Renewable Energy Grid Integration: Scorecard and Roadmap

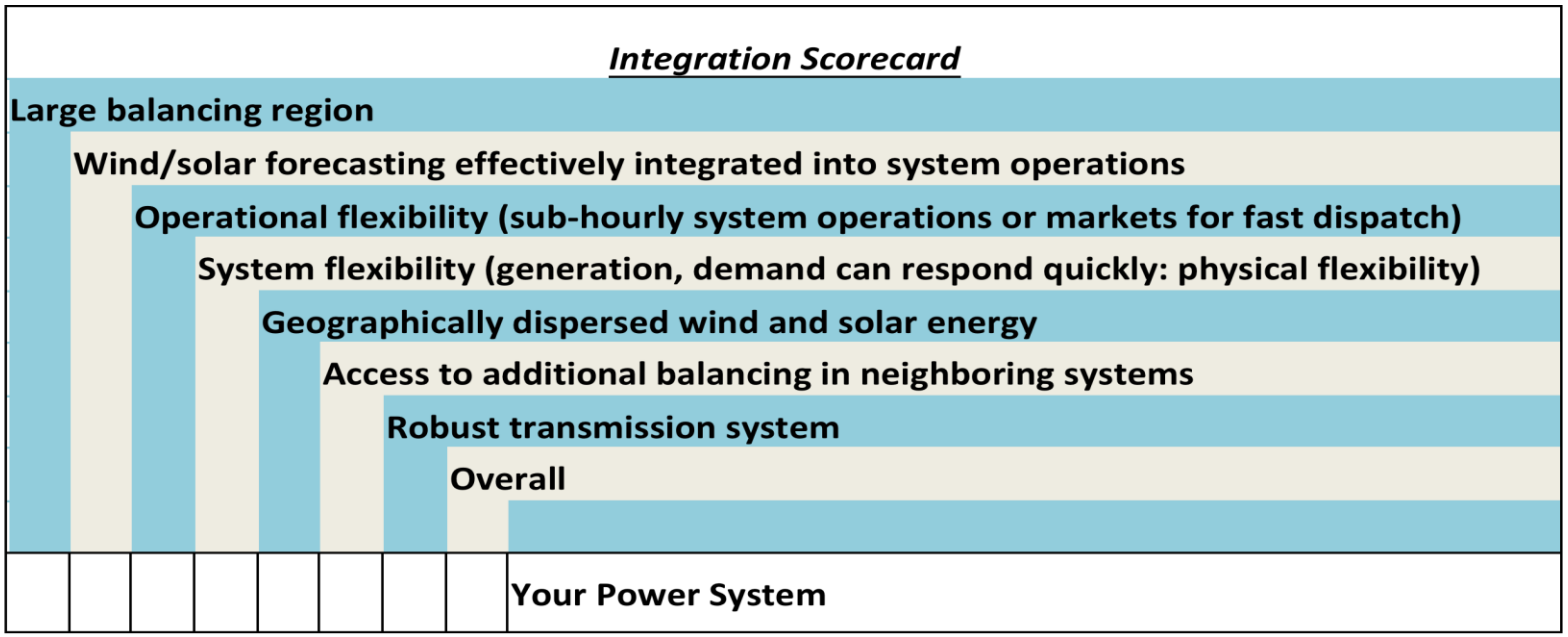
Asia Clean Energy Forum

GIZ-USAID Grid Integration Deep Dive Workshop

June 16, 2015

Part 1: Scorecard

- Purpose: characterize the flexibility of your power system
- Group **by table, by country** with a facilitator
- Complete Scorecard using “Scorecard Guidance”



What is the size of the balancing area?

3. Large (e.g., covers multiple time zones, the entirety of a medium-size country….)

2. Medium (e.g., one of several balancing areas in a medium-size country)

1. Small (e.g., island, isolated system, one of many balancing areas in a medium or small country)

How is wind and/or solar forecasting integrated into system operations?

