Smart Inverters and Utah

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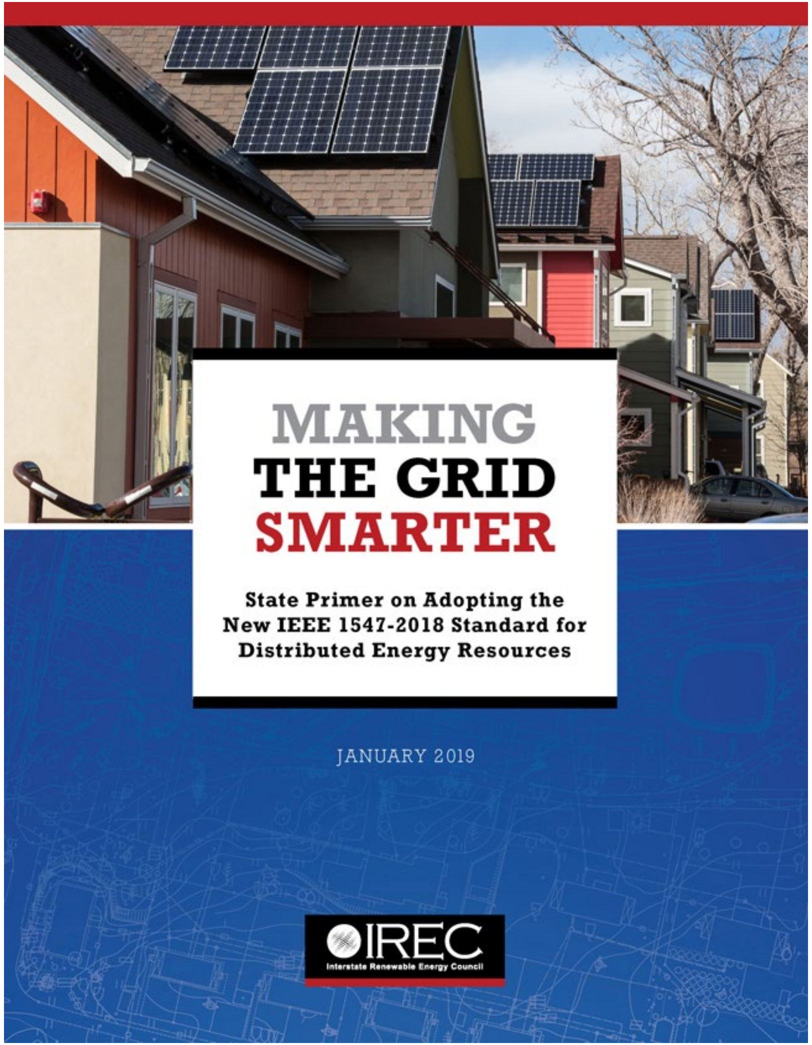
MAKING
THE GRID
SMARTER
State Primer on Adopting the
New IEEE 1547-2018 Standard for
Distributed Energy Resources
JANUARY 2019
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Interstate Renewable Energy Council

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The California Special

Smart Inverters Today

- “Grid Support Utility Interactive” per UL 1741 SA
- Voltage and frequency ride-through (i.e., per CA Rule 21 and/or HECO 14H)
- Anti-islanding with grid support
- Ramp rates (soft start and normal)
- Set PF, volt-var
- Optional: Frequency-watt, volt-watt, permit service, limit max power

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Equipment lists

CALIFORNIA ENERGY COMMISSION

Home PV Modules Inverters Energy Storage Systems Batteries Meters Power Control Systems

Grid Sup

Manufacturers: All Model Names: All

Note #1: Grid support inverters are inverters that include advanced functionality and communication abilities and are commonl Support Inverter List are capable of different levels of advanced functionality. It is important that you verify with the applicable u Information about advanced inverter functionalities can be viewed by exporting the list.

Note #2: Hybrid inverters are capable of taking DC power input from both a solar system and an energy storage system. These m information on the exact functionality and limitations.

