Different Ways of Handing More Responsibility to Generators of Variable RES-E in EU Electricity Markets

A comparison of policy instruments

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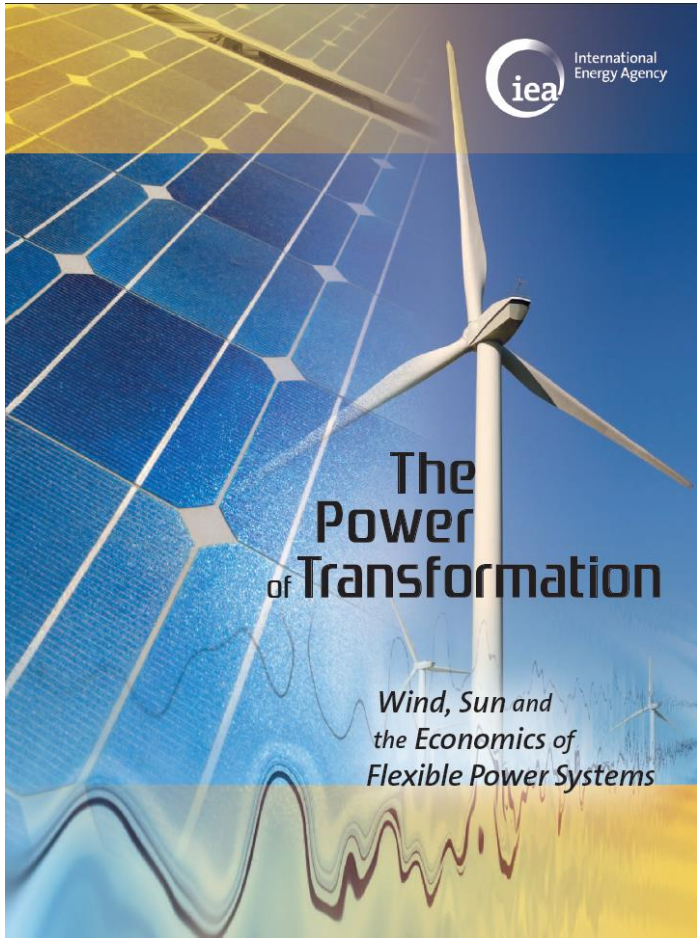
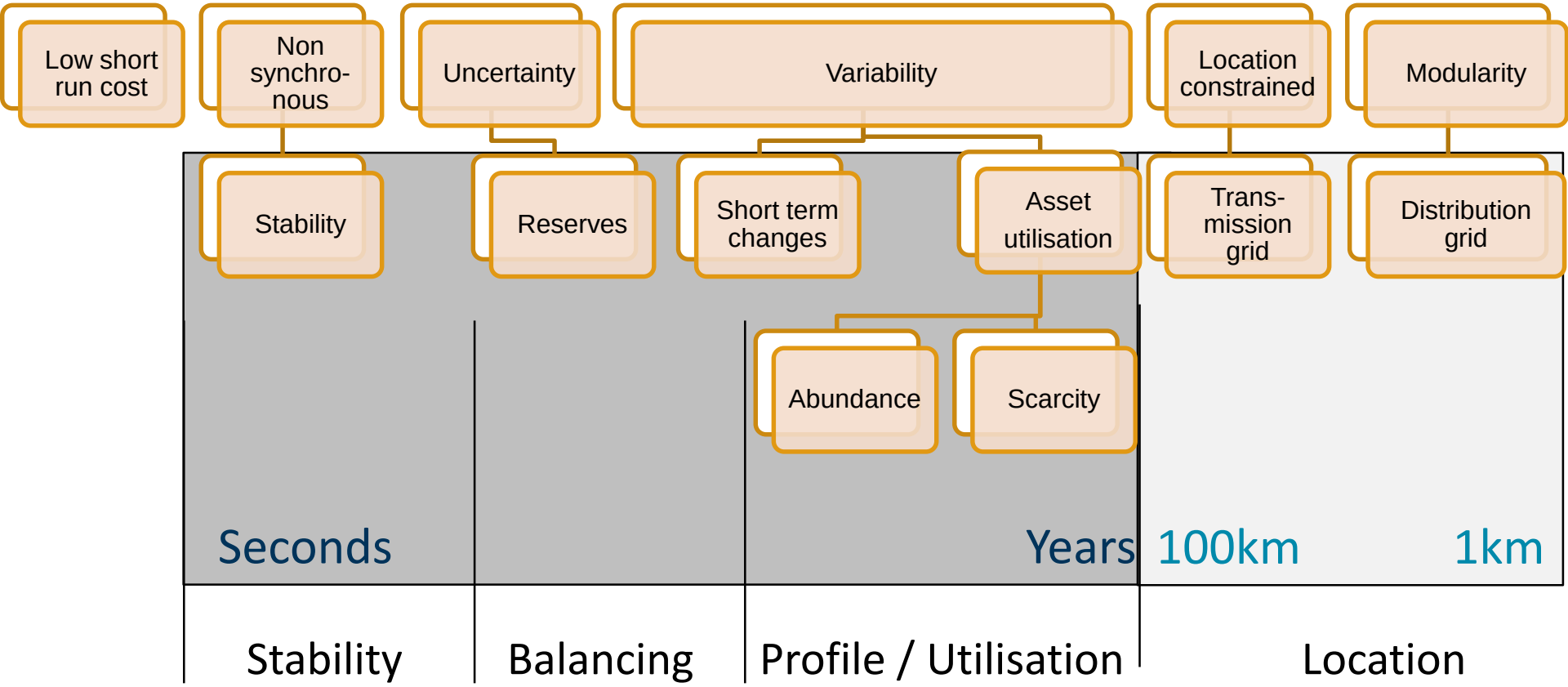
The Grid Integration of Variable Renewables Project - GIVAR

