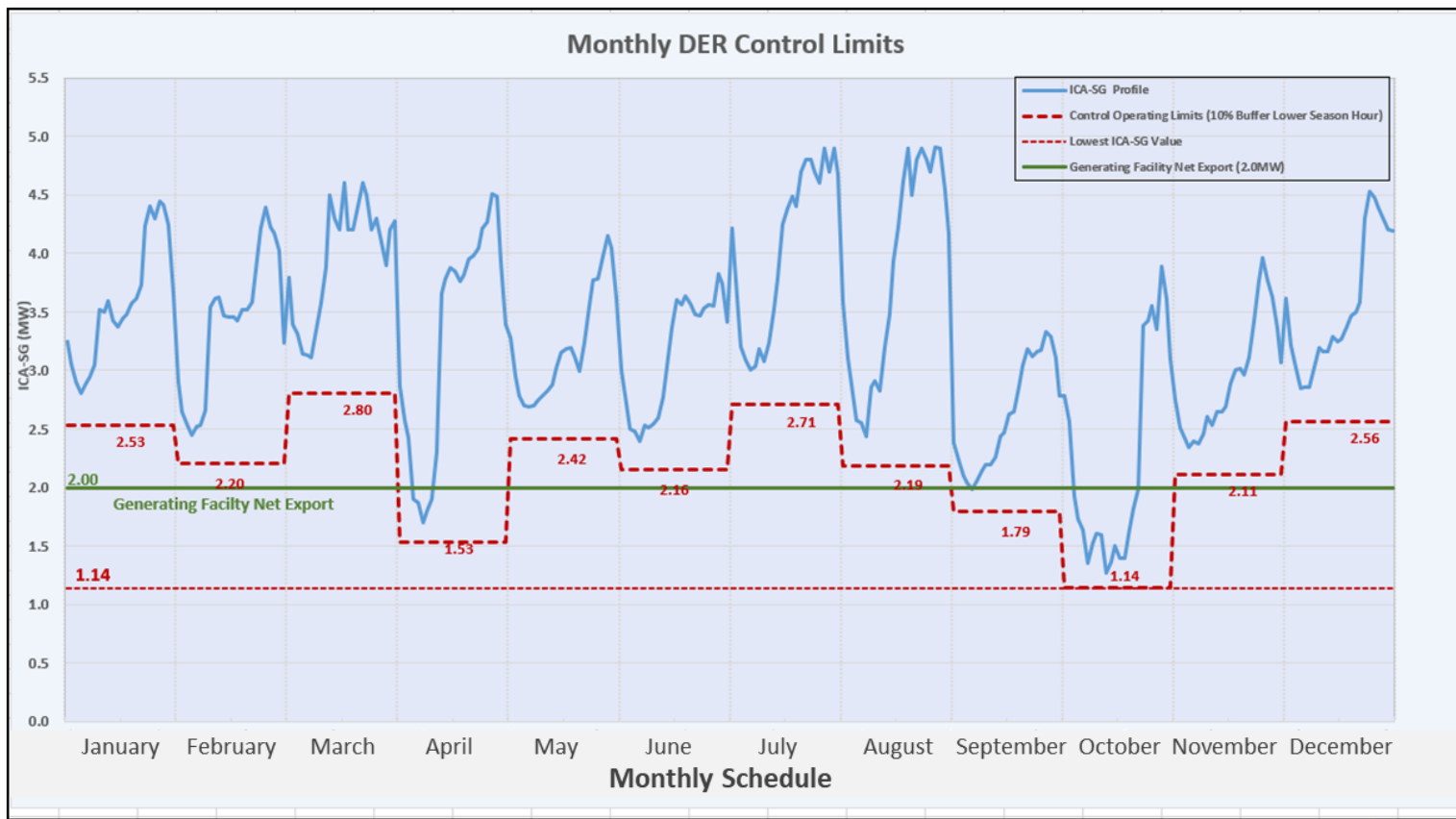


CONCEPTUAL LIMITED GENERATION PROFILE

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Scheduled output



PCS Scheduling Format

Metadata (optional)

MT_FILE_INFO_TYPE	AS
MT_DER_DEVELOPER_NAME	SolarCo
MT_INTERCONNECTION_ID	12345-6
COMMENT	Issued per state requirement R-12345
COMMENT	Based on PowerCo schedule file abc-12345

Comments (optional)

Schedule (mandatory)