Manufacturer ▲	Model Number	Description
ABB	PVI-3.0-OUTD-S-US-A [240V]	3 kW, 240 Vac Grid Support Utility Interactive I
ABB	PVI-3.0-OUTD-S-US-A [277V]	3 kW, 277 Vac Grid Support Utility Interactive I
ABB	PVI-3.0-OUTD-S-US-Z-A [208V]	3 kW, 208 Vac Grid Support Utility Interactive I
ABB	PVI-3.0-OUTD-S-US-Z-A [240V]	3 kW, 240 Vac Grid Support Utility Interactive I
ABB	PVI-3.0-OUTD-S-US-Z-A [277V]	3 kW, 277 Vac Grid Support Utility Interactive I
ABB	PVI-3.0-OUTD-S-US-Z-M-A [208V]	3 kW, 208 Vac Grid Support Utility Interactive I detection and meter
ABB	PVI-3.0-OUTD-S-US-Z-M-A [240V]	3 kW, 240 Vac Grid Support Utility Interactive I detection and meter

Hawaiian Electric

QUALIFIED GRID SUPPORT UTILITY INTERACTIVE INVERTERS AND CONTROLLERS MEETING MANDATORY FUNCTIONS SPECIFIED IN RULE 14H

Last Updated: 10/29/2021

The following list of certified advanced inverters has been approved by the Companies for use with the Net Energy Metering (Rule 18), Customer Grid-Supply (Rule 23), Customer Grid-Supply Plus (Rule 24), Smart Export (Rule 25), and Standard Interconnection Agreement programs. The equipment manufacturers represent that the designated models with associated firmware have been formally certified to Underwriters Laboratories Standard 1741, Supplement A ("UL-1741 SA") per the Companies interconnection requirements.

Technology Type	Manufacturer	Model	Firmware Version
Inverter	Apparent Energy	SG424U HI 120VAC	313, Profile #12 ATIRA5488
Inverter	DAIHEN Corporation	B25OUHL2-A01	8.0
Inverter	Darfon Electronics	H5000 may be followed by one character	INV DSP: INV 1.2; DD DSP: DD 19.4; EEROM: EE 1.0; DIS DSP: DIS 3.1; Photo: PH 1.0 Heco1: Oahu, Maui and Hawaii Island. Heco2: Molokai and Lanai.
Inverter	Darfon Electronics	H5001 may be followed by one character	INV DSP: INV 1.2; DD DSP: DD 19.4; EEROM: EE 1.0; DIS DSP: DIS 3.1; Photo: PH 1.0 Heco1: Oahu, Maui and Hawaii Island. Heco2: Molokai and Lanai.
Inverter	Darfon Electronics	HB51 may be followed by six characters	INV DSP: INV 1.2; DD DSP: DD 19.4; EEROM: EE 1.0; DIS DSP: DIS 3.1; Photo: PH 1.0 Heco1: Oahu, Maui and Hawaii Island. Heco2: Molokai and Lanai.

Grid

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Also in IEEE 1547-2018

- Volt-var autonomous Vref
- Other voltage regulation modes
- ROCOF and phase jump ride-through
- Power Quality
- Islanding (Microgrids)
- Fault current characterization

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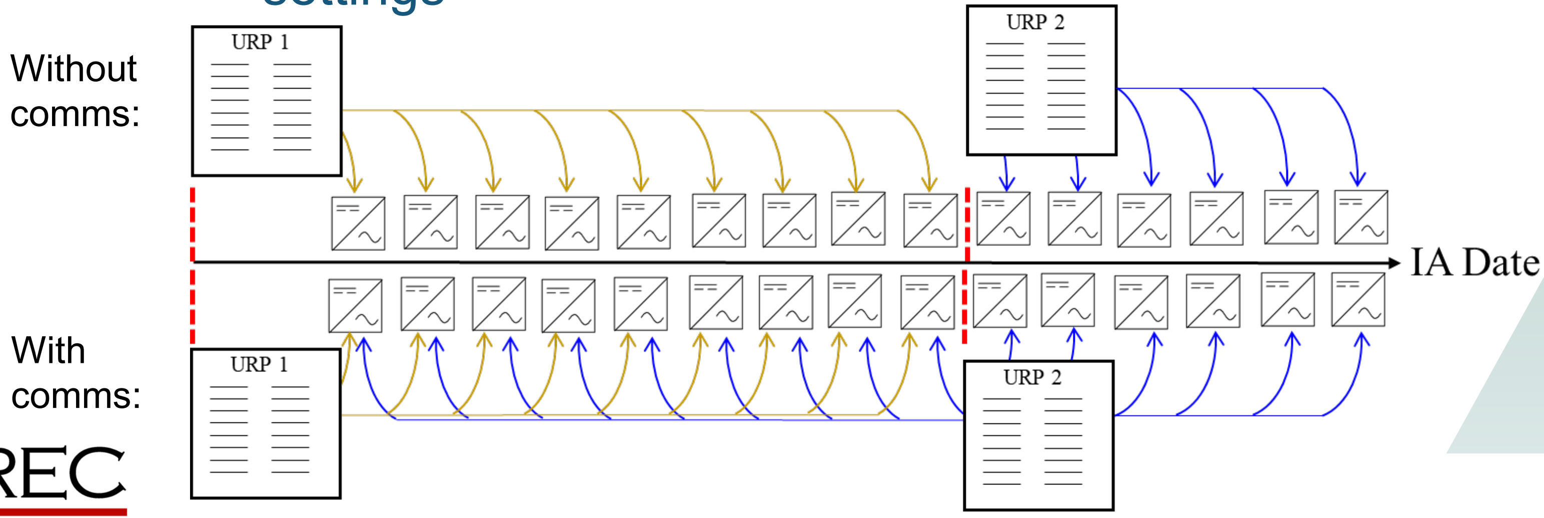
Retro-active enablement

