Session 1: Oscillation Monitoring, Tracing & Mitigation in Operations

Setting the Stage

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2024 ESIG/G-PST SPECIAL TOPIC WORKSHOP

A DEEPER LOOK AT OSCILLATIONS

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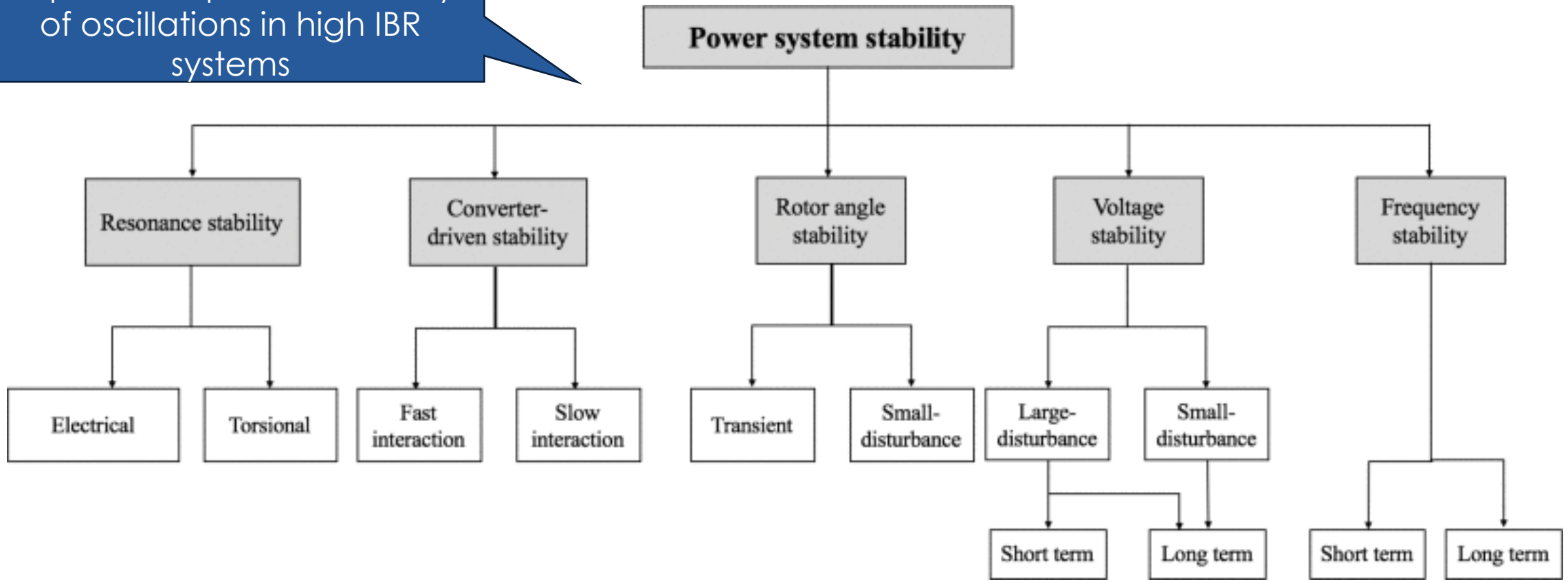
Stability: A big space.

Helpful…but doesn't quite capture the practical reality of oscillations in high IBR systems