- **Third project phase at a glance**
  - **7 case studies covering 15 countries, >50 in-depth interviews**
  - **Technical flexibility assessment with revised IEA FAST tool**
  - **Detailed economic modelling at hourly resolution**



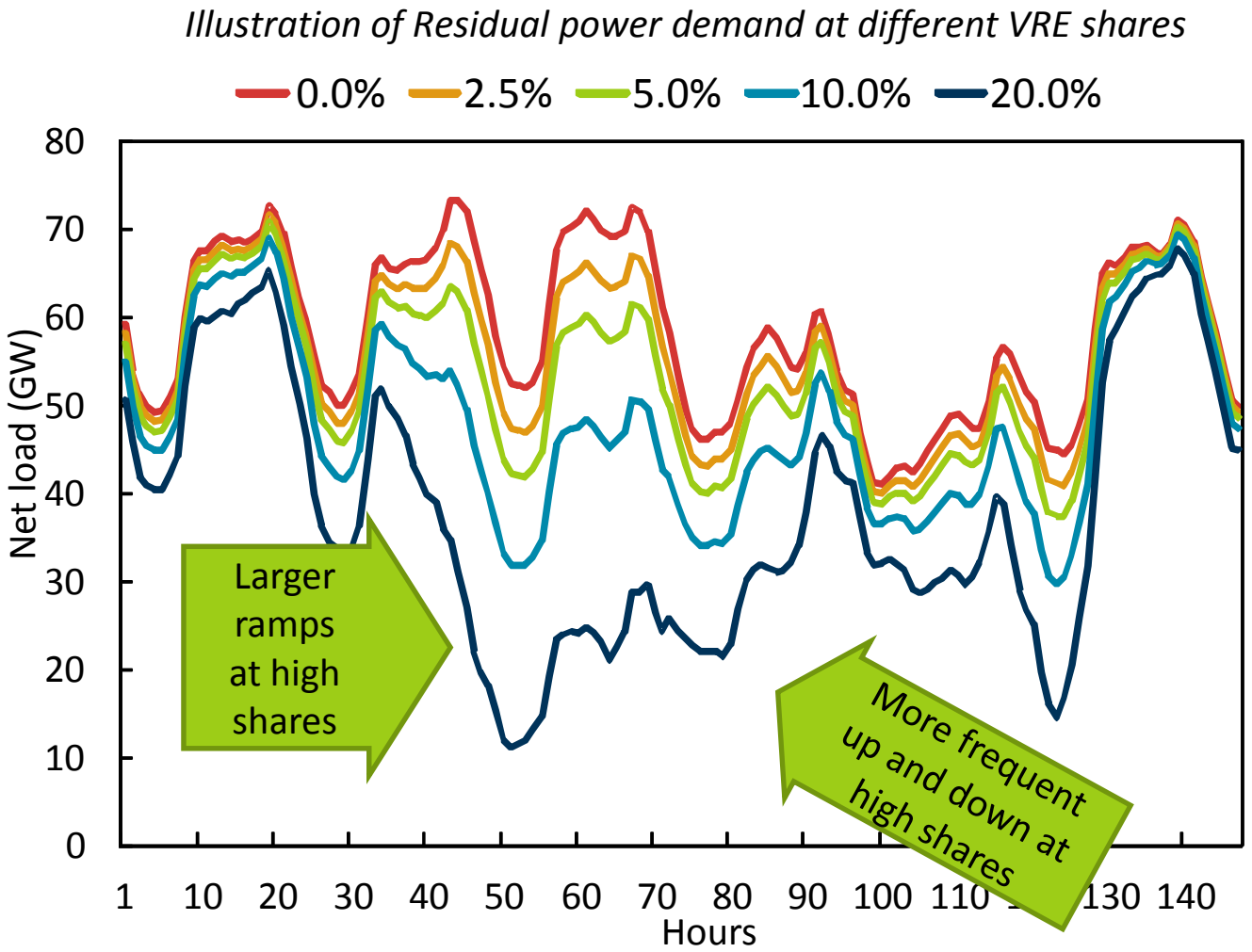
Properties of variable renewables and impact groups