- CA found "natural turnover" to be preferred to requiring/stimulating smart inverter updates
- HI intends to only use communications to deploy new settings



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Voltage Regulation Function Considerations

Voltage regulation considerations

- IEEE 1547-2018 default is the constant power factor mode with PF=1
  - i.e., **no reactive power = no voltage support**
- States/utilities to clarify which voltage regulation function DERs should use; adjust from Standard defaults accordingly
- Potential for DER customer impacts

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Why early adoption of voltage regulation functions?

- Certain DERs can connect to the grid where once they couldn't (w/o upgrades)
- Increase hosting capacity of a circuit
- Functions are optimized if all or most DER systems participate in voltage regulation
- Effectiveness dramatically reduced if adopted after higher DER penetration

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How will 1547 functions impact the customer?

- Curtailment
  - Headroom loss
    - reactive power functions (most likely de minimis)
  - Curtailment functions
  - **volt-watt**
  - frequency-watt (most likely de minimis)
  - control (max active power limitation)

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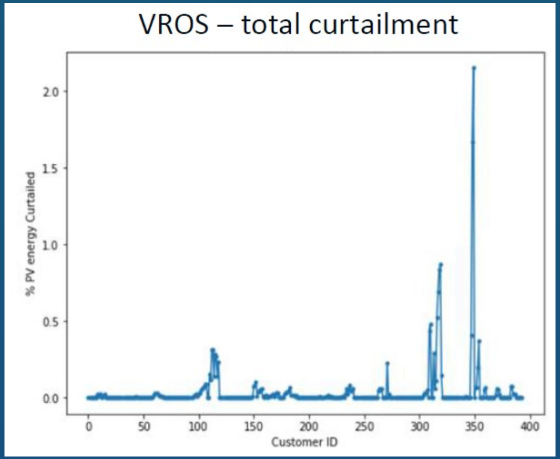
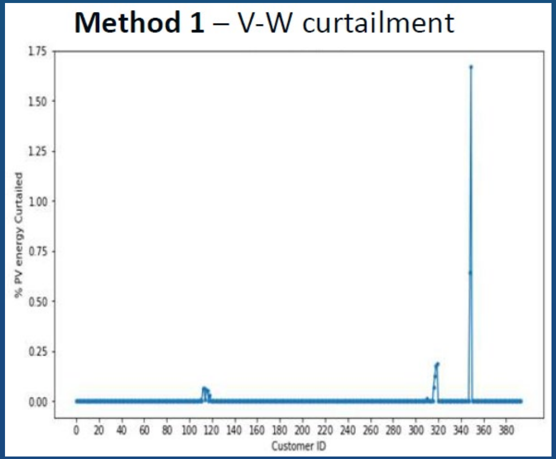
Voltage complaints and reporting

- Ensure complaint process handles DER complaints appropriately
- Consider reporting on how many voltage-based curtailment issues arise
- Consider metric based on voltage data to determine potential for curtailment





