

# ENERGINET

## CURTAILMENT – THE DANISH CASE

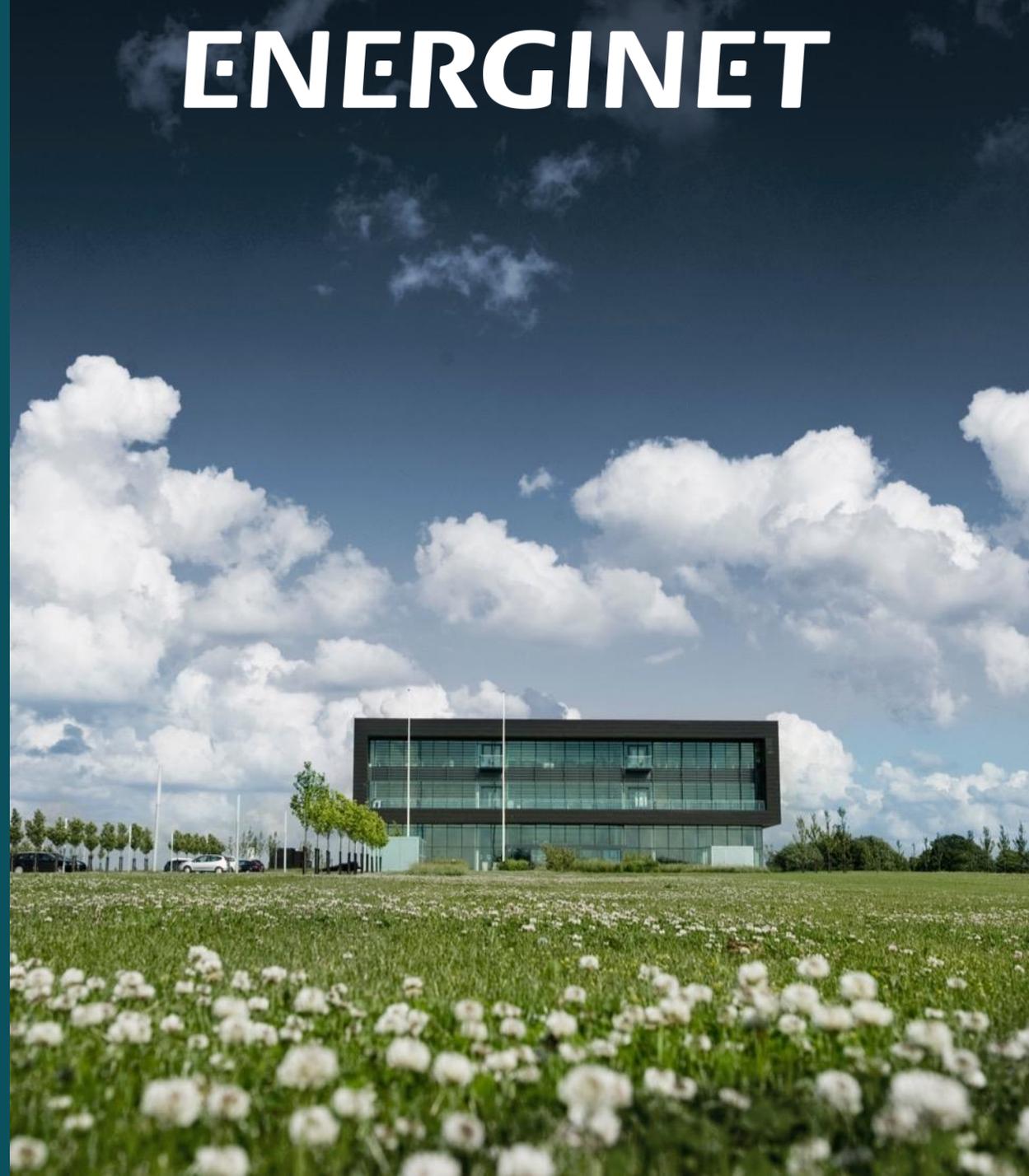
May 2023

*Klaus Winther, Vice President, System