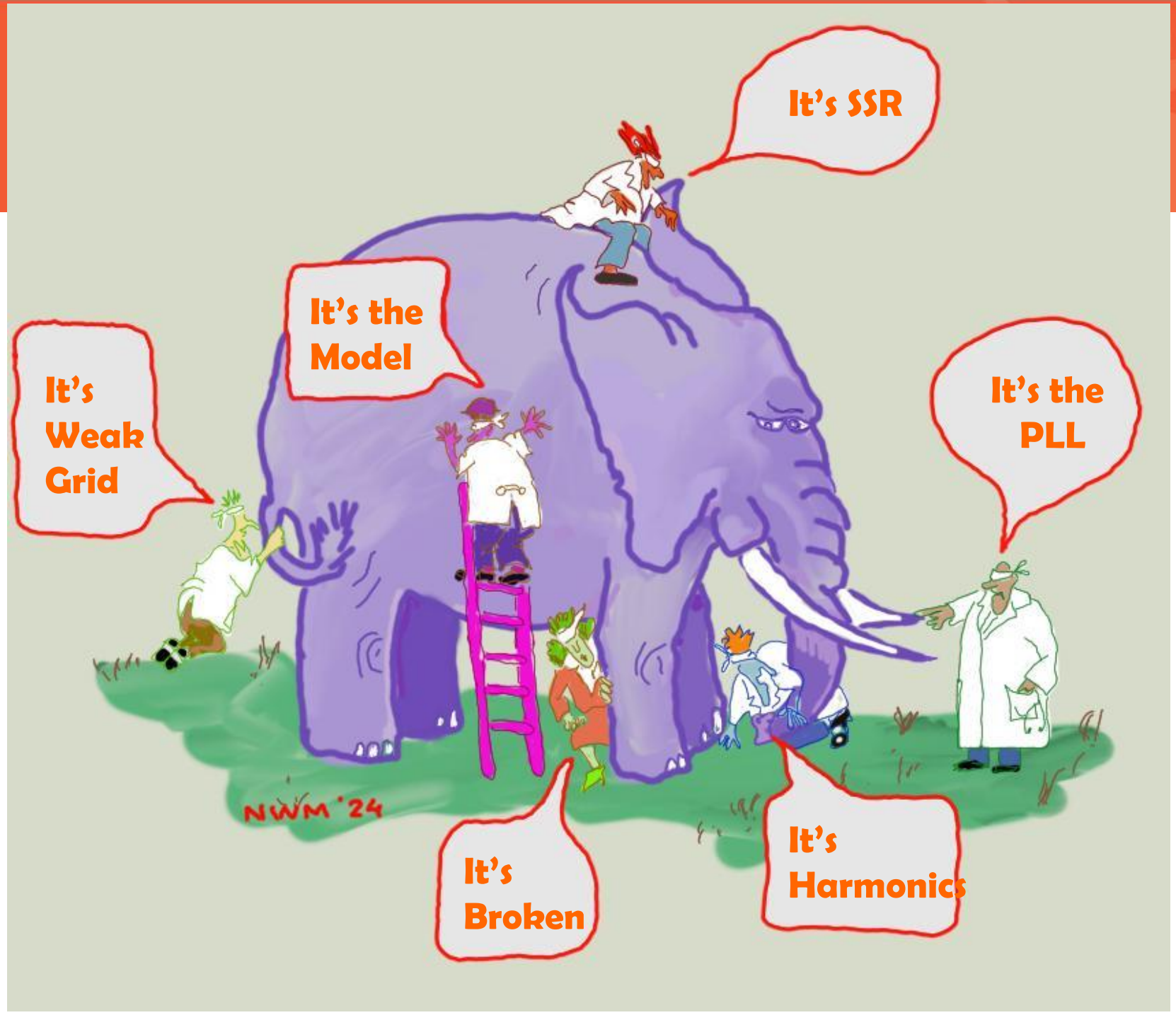


N. Hatziargyriou *et al.*, "Definition and Classification of Power System Stability – Revisited & Extended," in *IEEE Transactions on Power Systems*, vol. 36, no. 4, pp. 3271-3281, July 2021, doi: 10.1109/TPWRS.2020.3041774.

It's complicated

Practitioners and researchers have focused on many faces of oscillations with IBR involvement.

The relationships between them can be confusing.



Occam's Razor*
(The simplest explanation is usually the best one)

While this topic is complex, practical simplifications cover most oscillations:

1. **Something is broken:**
   some aspect of the installation is not what you thought it was
2. **Controls are too aggressive for the condition:**
   gains too high, time constants too short, delays too long
3. **The simulation is bad:**
   wrong or inadequate models or the wrong tool is used

Yes, there are more complicated, more "interesting" problems that get the experts and researchers excited.

But don't start there!

*Entia non sunt multiplicanta praeter necessitate: "Entities must not be multiplied beyond necessity"

Something is Broken

Such as.....

- Bad signals, e.g. switched polarity or phase rolling on signals
- Parameters like gains or ratios improperly implemented, documented or per-unitized
- Equipment in improper operating paradigm, e.g. start-up, standby, island mode, or off.
- Equipment is physically broken, such as stuck actuators, shorts, or failed circuitry

Doesn’t lend itself to simulation, as such

Need:
Tools to localize the “bad actor”

Controls are too aggressive for the condition

Simple reality, complicated mitigation. A path of increasing cost, time and complexity tends to emerge: (e.g.)

- Control setpoint adjustment; Operation or dispatch adjustment (within plant)
- Operation adjustment on host network (dispatch, topology switching)
- Control parameter modification (tuning)
- Reduction of series (or shunt) compensation levels.
- Control structure modification (e.g. POD, reduced latency, altered PLL,convert to GFM,...)
- Additional passive elements within plant (e.g. compensation, filtering, detuning of resonances)
- Additional active elements within plant (e.g. STATCOM, active filters, Storage with GFM)
- Grid reinforcement, SCR increase, addition of dynamic compensation or other active devices

Mitigation options are likely to have some negative consequences

Need:
Tools to design the “best” mitigation

Simulation is bad

- IBR model structure inappropriate for the problem
- IBR model poorly parameterized
- Choice of simulation platform inappropriate for the problem
- Network representation of inadequate scale for the problem
- Network representation poorly parameterized
- Linearization incorrect/inappropriate for the needed small signal analysis

Need:
Tools to assure good fidelity simulation results

Where are we with Oscillations?