- Systems are different – impacts will vary too
- But common groups of effects



Main persistent challenge: Balancing

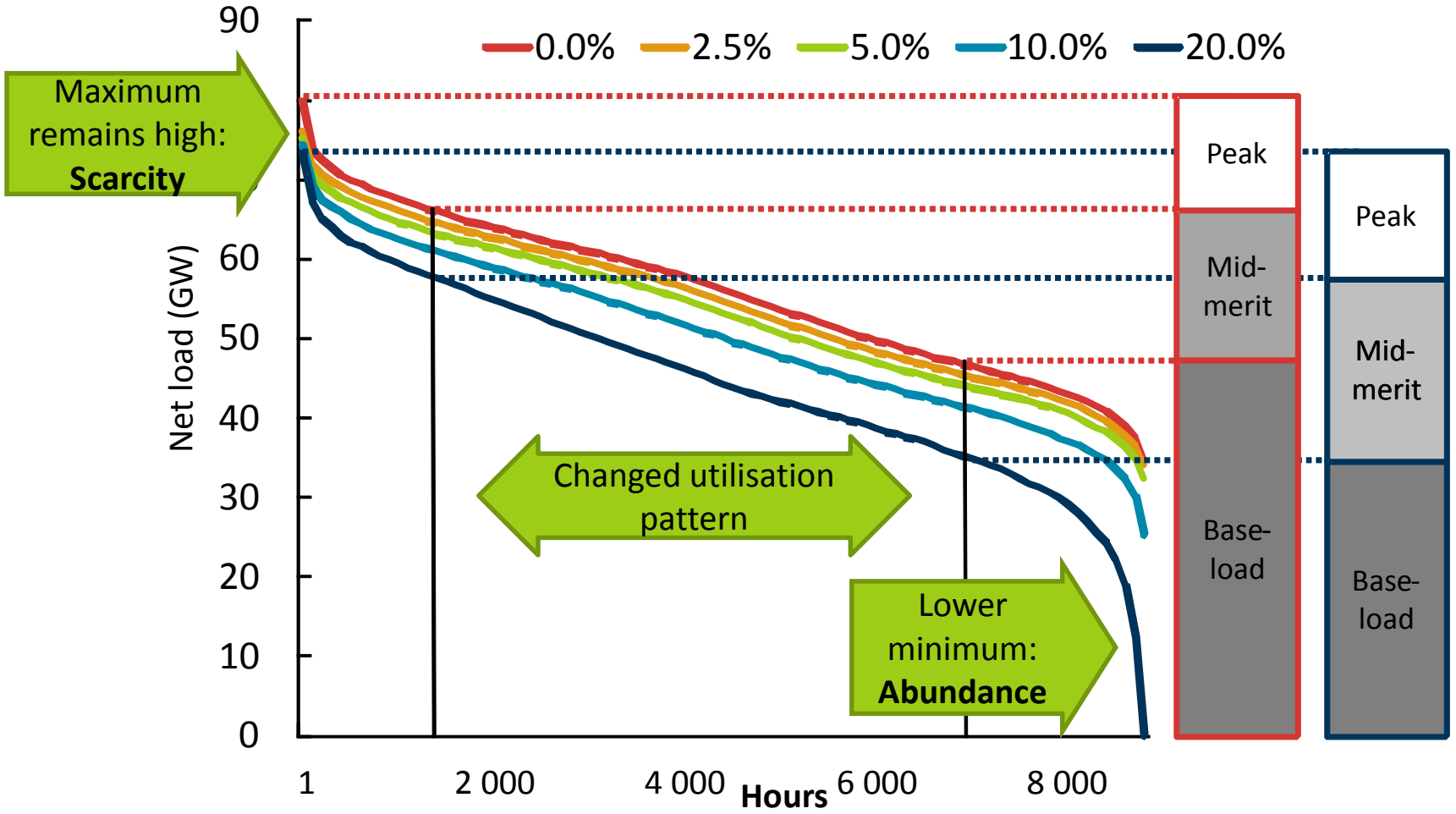
- Higher uncertainty
- Larger and more pronounced changes



