CSIRO AEMO Roadmap

Professor John Fletcher

Director – Digital Grid Futures Institute

Electrification Lead: Trailblazer Clean Technology and Recycling

Electrification Lead: NSW Government Decrabonisation Inovation Hub

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Purpose – Australia's GPST Roadmap

Topic 1

Inverter Design

Topic 2

Stability Tools and Methods

Topic 3

Control Room of the Future

Topic 4

Planning

Topic 5

Restoration and Black Start

Topic 6

Services

Plus

Australian-specific research areas

Topic 7

Architecture

Topic 8

Distributed Energy Resources (DERs)

Topic 9

DERs and Stability

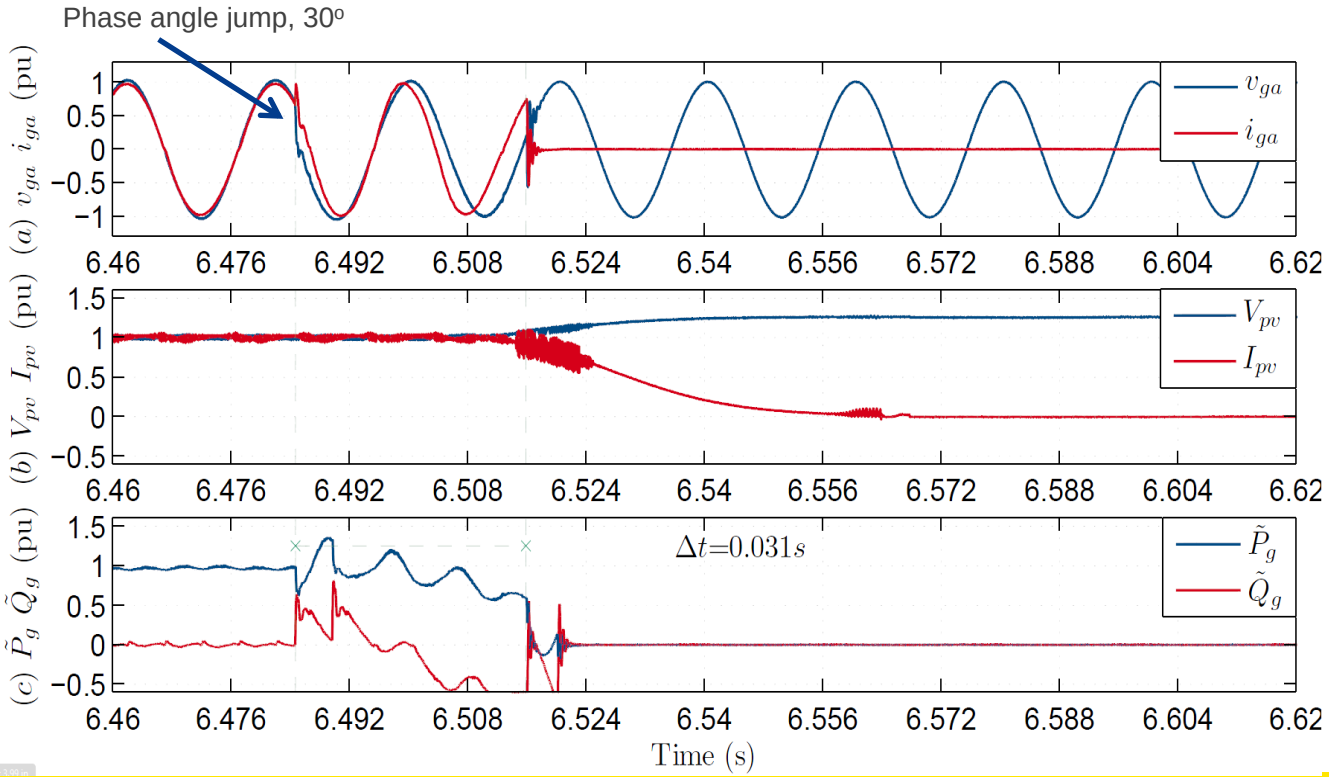
Australian-focussed Topics

Rooftop Inverters Mis-Behave

AC side

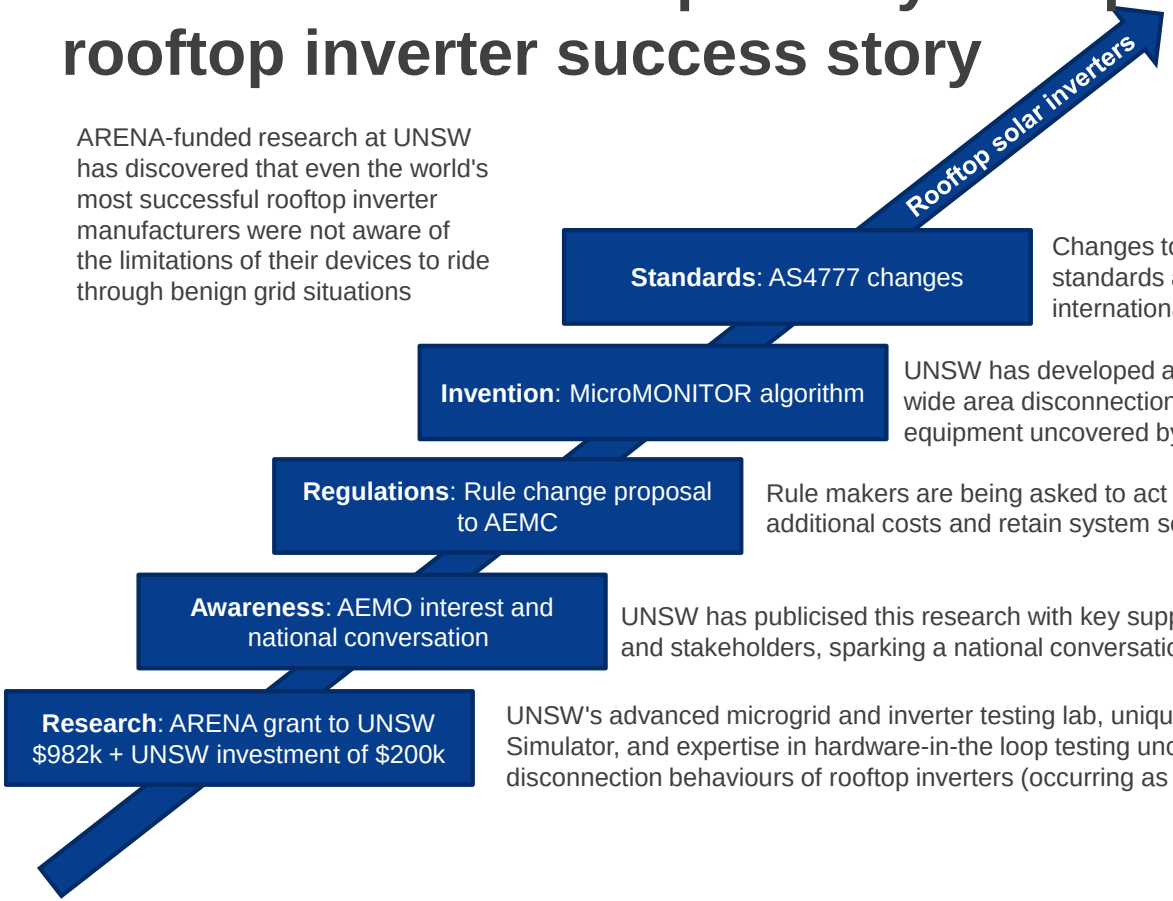
DC side

AC side



Australian research pathway to impact: rooftop inverter success story

ARENA-funded research at UNSW has discovered that even the world's most successful rooftop inverter manufacturers were not aware of the limitations of their devices to ride through benign grid situations