Credit: NREL

Key Takeaways

Settings commissioned today will be challenging to change for the next 20 years

Voltage and frequency control matters today and will matter more in the future

Ensure customers are not unduly affected by the required settings

Adopting and Implementing Smart Inverters

Adopting IEEE 1547-2018

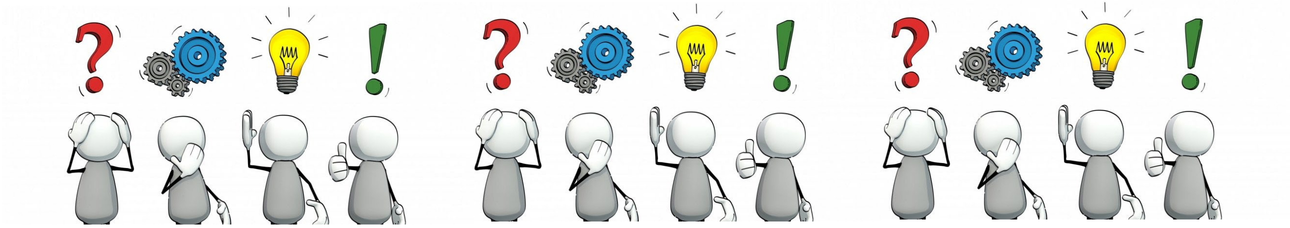
Where will the technical requirements reside?

Choose categories

Define default function states (or not)

Define default settings (or not)

Determine timeline for implementation



Adopting IEEE 1547-2018

Also:

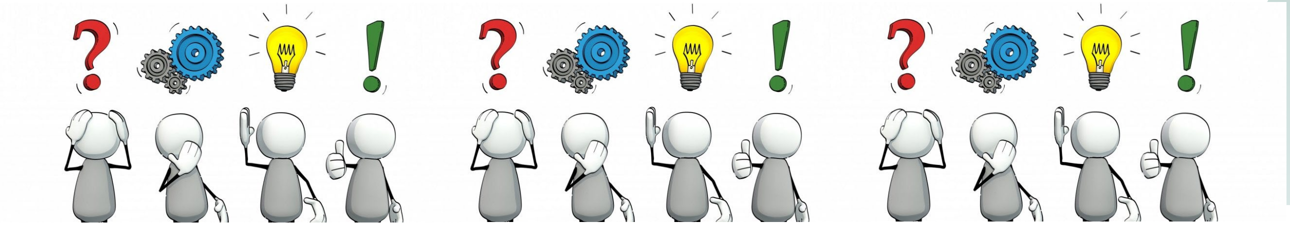
Communications (capability vs utilization, pathways, protocols)

Process updates (mitigations, settings changes/selection)

Interconnection Agreements

Applications

Related processes (e.g. voltage complaints for DER, HCA)



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Details, details

- Reference Point of Applicability– application?
- Voltage requirement changed from “Range A” to “C84.1”
- New RVC, Flicker requirements (check Supplemental Review references, esp.)
- Non/limited export (for RPA, volt-watt, limit max active power, networks)

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Adoption/Implementation Challenges

- Details
- Expertise level
- Having time/resources to have utilities analyze options
- Getting it all done at once

Implementation Examples

- MN: Detailed reference, tech req's only, default constant PF + VW, clean up items, comms capability only
- MD: Compliance date only for inverters, technical req's TBD
- HI: General reference (+SRD), tech req's and process, default VV, VW optional, no new comms, +URP
- CA: Detailed ref/full spec, tech req's and process, default VV+VW, comms uses 2030.5 but not implemented

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Key takeaways

- Stakeholder group
  - Ensure regional reliability coordinator input
  - Existing interconnection working groups can work well, but broad participation can generate support and catch other issues
  - Ensure a common understanding of the Standard, deal with differing interpretations
  - Iterative process may be required to address all issues
- Voltage regulation
  - Studies/modeling may be needed to determine best fit default settings
  - Plan for field data collection and review to analyze/adjust in future
- Communications
  - Implementation is laborious, important to get right
  - Systems that require comms should be able to comply with standardized protocols

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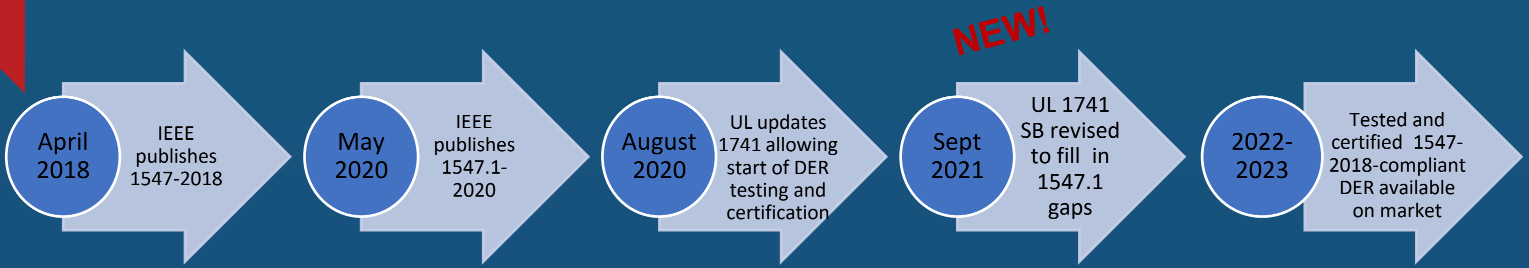
Timeline to compliance