Note: Load data and wind data from Germany 10 to 16 November 2010, wind generation scaled, actual share 7.3%. Scaling may overestimate the impact of variability; combined effect of wind and solar may be lower, illustration only.

Main persistent challenge: Utilisation

- **Netload implies different utilisation for non-VRE system**



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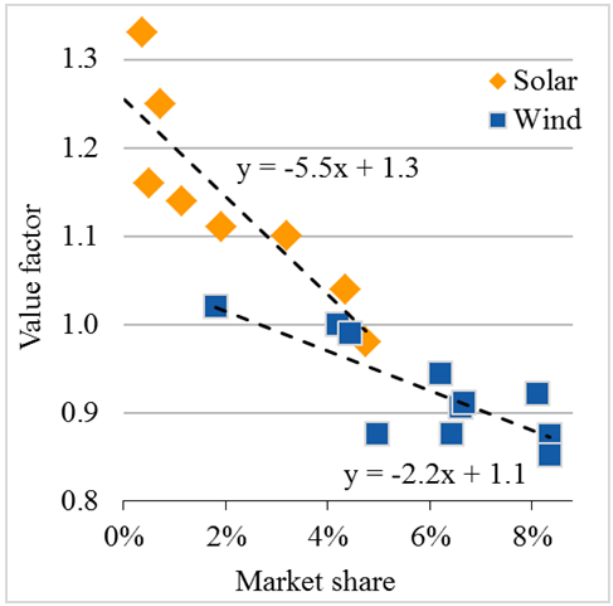
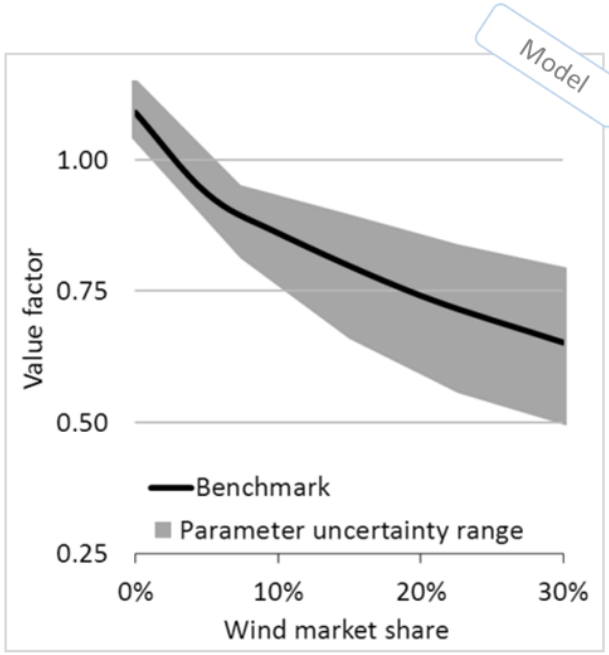
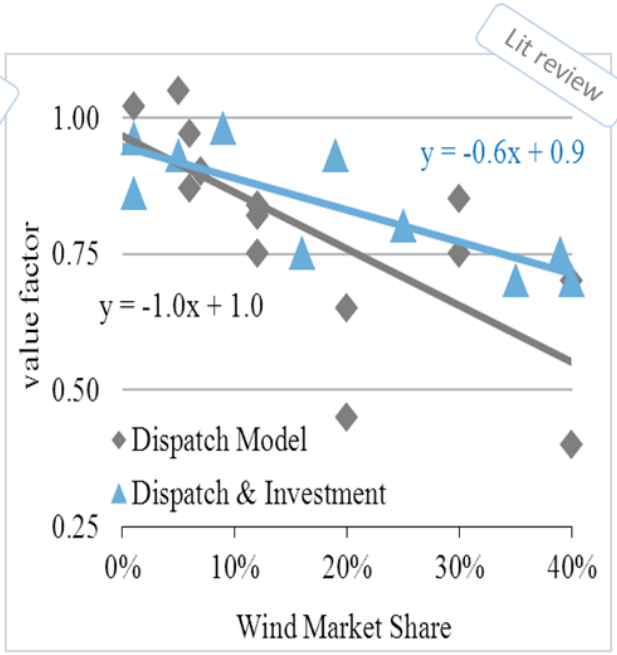
The value of variable renewable energy





