Experiences with Grid Integration of Wind Power in the Philippines

Wind Power: Accelerating Deployments in Emerging Wind Markets

Asia Clean Energy Forum

6 June 2016

National Grid Corporation of the Philippines

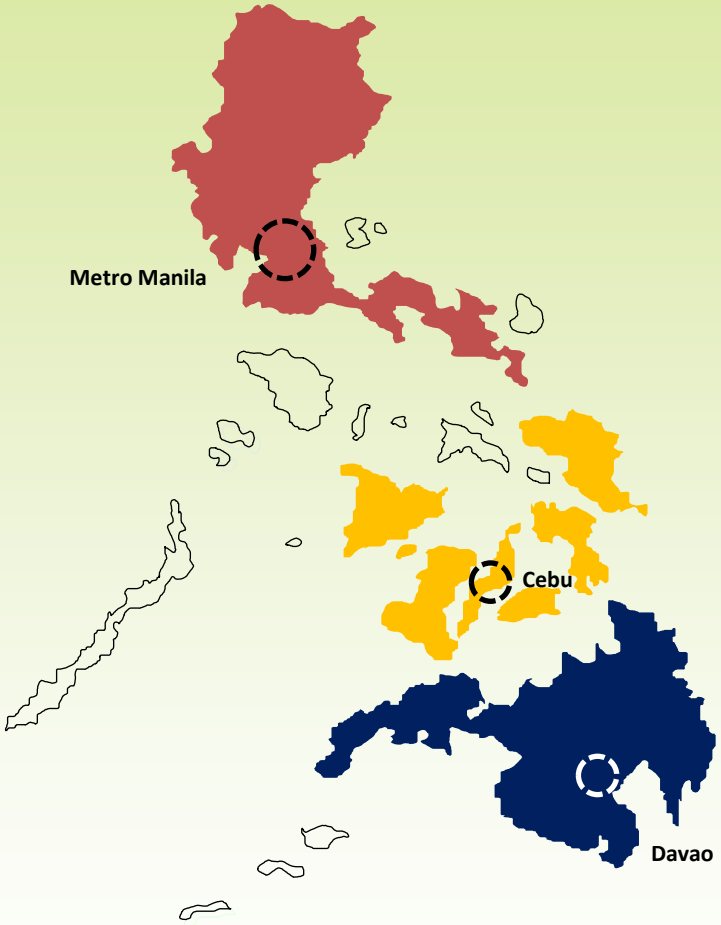
NGCP

Stronger transmission
for a stronger nation.

Outline

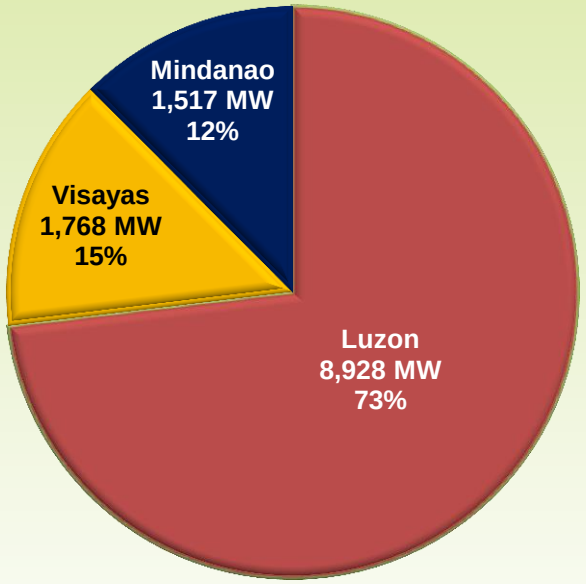
1. Philippine Power System Background
2. Challenges on Wind Power Integration
   a) Remoteness of VRE
   b) Breach of Frequency Limits
   c) Forecast Errors
3. Renewable Energy Integration Study Results
   a) On Variability
   b) On Limited Predictability
4. Recommendations for successful RE Integration

System Peak Demand



Year 2015 Total Demand:

12,214 MW



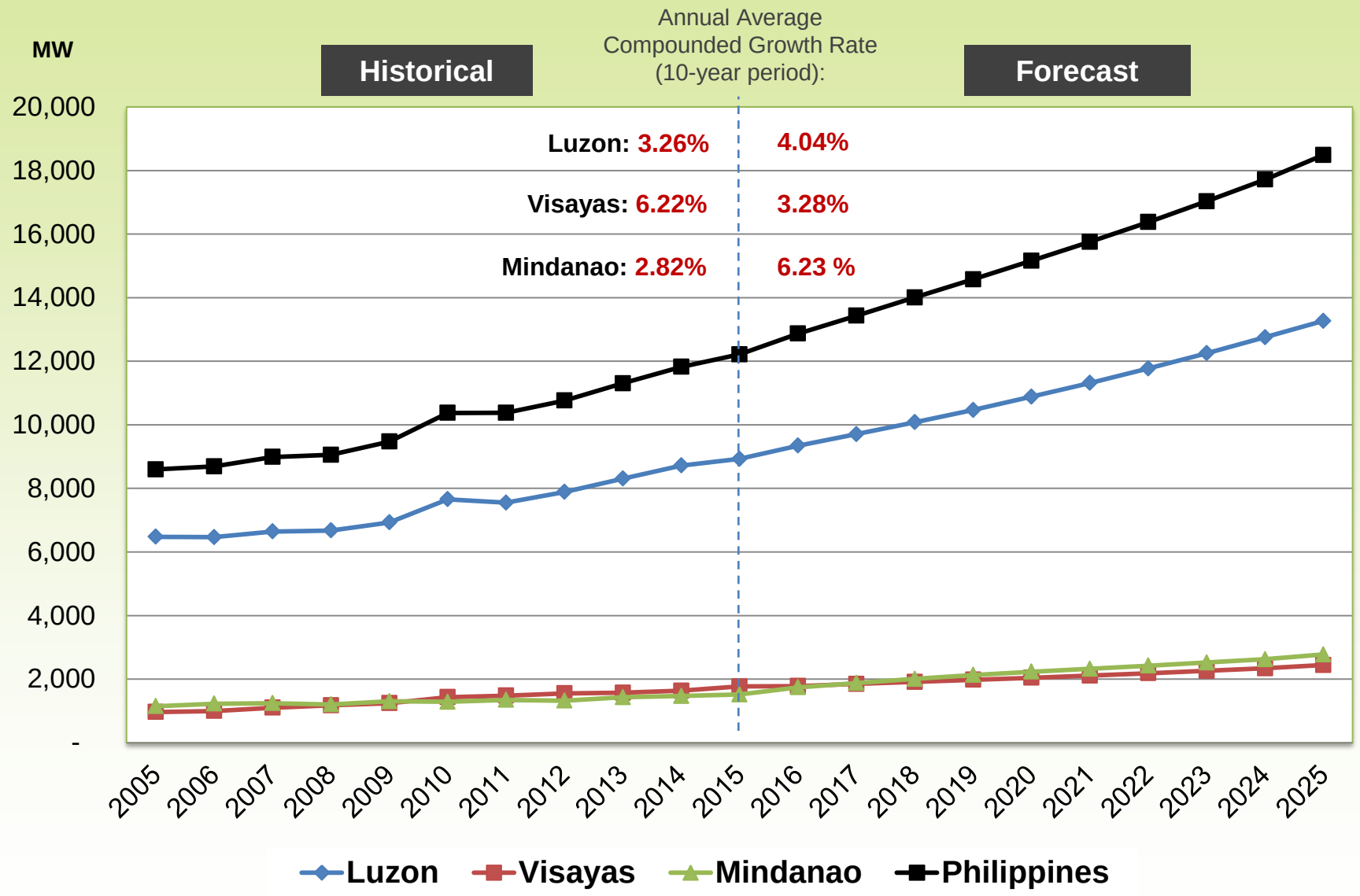
Load Distribution among the Main Grids

Note: Transparent islands in the above map are not covered by NGCP's present network.