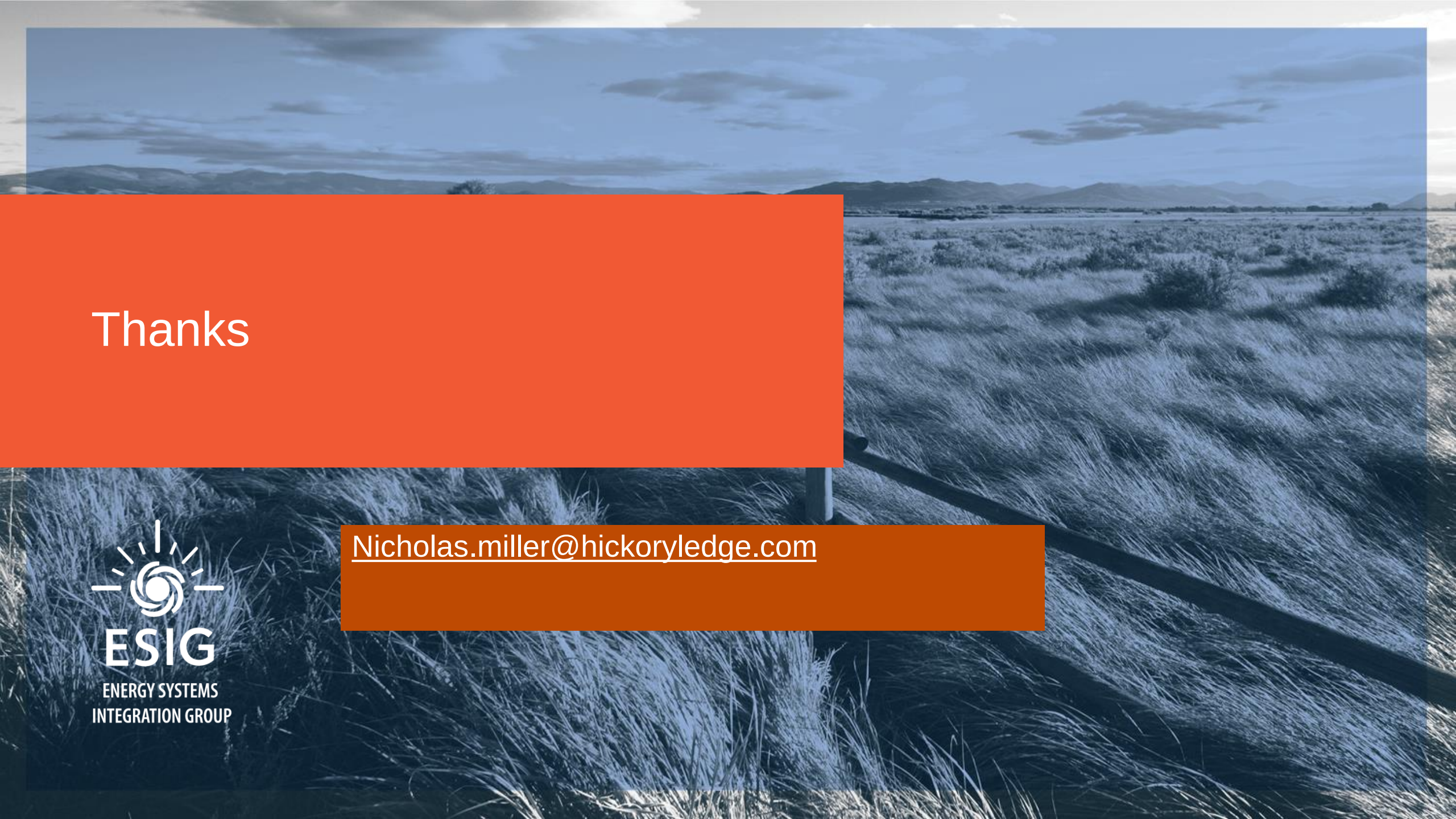
- It can be complicated, but not always
- We know and understand a lot
- But not everything

What do we need to go forward?

- Understanding
- Tools
- Technology
- Rules....

Diagnosis and Mitigation of Observed Oscillations in IBR-Dominant Power Systems: A Practical Guide

Coming soon!



Thanks

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