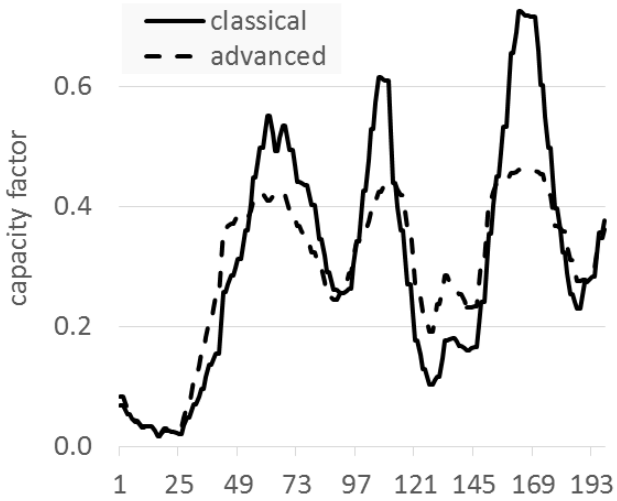


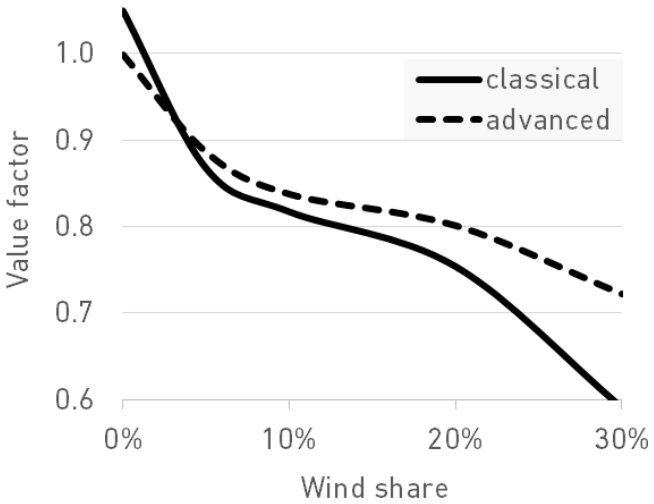
Source: updated from Hirth (2013)

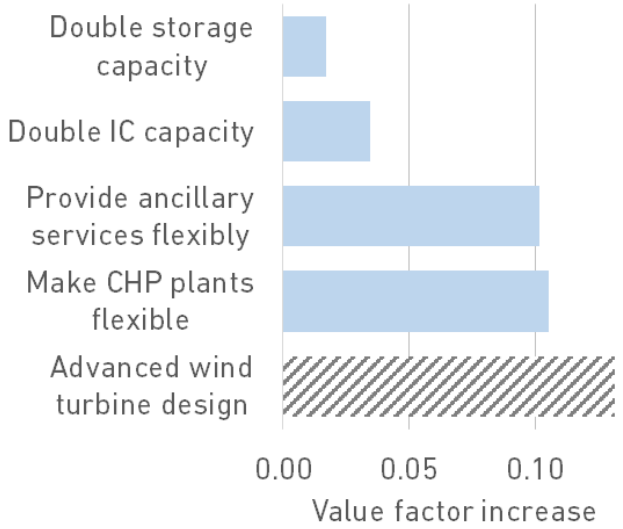
- Value factor = 1 average market price, >1 above, < below
- As share of VRE rises, average value per MWh decreases

Why expose VRE generators to risks associated with balancing / utilisation?

- VRE plant design may be able to contribute to minimising these costs
- Example: classical vs advanced wind turbine design in North-West Europe