Based on NGCP-SO recorded total demand (non-coincident**)**

System Peak Demand

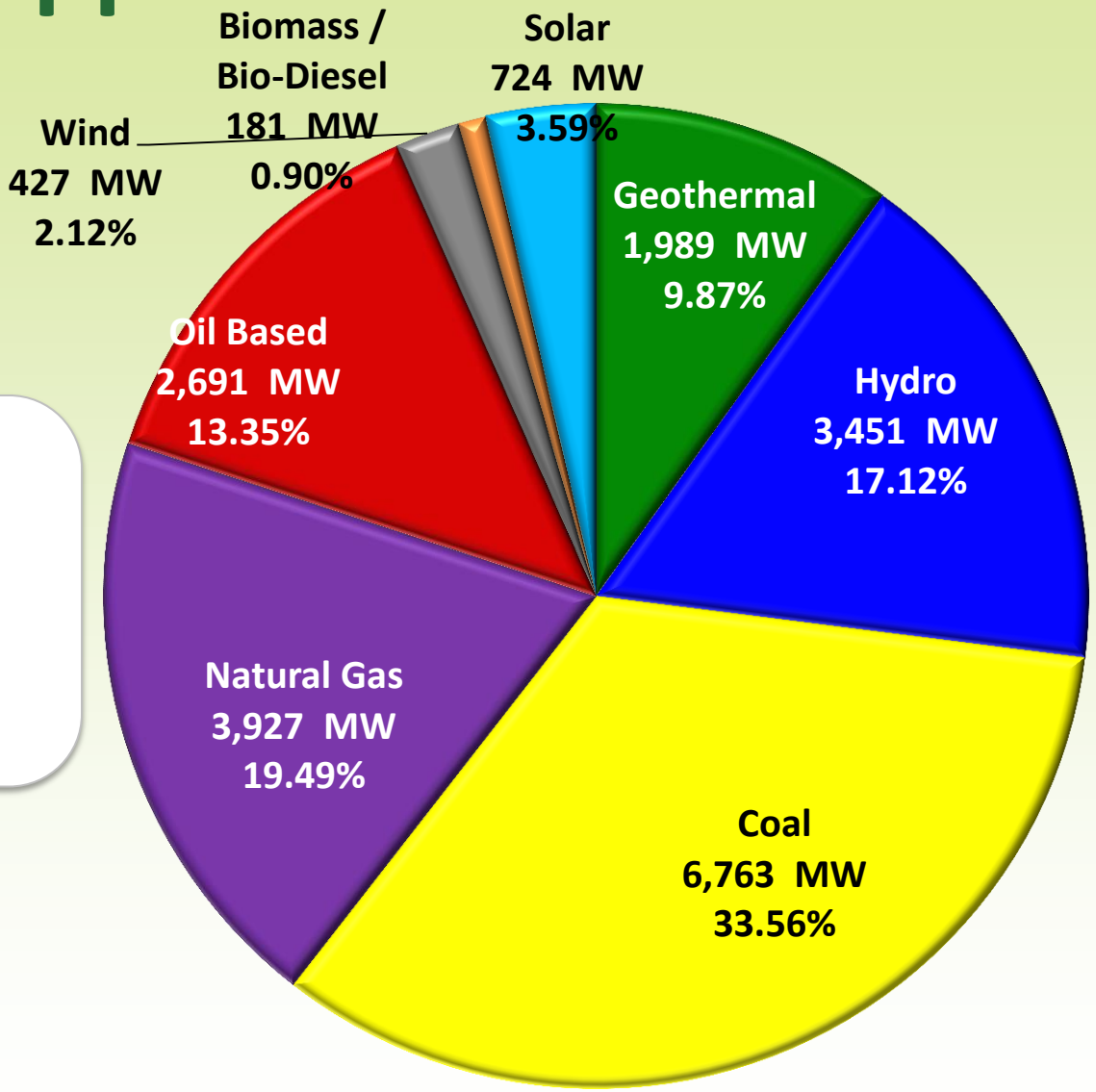
Based on DOE's Forecast as of Sep 11, 2015



NGCP

Stronger transmission for a stronger nation.