SCHEDULE_ENTRY	START_DATE	EFFECTIVE_DAY_TYPE	START_TIME	EXPORT_LIMIT_WATTS
SCHEDULE_ENTRY	01/01	MO-FR	08:00	55000
SCHEDULE_ENTRY	01/01	MO-FR	11:00	45000
SCHEDULE_ENTRY	01/01	MO-FR	16:00	55000
SCHEDULE_ENTRY	01/01	MO-FR	20:00	60000
SCHEDULE_ENTRY	01/01	SA-SU	10:00	53000
SCHEDULE_ENTRY	01/01	SA-SU	18:00	53000
SCHEDULE_ENTRY	05/15	ALL	07:30	51500
SCHEDULE_ENTRY	05/15	ALL	10:45	43000
SCHEDULE_ENTRY	05/15	ALL	15:00	46000
SCHEDULE_ENTRY	05/15	ALL	19:30	58000
SCHEDULE_ENTRY	09/01	MO-FR	11:04	49000
SCHEDULE_ENTRY	09/01	MO-FR	17:22	53550
SCHEDULE_ENTRY	09/01	SA	14:00	59000
SCHEDULE_ENTRY	09/01	SA	17:30	60000
SCHEDULE_ENTRY	09/01	SU	09:45	43500
SCHEDULE_ENTRY	09/01	SU	14:00	51250
SCHEDULE_ENTRY	09/01	SU	16:30	60000

FlexIX experience

■ NY: NYSEG, RG&E

- Uses ADMS/DERMS
- 3% curtailment prediction, actual 0.006%

■ IL: ComEd

- Uses forecast load/DER with setpoints from ADMS/DERMS

■ Aus: SAPN

- Uses ADMS/DERMS

Smart Inverter Communications

- Limit Maximum Active Power command (a.k.a. P_{limit}) is available from all 1547-2018 compliant DER
 - Server needs to send commands at the proper hour, or use gateway scheduling functions to enact limit at correct time



Schedule
server



Gateway

DER Site



Inverter

Volt-watt as FlexIX

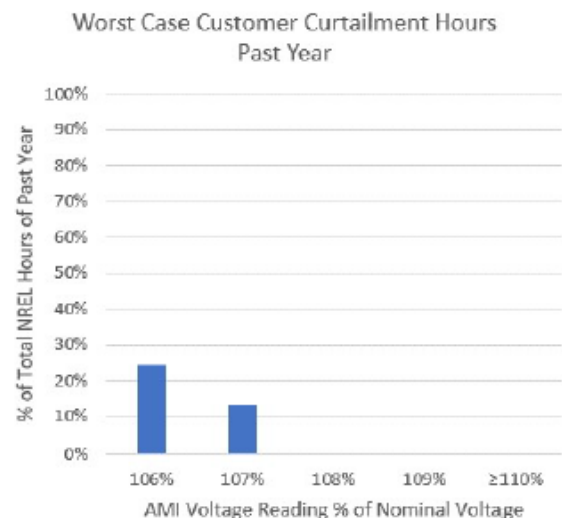
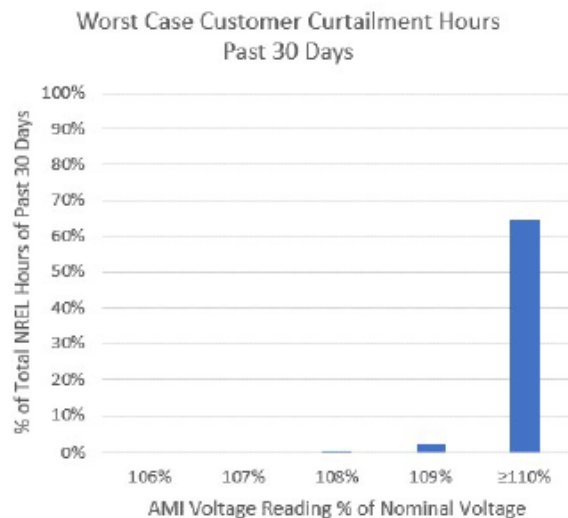
Summary Results for Utility (or Pending) Mitigations

NREL Method 1 Estimation of Curtailment %	# of Customers with 1 year Curtailment %	# of Customers with 1 month Curtailment %
≤ 2%	15	10
> 2% ≤ 4%	0	1
>4%	4	8
Total	19	19

Summary Results for Customer Issues

NREL Method 1 Estimation of Curtailment %	# of Customers with 1 year Curtailment %	# of Customers with 1 month Curtailment %
≤ 2%	16	15
> 2% ≤ 4%	2	0
>4%	0	3
Total	18	18

Worst Case Customer (>5% Curtailment) Voltage Histograms



Volt-Watt Curtailment Reports

California Experience

- PG&E (largest IOU) reported only 9 customers with potential yearly curtailment >4%
- Worst yearly potential loss reported was 38.7% (failing distribution transformer)
- Next highest was 7.3%
- It appears true that volt-watt is unlikely to cause widespread curtailment, but individual customers can be highly impacted



Thank you!

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