MD: January 1, 2022 …extending

HI: January 1, 2022 …extending (currently April 1, 2022)

LIPA: January 1, 2022 …extending

MN: “such time the equipment is readily available”

CA: Proposed Nov 1, 2022, but reviewing

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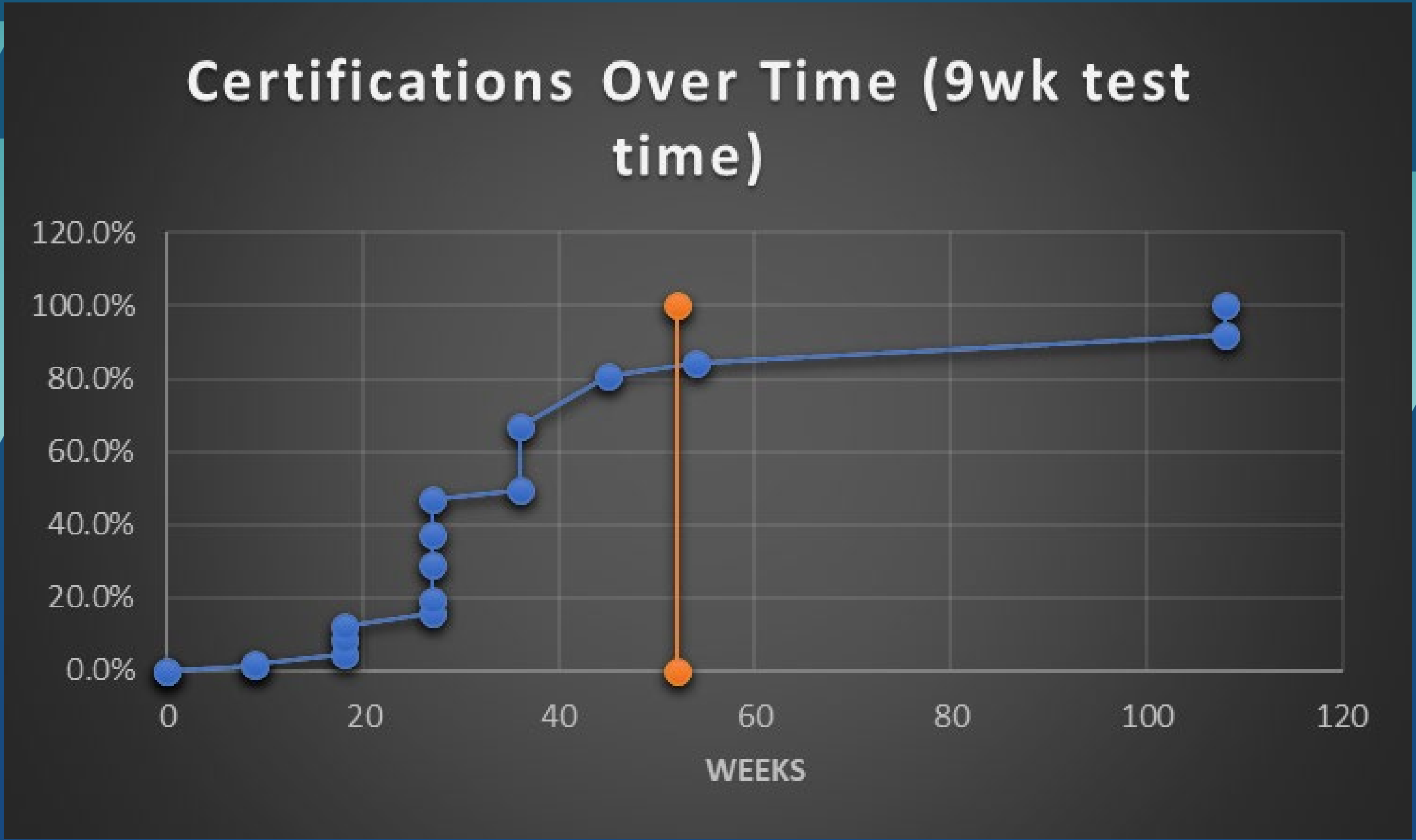
Basic Components of Timeline