Philippine Generation Mix



Total Installed Capacity:

20,154 MW

*As of April 30, 2015

Variable Renewable Energy (VRE) Portfolio

Wind

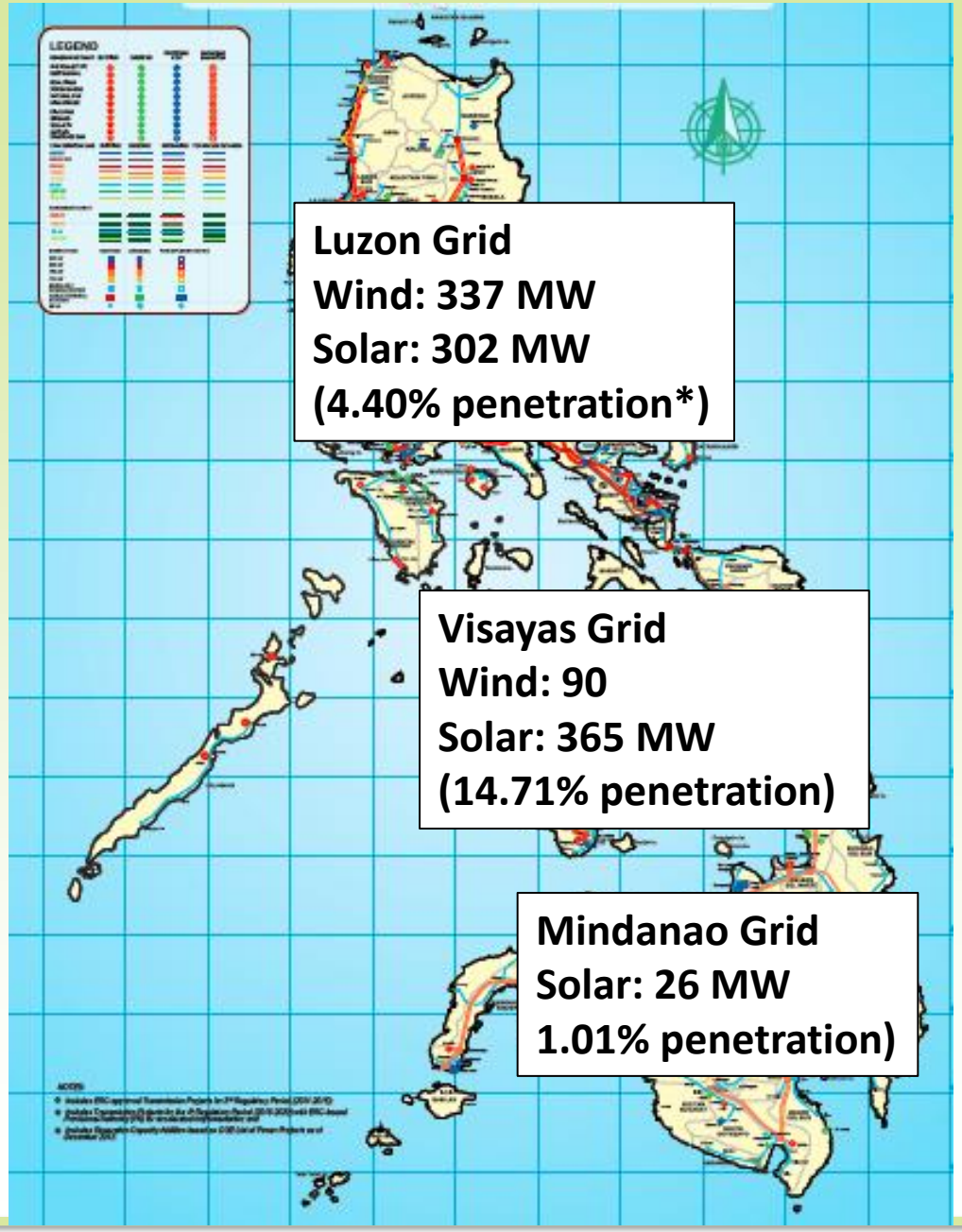