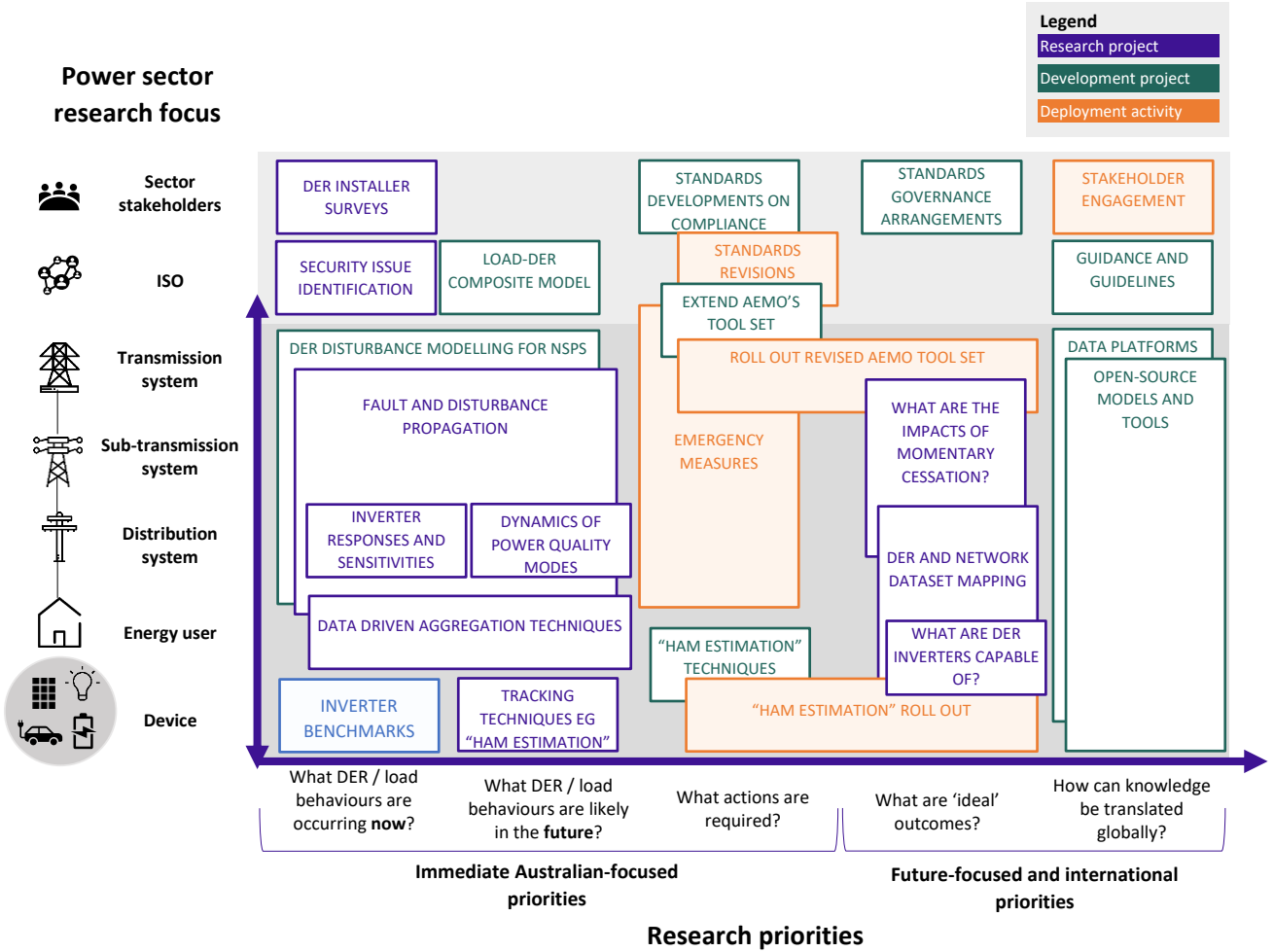
What are we proposing?

A multi-faceted approach that focuses on early deployment of improved models that the transmission network operators and market operators can use that capture IBR responses.

- Develop an improved load-DER model tool set that supports AEMO's development of TNSP models
- Expand UNSW's inverter benchmarking: market share is fluid, changing, 'stranded'
- Start benchmarking portfolios of three-phase inverters, hybrid- and storage-only inverters, EV chargers, inverter-based loads
- Assess the impact of AS4777.2020 on inverter performance
- Further develop our excellent CHIL and PHIL capabilities to assess inverter controller response to grid disturbances.

Research landscape

- Build a (more) complete picture of DER disturbance response risks
- Identify key research priorities
  - Immediate Australian focused priorities
  - Future focused and international priorities

