Danish Energy
 Agency

What does Vietnam do to integrate variable renewables?

- Experiences from the Danish-Vietnamese cooperation

- 1. The Danish-Vietnamese Cooperation
- 2. Vietnam's power system
- 3. Integration measures in the Danish-Vietnamese cooperation
- 4. Q&A

Bio



- Loui Algren
- 2013: Engineer in sustainable energy from Danish Technical
 University
- <u>2013-2018:</u> Energinet (Danish TSO)
- 2018-2021: DEA-GR working with Indonesia, Vietnam, Mexico.
 Long-term planning and VRE integration
- <u>2021- :</u>
 Long-term advisor in Vietnam

Danish-Vietnamese Energy Partership Programme (DEPP)

- Government-to-government cooperation
- Primary objective is capacity building
- Cooperate with:
 - o EREA: Electricity and Renewable Energy Authority
 - o ERAV: Electricity Regulatory Authority
 - o NLDC: National Load Dispatch Centre
 - o EESD: Energy Efficiency authority
- Cooperation with Vietnam initiated in 2013
- Currently 3rd phase 2020-2025



Challenges in the Vietnamese energy system

- Serve rapidly increasing **demand** (x4 by 2045)
- Ensure high level of security of supply
- Keep **costs** at a minimum
- Limit climate impact
- Integrate large shares of renewables
- Limit **dependency** on fuel import
- Limit **pollution** effects on public health



6 April 2021

Draft Power Development Plan 8 (Feb 2021)

- 1. Long-term planning based on least cost-optimisation
- 2. Include **pollution** costs in the optimisation
- 3. 30 % wind and solar power in 2045 (TWh)



BỘ CÔNG THƯỜNG VIỆN NĂNG LƯỢNG

MÃ CÔNG TRÌNH: E-542

Draft Power Development Plan 8 (Feb 2021) Other initiatives

- 1. Double **transmission** capacity by 2030. Quadruple by 2045
- 2. Power **Market** development: Wholesale, retail and derivative markets to increase efficiency and attract investors
- 3. Establish **independent system and market operator** to increase efficiency and attract investor, increase transparency, easier regulation.
- 4. Adjust **BOT** schemes to suit market development.
- 5. FiT to auctions
- 6. Costs-reflective system **tariffs.** Separate from sociopolitics
- 7. Improve renewable **forecasts** for system operator
- 8. Smart Grid, AI, IoT, control, protection, monitoring, SCADA, PMU, data and demand-response



Energy Outlook Report 2019 main findings

- 1. Energy efficiency can reduce the need for new generation capacity and overall system costs
- Vietnam can cost-effectively integrate 59% renewables by 2050 (42% wind+solar)
- 3. Solar power, wind power and storage will play a large role
- 4. Pollution and fuel import dependency will be reduced



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Reality can be different!

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Vietnam: Rooftop Solar Installed Capacity Exceeds 9.5 GW

Vietnam Reports 9.5 GW Installed Rooftop Solar PV Capacity Till January 5, 2021—Exceeding 1 GW Target 5 Years Ahead Of Scheduled 2025 Date— Thanks To Rush To Avail Attractive Feed-in-Tariff Before December 31, 2020 Deadline 10:28 PM (Beijing Time) - 05. January 2021 12000 10000 8000 6000 4000 2000 0 5587¹⁹ 0^{42¹⁹} 10⁴¹⁹ 10

Vietnam Rooftop Solar PV Installations

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Integration measures in the Danish-Vietnamese cooperation

Measures for integration variable renewables

Danish-Vietnamese cooperation

Partners:

- DEA: Danish Energy Agency
- ERAV: regulator
- NLDC: system operator
- Energinet (Danish TSO)

Approach:

- Bring Danish and Vietnamese
 experts together
- Share Danish experience
- Review Vietnamese regulations

- Discuss and develop solutions in small expert teams
- Weekly missions in Denmark and Vietnam

<u>Subjects:</u>

- 1. Forecasting
- 2. Grid Codes
- 3. Inertia
- 4. Dimensioning of reserves



1. Forecasting of renewables

- Important for the system operator to be able to predict the system balance in the short term
- Energinet has long-term experiences in forecasting renewables and applying the forecasts in system balancing with large shares of renewables (50% wind+solar on average in 2020)



A week in the Western Danish power system

West Denmark, Sunday, 2021-3-7 to Saturday, 2021-3-13 Electricity consumption Wind turbines Photovoltaics Local CHP units Central power plants 3250 束 75Q -50 -100 -150 Time Source: www.emd.dk/el



1. Forecasting of renewables

Small team of Vietnamese and Danish experts cooperating closely



1. Forecasting of renewables *Results*

- NLDC now has their own in-house developed forecast for solar PV and wind power, on plant level, for dayahead and intraday.
- NLDC actively uses the developed forecast in system operation inspired by the Danish approach.
- NLDC is able to test, maintain and develop the forecast independently.



2. Grid Codes *Key messages from DK / Europe*

- 1. Adequate requirements for safe system operation
- 2. Transparency, well-organized, following international standards for easier access for developers.