Target: 2,345 MW by 2030

Total Installed: 427 MW

Solar

Target: 500 MW by March 2016 and 1,528 MW by 2030

Total Installed: 693 MW



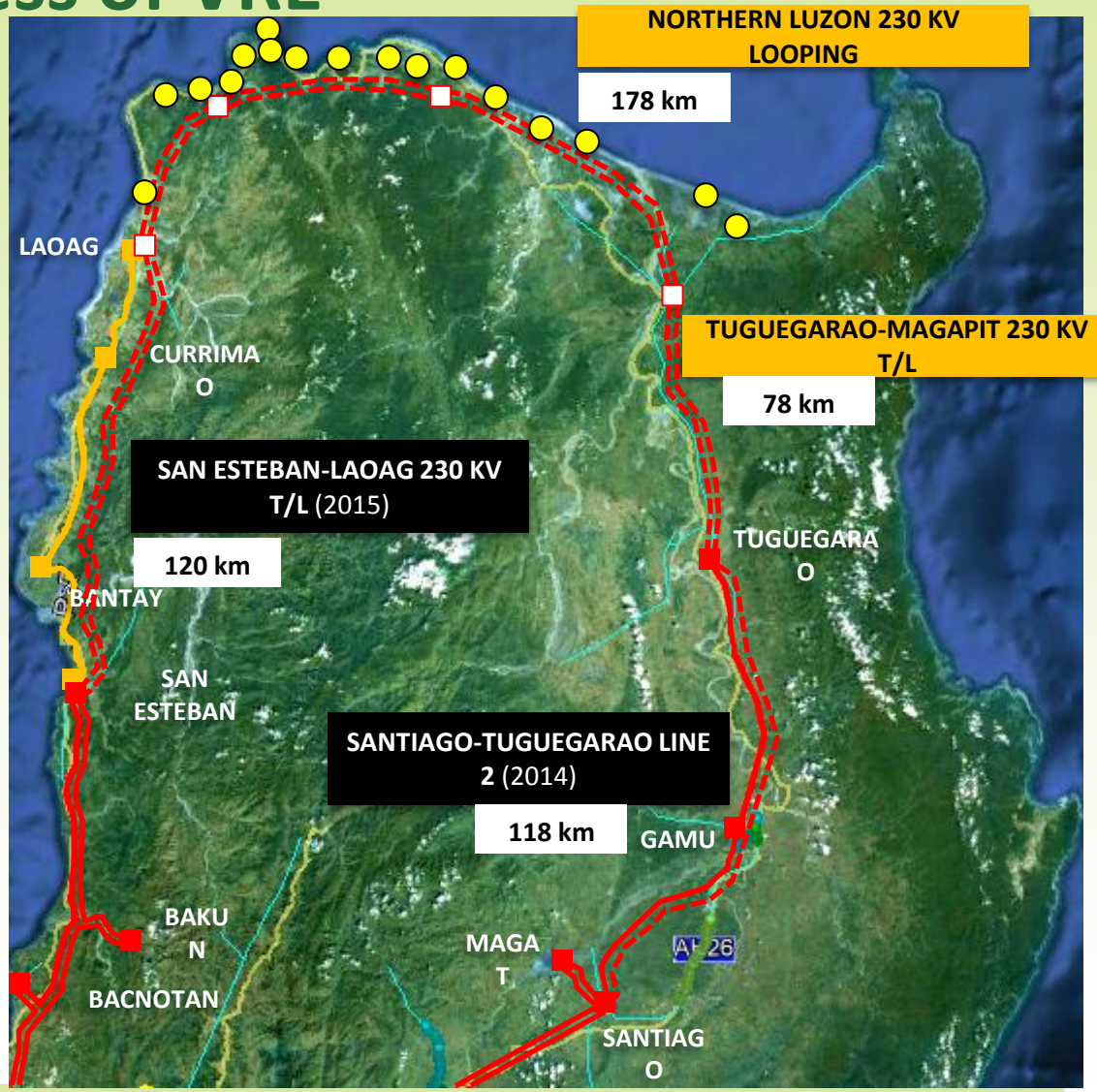
*installed capacity penetration

NGCP

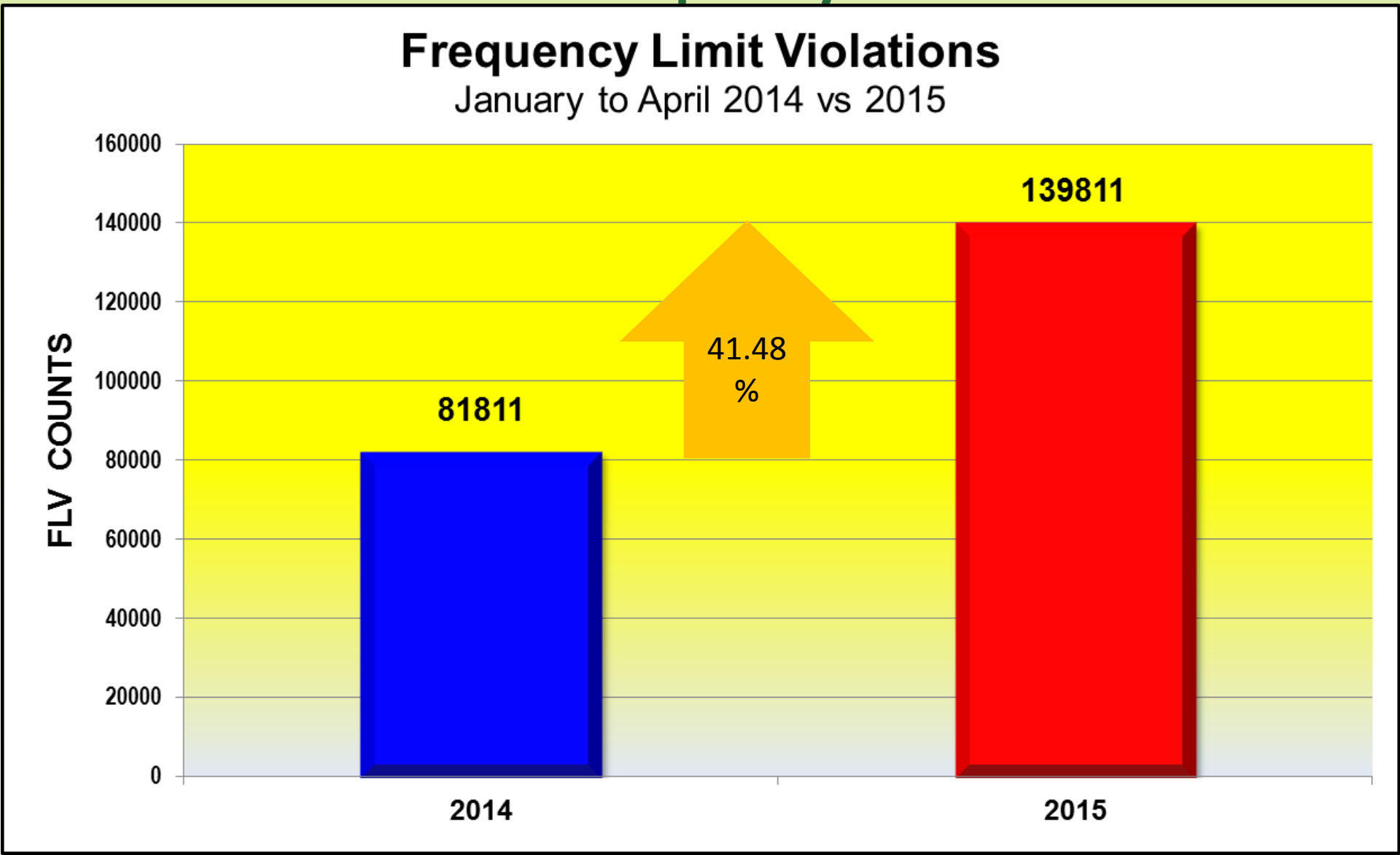
Stronger transmission for a stronger nation.