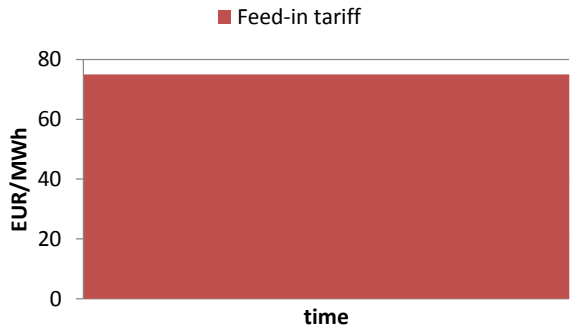




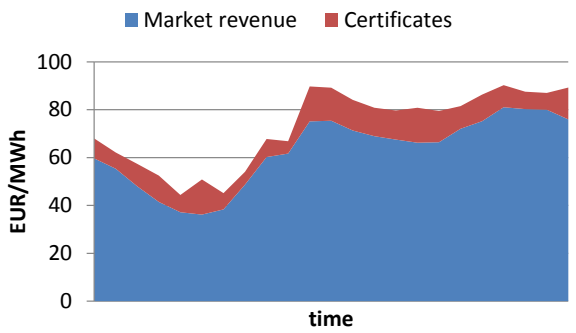
Source: Hirth, Mueller, 2014, unpublished

Policy instruments and resulting remuneration

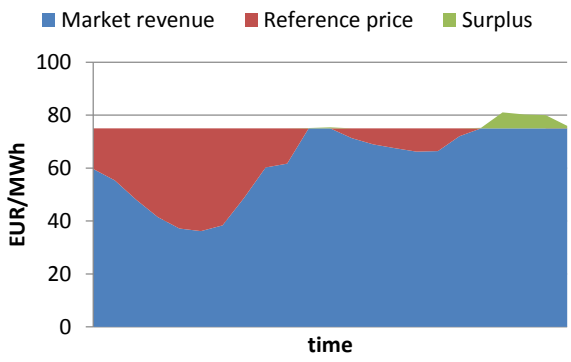
Feed-in tariff

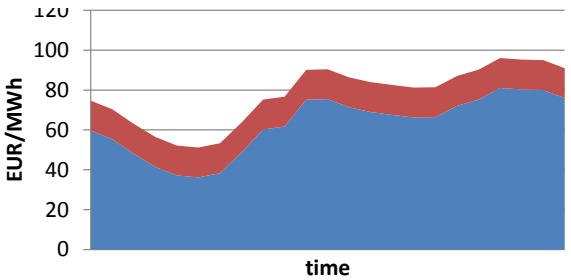


Certificates

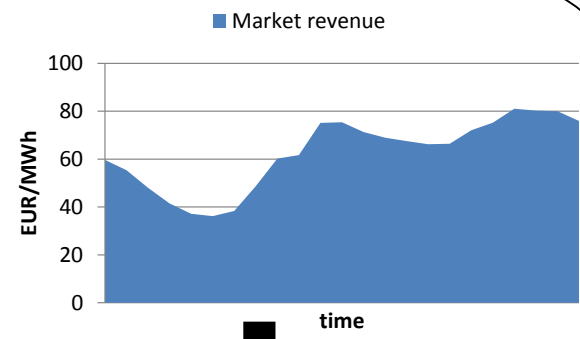


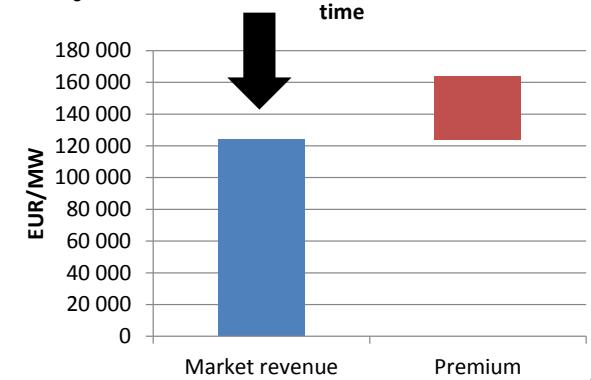
Energy premiums (per MWh)





Capacity premiums (per MW)





Examples: Germany and Spain

- German premium model*
  Variable per MWh premium
  - Calculate (monthly) average per MWh market remuneration of technology class (wind, solar etc.) ex post
  - Calculate premium (p) on to of market remuneration (m) to reach target remuneration (t)
    $MWh_t = MWh_m + MWh_p$
  - Top-up each MWh of generation by MWh_p
- Implications:
  - Removes (most of) priority dispatch
  - Exposes generators to imbalance costs
  - Bid up to short-run cost minus premium
  - Partial exposure to volume risk
  - Removes technology market value risk

- Spanish premium model*
  Variable per MW premium
  - Calculate (yearly) average per MW market remuneration of technology class (wind, solar etc.)
  - Calculate premium (p) on to of market remuneration (m) to reach target remuneration (t)
    $MW_t = MW_m + MW_p$
  - Pay out MW_p to each MW, subject to minimum availability/production
- Implications:
  - Removes (most of) priority dispatch
  - Exposes generators to imbalance costs
  - Bid up to short-run cost
  - Full exposure to volume risk
  - Removes technology market value risk