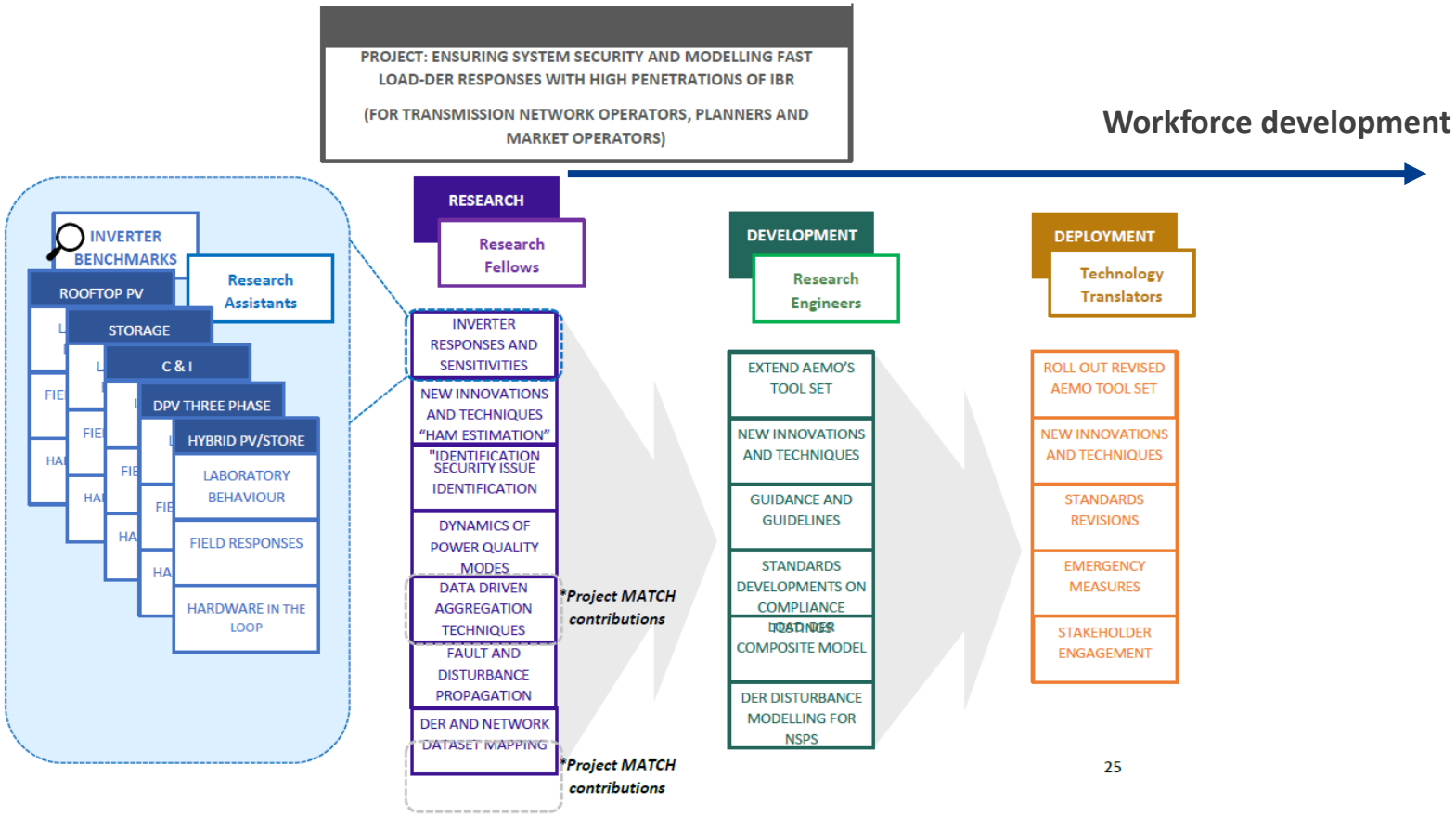


Why this research is essential?

- The growth of inverter based resources (IBR) will continue unabated if we are serious about removing emissions from our growing electrical energy system
- AEMO and other stakeholders need the tools to model all the different timescales and response times associated with IBR and understand performance ‘on aggregate’
- Load-DER Composite Models will need to adapt and change continuously during the transition
- The impact of large signal responses of inverter based-resources will remain a security issue now and into the future

The objective is to ensure that ISOs and TSOs have appropriate and verified models to maintain power system security under very high penetrations of IBR such as distributed PV, energy storage, and other resources including inverter-based demand.

Figure 9 – Research Program overview: Research and Development supporting Practical Deployment



Outcomes

- Continued development of AEMO's toolset
- Research/develop/deploy new technologies to solve problems
- Support Standards revisions and Emergency Measures by identifying security issues related to IBR behaviours
- Continue to educate, train, disseminate findings nationally and internationally

Australia is uniquely placed to deliver valuable insights to ISOs and TSOs internationally, due to its distant and poorly-interconnected power system and substantial, if not world-leading, deployment of distributed solar PV systems, as well as a growing fleet of distributed battery energy storage systems.

Topic Links

Australian GPST Topic ("Identified Topic")	Relevant inputs to this proposal from Identified Topic	Relevant outputs from this proposal that inform Identified Topic
1 Inverter Design	Performance metrics: A/us, large- and small-signal current bandwidth	Response requirements
2 Stability Tools	Performance requirements of models including physical range, time granularity, small-signal response	Large-signal response of DER/IBR
3 Control Room of the Future	Definition of HMI and underpinning modelling toolset requirements	Load-IBR composite models
4 Planning	Planning tools and developments	Load-IBR composite models, security issues related to large-signal responses
5 Black start	Blackstart procedures based on Topics 4 and 7	Large-signal response of DER/IBR, start-up behaviour, standards
6 Services	Service requirements and specifications	Verification of IBR performance
7 Architecture	Proposed suite of architectures and	Load-IBR composite models, security issues related to large-signal responses,