Challenges on Wind Power Integration – Remoteness of VRE

- Wind power is highly concentrated along the northern coast in Luzon where local electricity demand is low
- NGCP recently completed the first 230kV transmission extension dedicated on the northwest tip of Luzon and there is still 260 km remaining



Challenges on Wind Power Integration – Breach of Frequency Limits



NGCP

Stronger transmission
for a stronger nation.

Challenges on Wind Power Integration – Breach of Frequency Limits(cont'd)

Possibly causes:

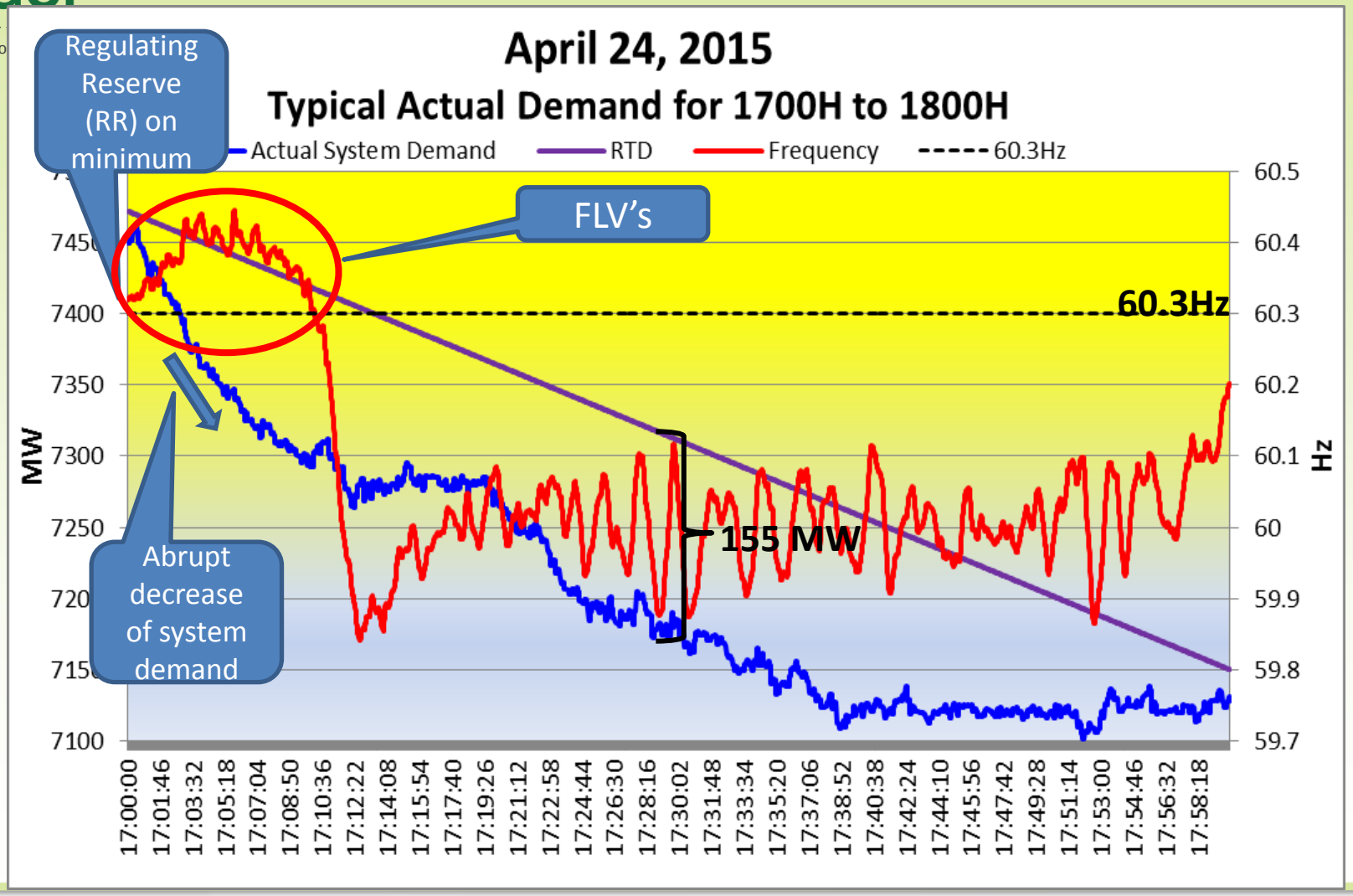
- HVDC is affecting the power quality in Luzon
- VRE generation
- Cyclic operation of Steel Mills
- Tripping of KSPP as pump
- Number of ALD incidents
- Higher peak demand and lower off-peak demand
- Synchronization of Sual unit with higher Pmin