3. Good integration— state-of-the-art forecasts are required, meets system operators' needs, and used in scheduling and dispatch decisions

2. Moderate integration—system operators have access to basic wind and/or solar forecasting data

1. No integration—no forecasting is being done or is required

How flexible is the system operator's scheduling and dispatch practice?

3. Very flexible—sub-hourly (e.g., 5 or 15 minute) dispatch is regularly… and plants respond to operational signals

2. Somewhat—system operator has 5 or 15 minute dispatch, but this is not applied to many units due to contractual agreements or other scheduling constraints

1. Not very—hourly dispatch and/or lots of scheduling constraints

How flexible are the portfolio of generation and demand?

3. Very flexible—sufficient number of plants can be started and stopped quickly and can change output quickly (natural gas plants, hydro); effective demand response programs and metering are in place

2. Somewhat—a majority of generation is dominated by inflexible plants (nuclear, run-of-river hydro), but curtailment of RE is still kept to a minimum; demand response programs may exist

1. Not flexible—portfolio of generation is not able to respond to changes in demand and no demand response programs are in place, resulting in dropped load and/or RE curtailment

How geographically distributed are wind and solar resources?

3. Very disperse—good resource sites exist in many areas and generation profiles complement each other, including near load; both wind and solar resources are strong

2. Somewhat dispersed—strong wind OR solar; good resource sites are concentrated in a few locations

1. Very concentrated—the balancing area has wind or solar in one or two locations

Do system operators have access to additional balancing resources in neighboring interconnections?

3. Yes—lots of regional power exchanges occur with neighbors, and coordinated interaction is common

2. Okay—interconnection capacity exists but not used extensively

1. No—island or isolated area; insufficient transmission capacity with neighbors; neighbors aren't much help in contributing to balancing resources

How robust is the transmission system?

3. Very robust and stable—highly redundant and interconnected, very little congestion; few network outages, strong voltage and reactive power support

2. Okay—some pockets have recurring congestion issues; the system is susceptible to contingencies

1. Not robust—transmission contingencies commonly cause blackouts; extensive congestion constraints; voltage support is weak

Part II: Roadmap Next Steps/Interventions

Purpose: Identify and sequence interventions for increasing VRE integration

Timeframes:

- Short term: 0-3 years (e.g., no new construction needed)
- Medium-term: 4-7 years (e.g., easy to build or implement: new RE generation, small generators, reconductoring lines, retrofits)
- Long-term: 8+ years (e.g., new large generation; new transmission)

Complete Next Steps/Interventions table, focusing on highest priority actions

- Refer to “Example Actions for Addressing Grid Integration Needs” if you need ideas

Specify entity(s) responsible for each action

Interventions

Short Term	Medium Term	Long Term
Action: **Entity:**		
Action: **Entity:**		

Incorporating forecasting into system operations

- Analyze whether current forecasting systems adequately forecast variable generation ramps that are anticipated under higher penetration scenarios.
- Build historical datasets for demand and variable RE to understand the distribution of variability and uncertainty across the system.
- Work with policymakers to facilitate a national network of weather stations to create historical meteorological datasets that are useful for characterizing renewable resources and forecasting future power generation.
- Work with policymakers and regulators to incentivize or mandate variable RE generators to submit accurate estimates of resource availability at a variety of time scales.
- Explore with policymakers the development of a national network for the development of centralized forecasts.

Implementing Faster Dispatch and Scheduling

- Explore sub-hourly dispatch and intra-hour scheduling.