* Description of main concept of instrument

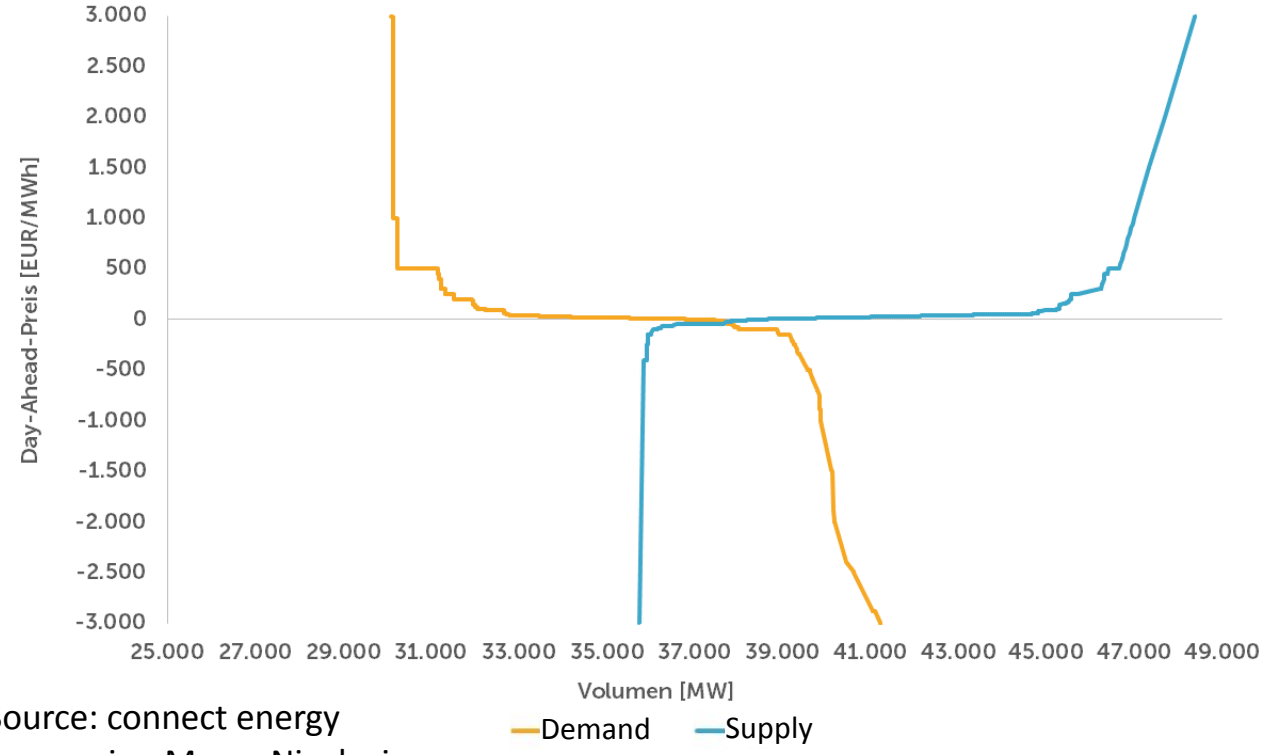
Different instruments – different risks for generators

	Feed-in tariff	Per MWh premium		Per MW premium		Quota + certificates
		variable	fixed	variable	fixed	
Balancing risk	shielded	exposed	exposed	exposed	exposed	exposed
Profile risk / energy value	shielded	shielded	exposed	shielded	exposed	exposed
Bid below short run cost (neg. prices)	-	Yes*	Yes*	No	No	Yes*
Quota / banding risk	No	No	No	No	No	Yes
Inherent technology neutrality**	No	No	Yes	No	Yes	Yes

* Unless supplementary provision removes incentive

** Providing same incentive to different technologies does not bear the risk of choosing technologies with lower net benefit

The magnitude of these risks depends on system flexibility!