Although most VREs entered in the start of CY 2015 and the Frequency Limit Violations significantly increased in the first four (4) months compared to CY 2014, a comprehensive assessment is still ongoing to identify the root cause.

Challenges on Wind Power Integration – Forecast Errors

NGCP

Stronger
for a stro



NGCP

Stronger transmission
for a stronger nation.

REIS Results -Variability

1. There is no apparent change between load variability and net-load variability at low VRE capacity percentage.

2. At higher share, the effect on variability is salient issue if VREs are geographically concentrated, for example, the case in northern Luzon.

NGCP

Stronger transmission
for a stronger nation.

REIS Results
-Limited Predictability

1. Limited predictability of VREs has stronger influence on the additional amount of required operational reserve than their variability.

2. Thus, the required operational reserves usually increase along with the growth of VRE.

NGCP

Stronger transmission
for a stronger nation.

Recommendations for Successful RE Integration -RE Transmission Corridors

1. A well coordinated power system planning is needed to synchronize the generation and transmission plans.

2. The following transmission plans is needed to accept more VREs to the Philippine Grid:
   a) "Northern Luzon 230kV Looping" - strategic project for RE developers to exploit the largest wind resources in Philippines.
   b) "Cebu-Negro-Panay 230kV Backbone" - critical interconnections to embrace green energy from Panay and Negros islands where wind farms as well as solar farms are growing.

VISAYAS

2020

Load Growth

Generation Entry

System Reliability

Panitan – Nabas 138 kV T/L Upgrading (Mar 2017)

Panitan – Nabas 138 kV Transmission Line 2 Project (Jun 2017)

CNP 230 kV Backbone Project - Stage 1 (Dec 2017)

Nabas-Caticlan-Boracay Transmission Project Stage 1 (Aug 2019)

Panay-Guimaras 138 kV Interconnection Project (Dec 2019)

CNP 230 kV Backbone Project - Stage 2 (Dec 2018)

CNP 230 kV Backbone Project - Stage 3 (Dec 2020)

Legend:

- 230 kV
- 138 kV
- 69 kV

NGCP

Stronger transmission
for a stronger nation.

Recommendations for Successful RE Integration -Mitigation of Variability

1. “Free governor” or primary response should be rendered mandatory

2. Refining of reserve market mechanism will have a strong bias towards AGC and tertiary reserve for real-time balancing.

3. VREs should also be encouraged to be grid-friendly by providing energy storage and frequency response.

NGCP

Stronger transmission
for a stronger nation.

Recommendations for Successful RE Integration -Joint Efforts in VRE Forecasting

1. The key to a high quality forecast is the wider and more detailed meteorological data

2. The real-time VRE data should be made available and accessible to the System Operator for its short-term forecasts

3. The responsibility of VRE forecast should be effectively shared by VRE operators and system operator.

End of Presentation
Thank you for your attention