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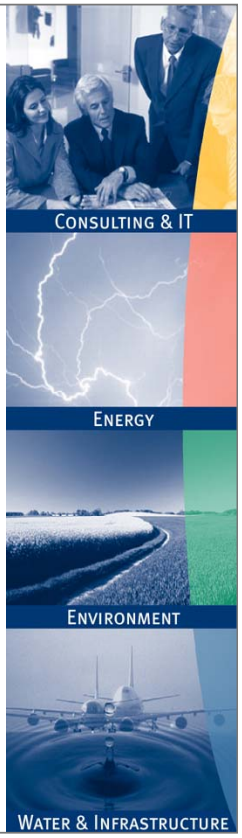
# Incentives for Grid-Friendly Wind Power Plants
# 对电网友好型风电场的激励措施
# -
# Examples from Spain and Germany
# 来自西班牙和德国的例子

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## Introduction 引言

- regulatory framework for grid codes in Spain and Germany:
  西班牙和德国并网导则的规章框架
  - requirements for wind power integration
    风电并网的要求
  - economic incentives for wind power integration
    风电并网的经济激励措施
- monetary incentives **or** mandatory?
  采用经济激励措施还是强制措施？

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## Why a grid code for wind power integration is required?

## 为什么需要风电并网的电网导则

- share of wind energy increasing 风电的比例在增加
- dependent on weather conditions 风电依赖于天气变化
- potential grid operational issues 潜在的电网运行问题
- potential reliability concerns: wind power trips off the grid because of grid faults.
  潜在的可靠性问题：风电因电网故障而脱离电网
- desire: wind energy contributes some grid support services:
  愿望：风电贡献一些支持电网服务：
  - reactive power 无功功率
  - frequency and voltage control 频率和电压控制
  - fault ride-through capability 故障穿越能力
  - efforts to minimize the deviation between day-ahead forecasted generation and actual generation. 努力减少天前功率预测和实际功率的偏差。

⇨ requirements for wind plants are pursued in many countries to meet various grid standards
为满足不同的电网标准，很多国家已经实施了对风电场的技术规定

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# Regulatory framework in Spain and Germany 西班牙和德国的规章框架

| Measure 措施 | Spain 西班牙 | Germany 德国 |
|---|---|---|
| Frequency control<br>频率控制 | **Required 要求**<br>All generators have to be operated with a reserve margin of 1.5%. 所有发电机组必须具有1.5%的频率备用裕度 | **Required *(new plants after 2010)***<br>**要求（适用于2010年后的新建风电场）**<br>**Incentive (new plants before 2011)**<br>**激励措施（适用于2011年前的新建风电场）**<br>temporary bonus of 5 €/MWh* 临时奖金5 €/MWh<br>**Incentive (existing plants)激励措施(已有风电场)**<br>bonus of 7 €/MWh*, 5 years 奖金7 €/MWh，5年 |
| Voltage control<br>电压控制 | - | **Required (new plants)对新风电场要求**<br>intermediate voltage [MV Code 2008] Δ ua ≤ 2 % or high voltage [Transmission Code 2007]<br>中压[MV Code 2008] Δ ua ≤ 2 % 或者高压[Transmission Code 2007]<br>grid connection 47,5 Hz < f grid ≤ 50,2 Hz<br>连网条件 47,5 Hz < 电网频率 ≤ 50,2 Hz<br>grid disconnection f grid ≤ 47,5Hz, f grid ≥ 51,5Hz<br>断网条件 电网频率≤ 47,5Hz, 电网频率 ≥ 51,5Hz |
| Supply of reactive power<br>无功功率支撑 | **Incentive激励措施**<br>Bonus: up to 8% of 78.4 €/MWh<br>奖金：可达78.4 €/MWh 的8%<br>Penalty: up to 4% of 78.4 €/MWh<br>罚金：可达78.4 €/MWh 的4% | **Required (new plants)**<br>**只对新建风电场做出要求** |
| Fault ride-through capability<br>故障穿越能力 | **Incentive激励措施**<br>Bonus: 3.8 €/MWh, 5 years<br>奖金：3.8 €/MWh，5年 | **Required (new plants after 2010)**<br>要求2010年后的新电厂<br>**Incentive (new plants before 2011)**<br>**激励措施（适用于2011年前的新建风电场）**<br>temporary bonus of 5 €/MWh* 临时奖金5 €/MWh<br>**Incentive (existing plants)激励措施(已有风电场)**<br>bonus of 7 €/MWh*, 5 years 奖金7 €/MWh，5年 |
| Plant operation in line with forecast<br>在线运行具有预测的电厂 | **Incentive激励措施**<br>Bonus if plant operation in line with forecast one day before, Penality if not对具有天前预测的在线运行电厂给予奖金，否则收取罚金 | - |

Table 1: Legislative framework in respect to grid integration of wind power 表1：风电并网的立法框架

*only if requirements are fulfilled for both frequency control and fault ride-through *只有在频率控制和故障穿越都满足要求的情况下

幻灯片 5

s3 Transmission Code 2007, Seite 35:
"Alle EEG-Erzeugungseinheiten müssen im Betrieb bei einer Frequenz von mehr als 50,2 Hz die momentane Wirkleistung mit einem Gradienten von 40% der momentan verfügbaren Leistung des Generators je Hertz absenken."
MV Code 2008 bezieht sich auf diese Stelle im Transmission Code 2007.
stehlem, 2010-11-11

s4 Aus MV Code 2008:
"Zulässige Spannungsänderung

Im ungestörten Betrieb des Netzes darf der Betrag der von allen Erzeugungsanlagen mit Anschlusspunkt in einem Mittelspannungsnetz verursachten Spannungsänderung an keinem Verknüpfungspunkt in diesem Netz einen Wert von 2 % gegenüber der Spannung ohne Erzeugungsanlagen überschreiten.
Δ ua ≤ 2 %"
stehlem, 2010-11-11

# Conclusion 结论

Mandatory technical standards: best practice in many countries and to be considered for new plants in China.

强制性技术标准：以在很多国家适用并且可以考虑适用于中国新建风场中。

Monetary incentives through economic regulation: in Germany, Spain

通过经济手段来实现经济激励措施： 在德国，西班牙

Incentives to encourage… 激励措施…

- …existing wind plants to meet newer grid integration requirements
  …已有风电场满足新的并网要求
- … early compliance with grid integration requirements that will strictly apply to wind power plants at a future date
  …以前的并网要求同样严格的用于拟建的风电场
- … grid services that may not be required but that would be valuable for the grid
  … 电网服务不是强制的但是电网服务对电网是有益的

Consideration: 考虑因素：

- financial incentives may make sense under some of the specific conditions
  财政激励措施在特定的条件下会有意义

Or 或者

- strict grid integration requirement may make more sense
  严格的并网要求可能更有意义