

September 6, 2022

Power System and Market to realize massive deployment of Renewable Energy



Hiroshi TAKAHASHI, Ph.D.
Tsuru University
Takahashi-h@tsuru.ac.jp

Learning from Denmark

- Most advanced nation in the era of carbon neutrality
- デンマークだから可能？

1) Sophisticated market mechanism of NordPool

- based on fair competition policy
- ノルドプールのような市場は日本でも導入可能

2) Interconnected power system operation

- interconnectors across seas
 - TSOs by ownership-unbundling
- 国内を送電網で繋ぐことは日本の方が容易

3) Clear vision for decarbonization and energy independence

- deploy wind power since 1990s
- Hokkaido can do?

1990年代から脱炭素とエネルギー自立のために風力発電を導入

VRE and Power System : システム統合

= VRE can be integrated in the power system
再エネ電力のシステム統合は可能

1) "Flexibility" is the key : 電力システムの柔軟性が鍵

- adjustable thermal, pumped hydro
- wide-area system operation with sufficient transmission lines
- distributed resources: battery storage, VPP
- demand-side management
- flexibility in future : sector-coupling, power-to-gas

2) Ownership Unbundling is the prerequisite : 所有権分離が前提

- neutral and independent TSO
- merger of TSOs : economy of scale
- OCCTO as an ISO

VRE and Power Market : 市場統合

= VRE can be integrated in the power market
再エネ電力の市場統合は可能

- 1) **Carbon Pricing is the basis : カーボンプライシングが基盤に**
 - carbon tax or emissions trading
 - incentivize investment to achieve carbon neutrality
- 2) **"Merit-Order" is the principle : メリットオーダーが基本原理**
 - fully competitive power market based on marginal cost
 - RE should be prioritized over nuclear
- 3) **From FiT to FiP and non-subsidy RE : 市場で自立する再エネへ**
 - RE-generator should be responsible for generation-plan
 - introduction of negative price
 - market-solution for variability : VPP, power-trading