Expanding Balancing Area Size and Coordination

- *Reserve sharing*.
- *Coordinated scheduling/interchange*
- *Consolidated operation*

Increasing Flexibility from Conventional Generation and Demand Response

- Address minimum conventional generation levels.
- Consider using conventional power plants and pumped hydropower optimized to flexibility needs instead of its traditional use as a peak/off-peak resource
- Upgrade/expand hydropower facilities
- Incorporate DR/Storage into integrated resource planning Contract with large customers to provide interruptible load
- Explore ratemaking practices

Enhancing the Geographic Distribution of Wind and Solar

- Update/establish resource assessments that are not adequate.
- Incorporate wind and solar considerations into transmission expansion planning

Strengthening the transmission system

- Consider augmenting the transmission system to expand transmission line ratings and/or enhance network connectivity (add new lines)
- Improve contingency/reliability constraints in dispatch models
- Assess the feasibility of smart network technologies such as dynamic line rating systems and advanced management practices, which can minimize bottlenecks and optimize transmission usage.

Discussion

What are your team’s top 1-3 next steps?

Scorecard Results

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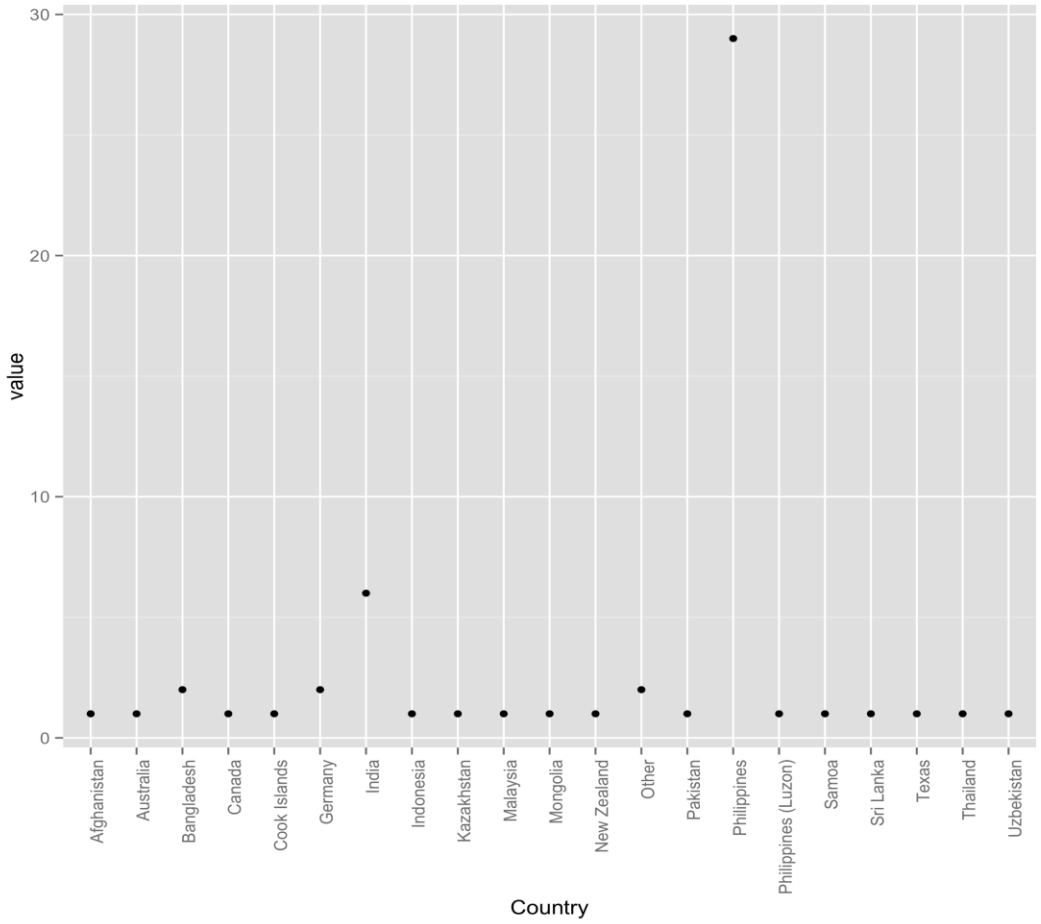
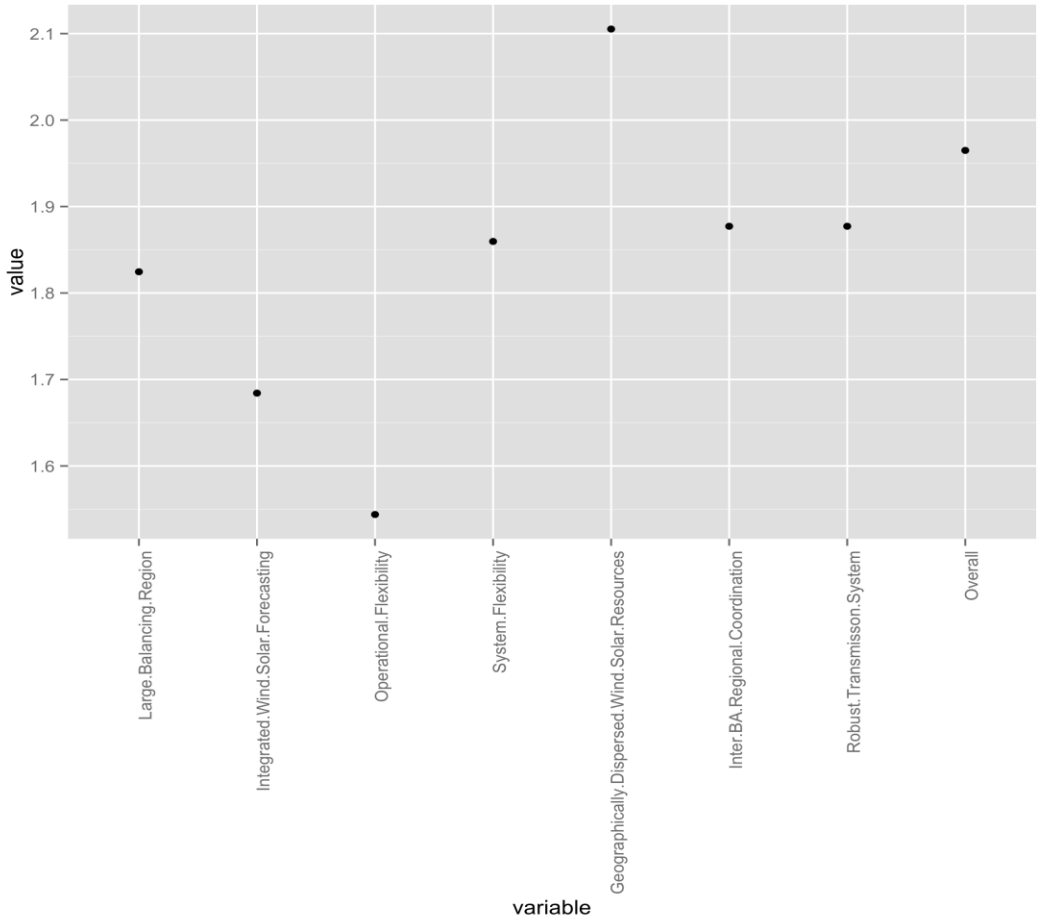
vRE Grid Integration