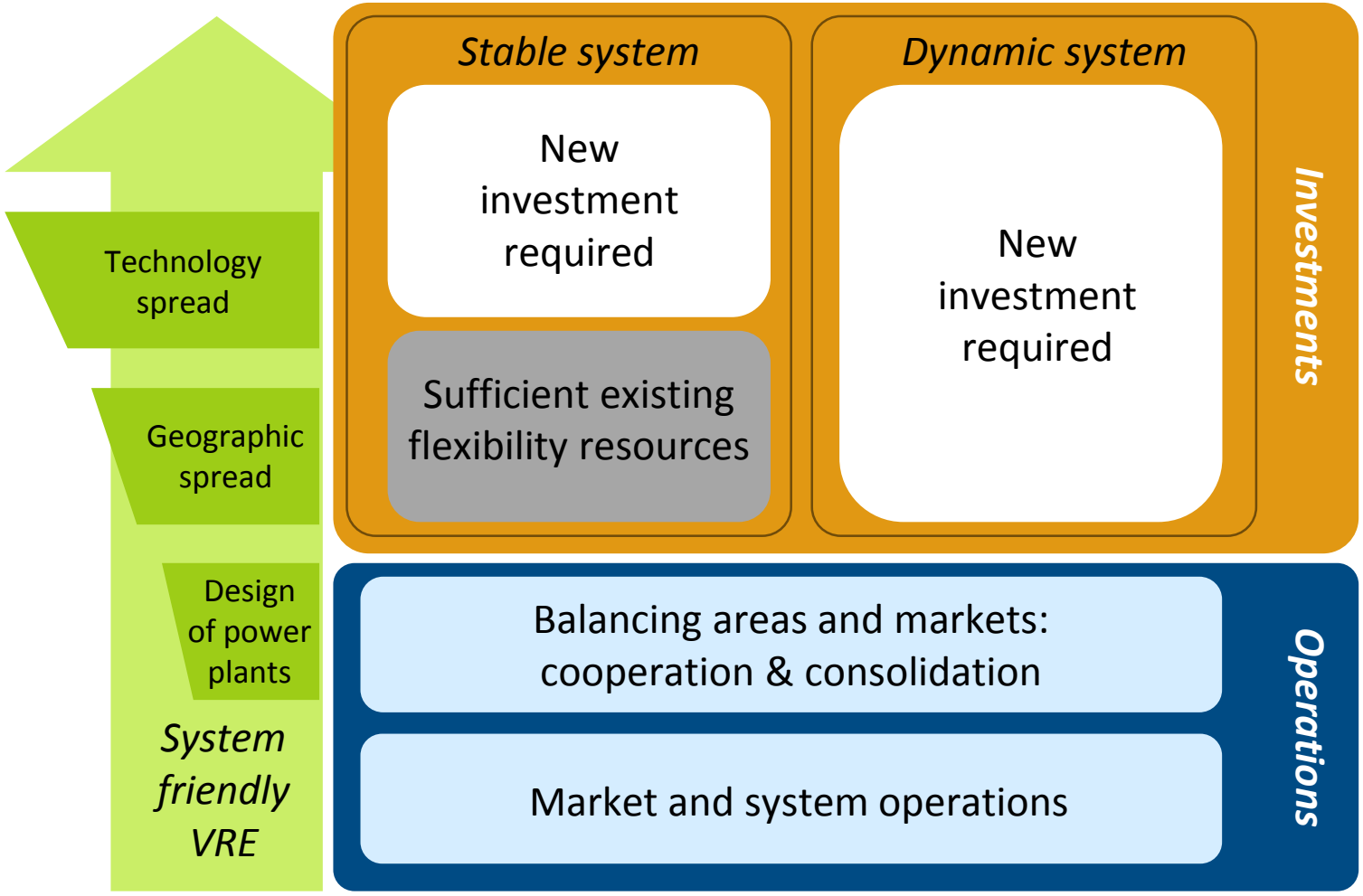


Source: connect energy economics, Marco Nicolosi

… and market design

- **Wholesale markets**
  - Sufficient liquidity
  - Short program time units
  - Trading close to real time
  - Large-scale geographic integration
- **System service markets**
  - Non-discriminatory access
  - Remuneration at marginal value
- **Imbalance market / cash-out pricing**
  - Significant portfolio effect for VRE!
  - Trading arrangements need to allow small participants to access aggregation benefits (after-day market, short-selling?)

Three pillars of system transformation



Conclusions

- **Passing price signals to generators that better reflect the value of electricity instrumental to …**
  - Optimising short-term operations
  - Drive innovation within a technology group
  - Allow for competition between technology groups
  - Provide feed-back mechanism to control deployment volume
- **Passing prices too directly can be problematic:**
  - High capital intensity of VRE (and other low-carb) raises importance of cost of capital > sensitive to risk
  - Currently sub-optimal market design
  - Pricing of CO2 and other externalities challenging
  - Drop in market value due to transitional overcapacity
  - Lack of visibility on future system flexibility

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