Europe is developing unified grid codes to ensure fair competition and for developers to easier enter each national market



2. Grid Codes Approach

- 1. Danish expert reviews Vietnamese regulation grid codes
- 2. Recommendations to the process of updating grid codes
- 3. Study tour to ACER (European association of electricity regulators) and Denmark
- 4. Vietnamese workshop for stakeholder involvement

C25/2016/TT-BCT		C39/2015/TT-BCT			Combi	ned Circular - Inte	rim version	
Chapter #, description	Section, description	Circular xx, article yyy	Chapter #, description	Section, description	Circular xx, article yyy	Chapter #, description	Section, description	Circular xx, article YYY
Chapter I, GENERAL PROVISIONS			Chapter I, GENERAL RULES			Chapter I, GENERAL RULES		
-		Article 1. Governing	-		Article 1. Scope			Article 1. Governing scope
-		Article 2. Regulated entities	-		Article 2. Subject of application			Article 2. Regulate entities
-		Article 3. Definitions	-		Article 3. Definitions			Article 3. Definitions
Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICITY TRANSMISSION SYSTEM			Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL DISTRIBUTION SYSTEM	Section 1. TECHNICAL REQUIREMENTS		Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL SYSTEM	Section 1. TECHNICAL REQUIREMENTS	Article 4. Frequency
-		Article 4. Frequency Article 5. Stabilization	-		Article 4. Frequency Article 5. Voltage			Article 5. Stabilization of electricity system Article 6. Voltage
		of electricity						



Expert2expert discussion is key to capacity building



2. Grid Codes Results

Detailed recommendations for:

- 1. Reorganising the regulation for easier access for developers and easier update
- 2. Adding content for safe operation
- 3. Roadmap for implementation



- 1. NLDC and ERAV concerned about the level of inertia in the power system
- 2. Danish experts share the DK / European approach
- 3. Vietnamese and Danish experts develop a solution for Vietnam based on Danish/European experiences

3. Inertia *Solution*

- 1. Asess need for inertia
- 2. Assess historic level of inertia from power plant trips
- 3. Assess future level of inertia from scenarios

Grid	Peak Demand [GW]	Minimum inertia [GWs]
Texas grid	73,0	105
Nordic	73,1	100 - 120
Vietnam 2019	~ 40	57

Event	Trip size (MW)	RoCoF	E _k [GWs]
Vĩnh Tân S1 3:21am	338+15=353	0,0474	186
Vĩnh Tân S3 1:05am	588	0,0606	243
Nghi Sơn S2 8:43am	274+22=296	0,023	322
Duyên Hải S2 9:42am	450	0,0456	247
Cẩm Phả S2 12:10pm	300	0,0324	231
Vĩnh Tân S1 6:44am	1200	0,1174	256
Duyên Hải 3 S1 17:12pm	578	0,0560	258

3. Inertia *Results and recommendation*

- 1. Pre-study of the level of inertia today and in a 2025 scenario from the Energy Outlook Report
 - No immediate lack of inertia
- 2. Recommendations
 - Refine the developed approach
 - Implement procedure for annual update and reporting
 - Include in grid codes requirements for ability to deliver synthetic inertia
 - Consider monitoring of inertia when implementing PMU/WAMS



- NLDC concerned about the level of secondary reserves
- Danish experts share experiences on dimensioning of reserves in Denmark and Europe
- Danish and Vietnamese experts compare the two methodologies
- Develop solution for Vietnam based on Danish experiences



4. Reserve dimensioning Comparison



Vietnamese approach	European approach	
Based on simulations	Based on historical frequency variations	
Consider many scenarios	Only consider historical data	
Does not consider variations in wind and solar power	Reflects wind and solar power dynamics	
Complex	Simple	
need apacity the nary uency	$\Delta P = (f - f)$	$(n) \times K$
		0.4



- Test both approaches in a period and gain experieces
- How to implement in Vietnamese regulation
- Define ancillary services more clearly in the regulation

MINISTRY OF INDUSTRY AND TRADE Electricity Regulatory Authority No. 106/OD-DTDL

SOCIAL REPUBLIC OF VIETNAM Independence - Freedom - Happiness

Hanoi, 14 December 2018

DECISION

Issuing the procedure of identifying and operating ancillary services

DIRECTOR OF ELECTRICITY REGULATORY AUTHORITY

Pursuant to the Decision No. 3771/QD-BCT dated 2 January 2017 of the Minister of Industry and Trade defining the function, task, authority and organizational structure of Electric Regulatory Authority of Vietnam (ERAV),

Pursuant to the 25/2016/TT-BCT dated 30 November 2016 of the Minister of Industry and Trade stipulating the transmission power \underline{system} ;

At the request of the Head of Power System Department,

DECISION:

Article 1. To promulgate together with this Decision the procedure of identifying and operating ancillary services to guide the implementation of Circular No. 25/2016/TT-BCT dated 30 November 2016 of the Minister of Industry and Trade stipulating the transmission power system.

Article 2. This Decision takes effect from the date of signing and replaces the Decision No 12/QD-DTDL dated 12 March 2015 of the Director of Electricity Regulatory Authority promulgating the procedure of planning and mobilizing frequency control service and spinning reserve service and Decision No. 33/QD-DTDL dated 02 June 2015 of the Director of Electricity Regulatory Department issuing the procedure of planning and mobilizing fast-start, cold-start, and mustrun services.

Article 3. Managers of ERAV's departments, Director of ERAV's Training and Electricity Market Development Research Center, General Director of Vietnam Electricity, Director of the National Load Dispatch <u>Center</u> and the relevant units are responsible for implementation of this Decision.

> DIRECTOR Signed Nguyen Anh Tuan

6 April 2021

Thank you for your attention!

Questions?

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