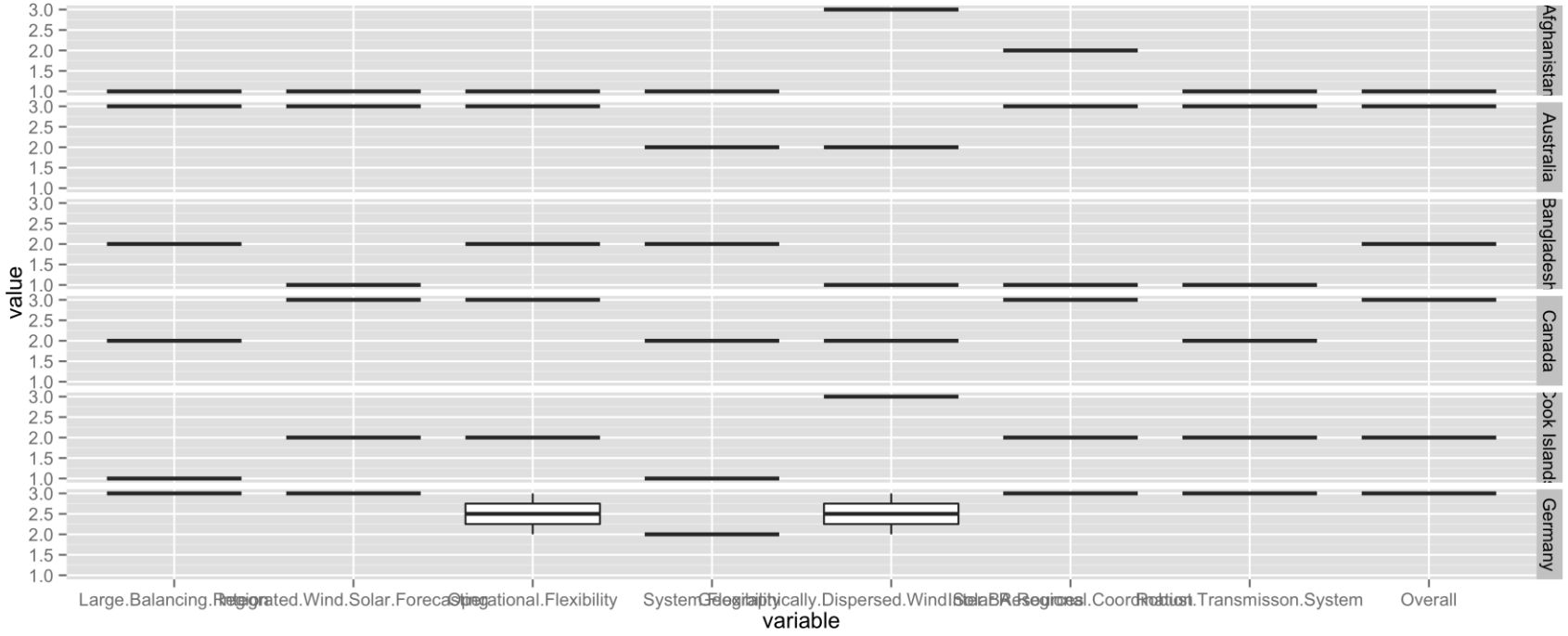
57 Total Responses



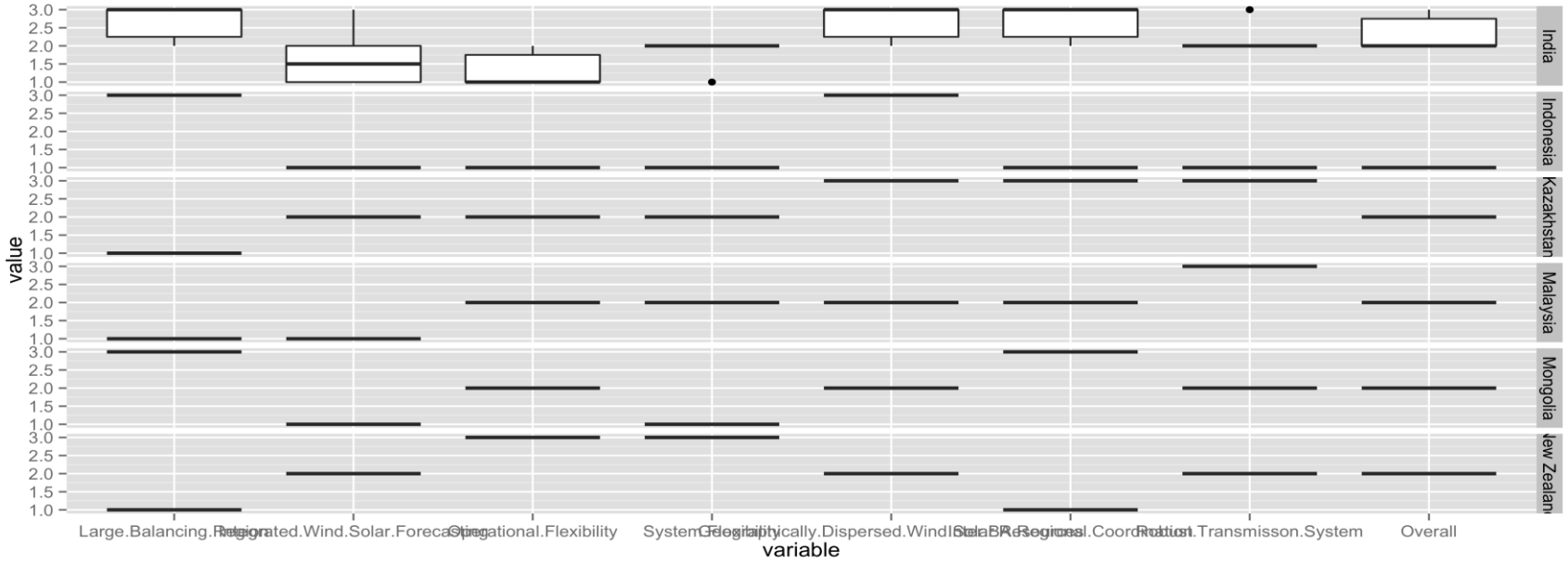
Average Values



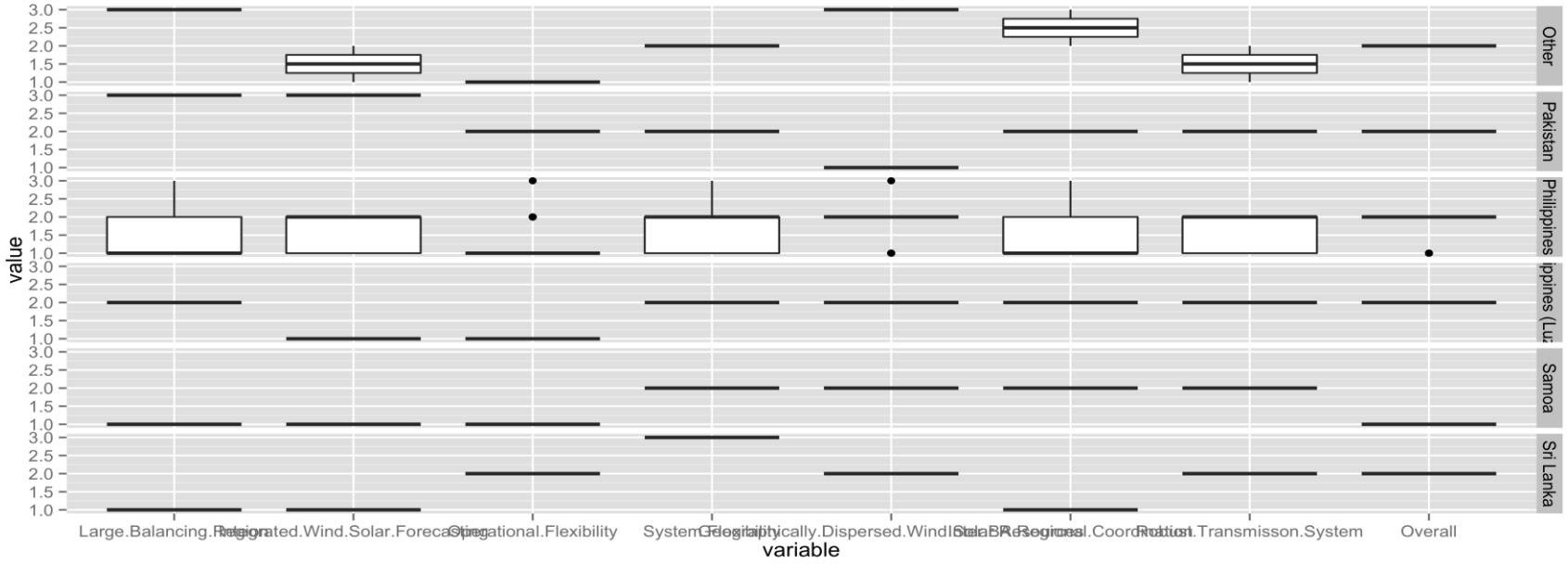
Responses from each country/system