- Testing
- Issuance of Certificate (~1-2 weeks)
- Qualified Equipment List (1 month ?)
- Shipping logistics (2-6 months, 3 typical)



Certifications Over Time (9wk test time)
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
0
20
40
60
80
100
120
WEEKS

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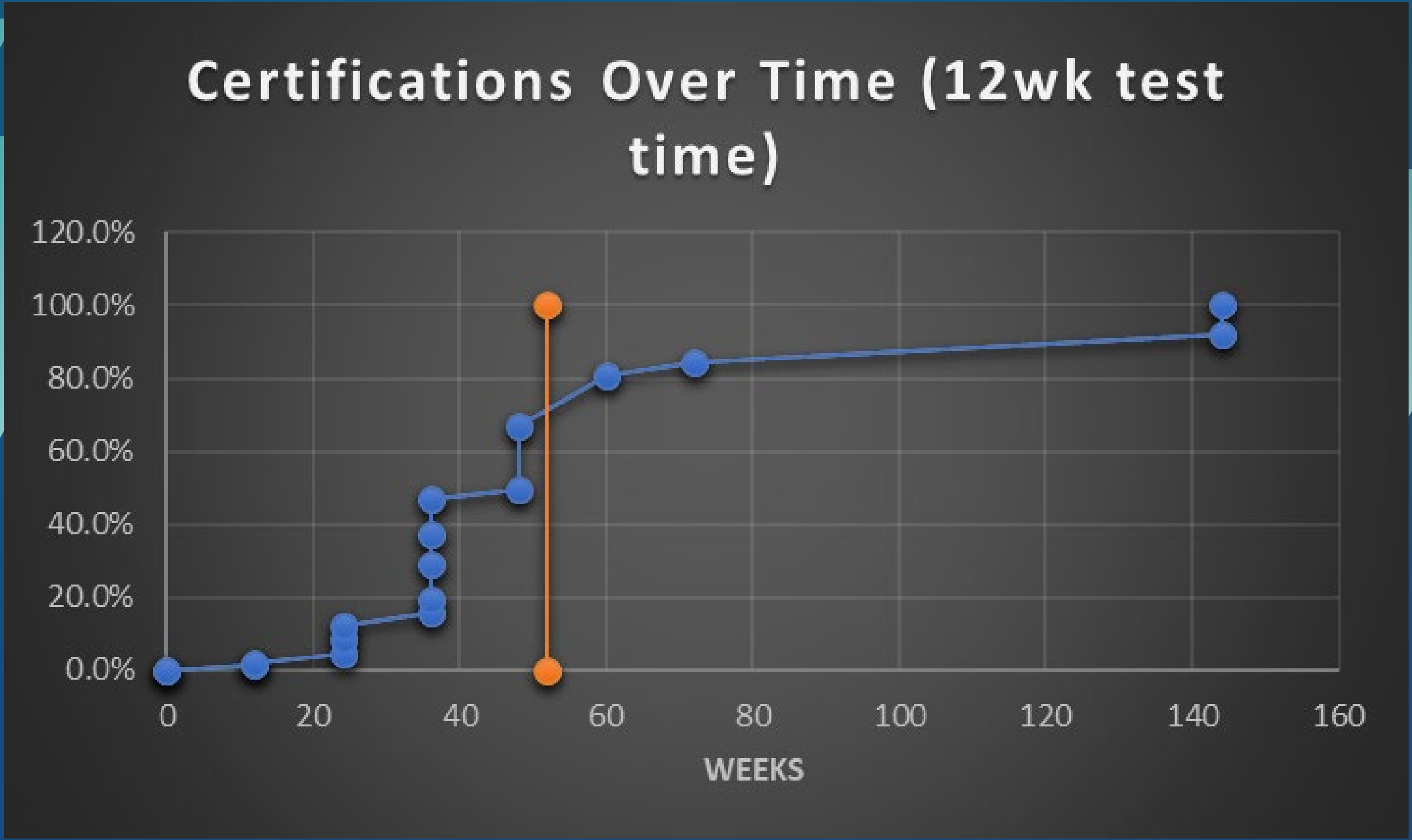
Certifications Over Time (12wk test time)
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
0
20
40
60
80
100
120
140
160
WEEKS

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What should timeline be?

- Add ~18 weeks to test time (certificate/listing/logistics)
- Uncertainty in actual timeline
- SA is similar functionality to SB
- Is a date certain necessary?

Thank you!

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