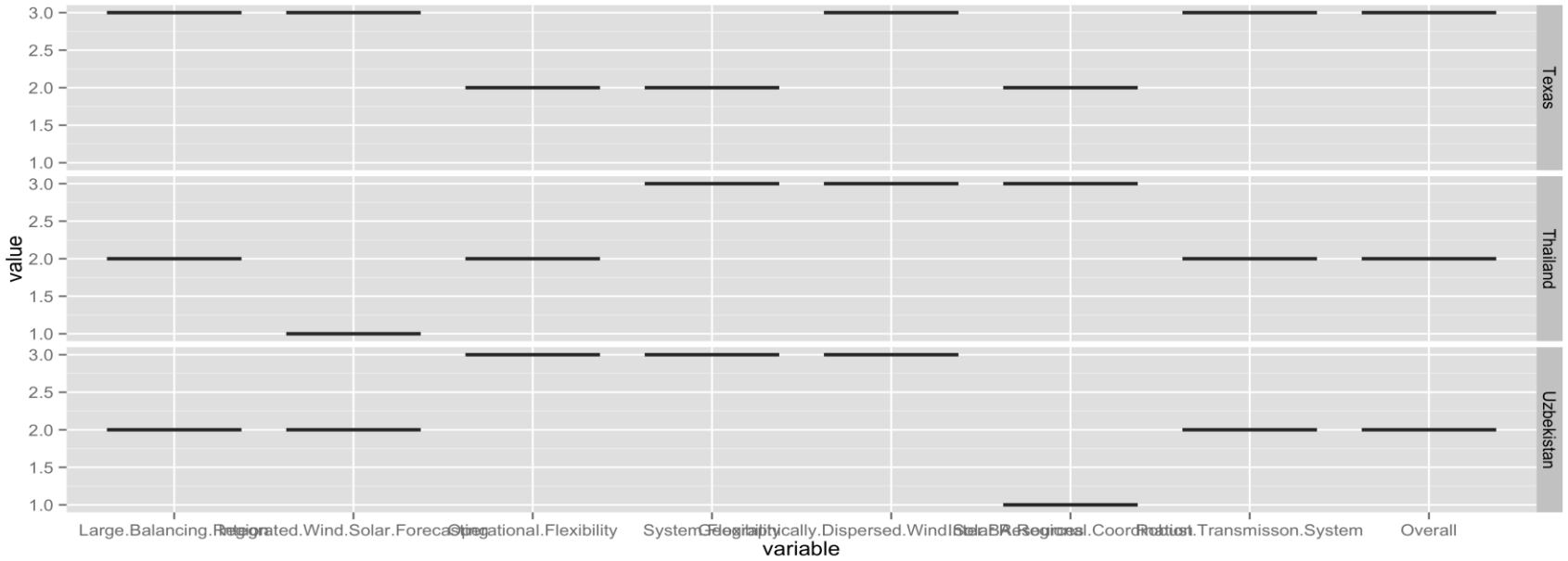


Responses from each country/system



Responses from each country/system




value
3.0
2.5
2.0
1.5
1.0
Texas
Thailand
Uzbekistan
Large.Balancing.Regions
Aggregated.Wind.Solar.Forecasting
Operational.Flexibility
System.Flexibility
Geographically.Dispersed.Wind.Solar.Resources
Regional.Coordination
Robust.Transmisson.System
Overall
variable