Operation, Energinet*



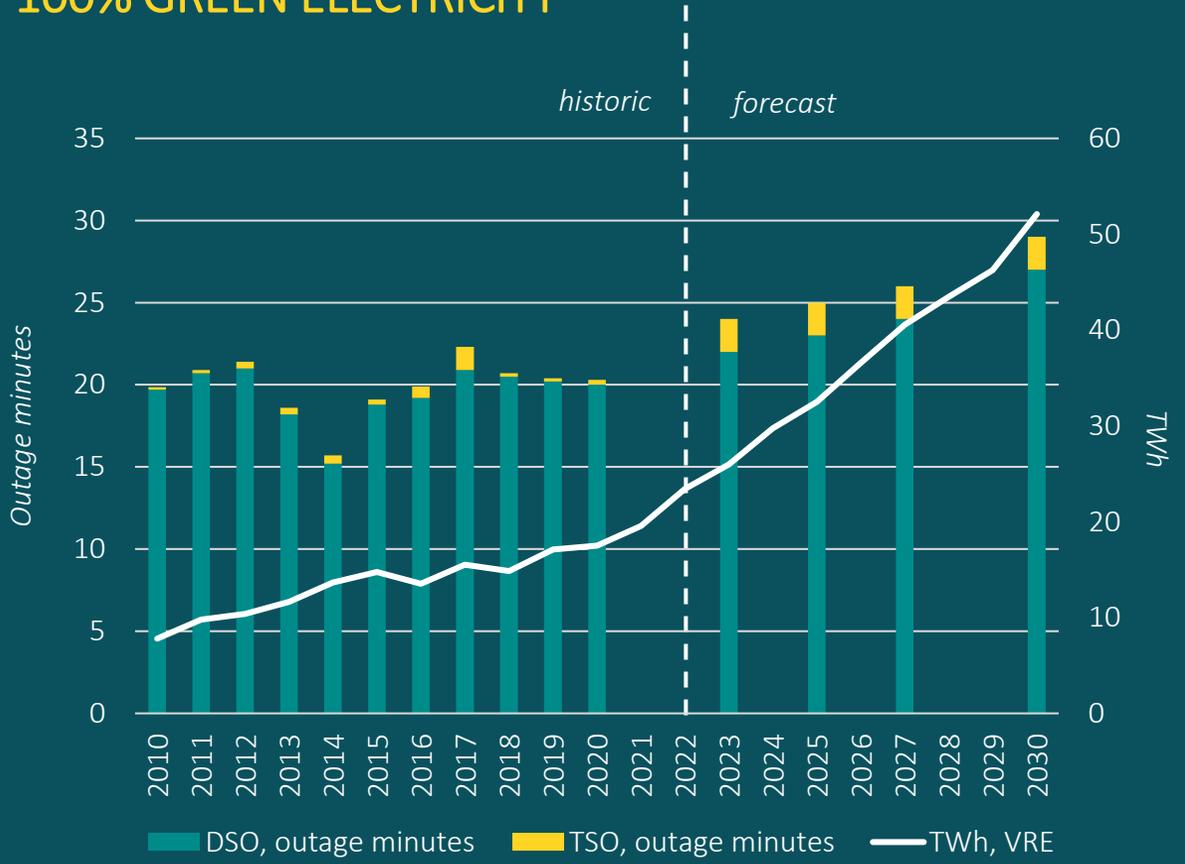
VISION

GREEN ENERGY FOR A  
BETTER WORLD

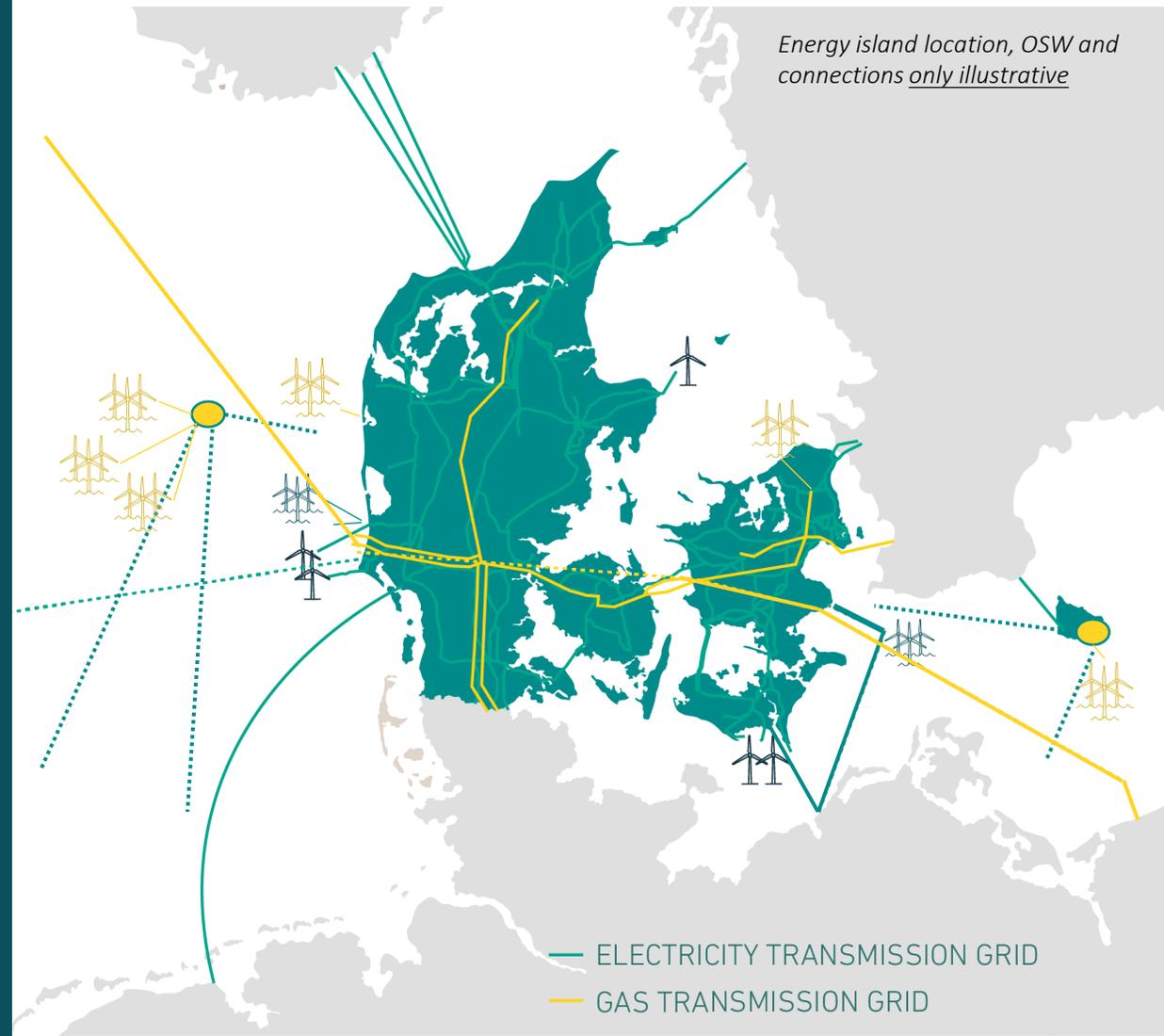


# ENERGINET

## HIGH LEVEL OF SECURITY OF SUPPLY TOWARDS 100% GREEN ELECTRICITY

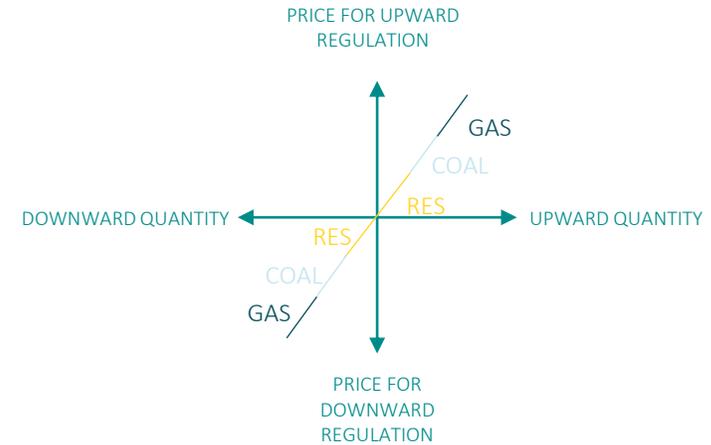
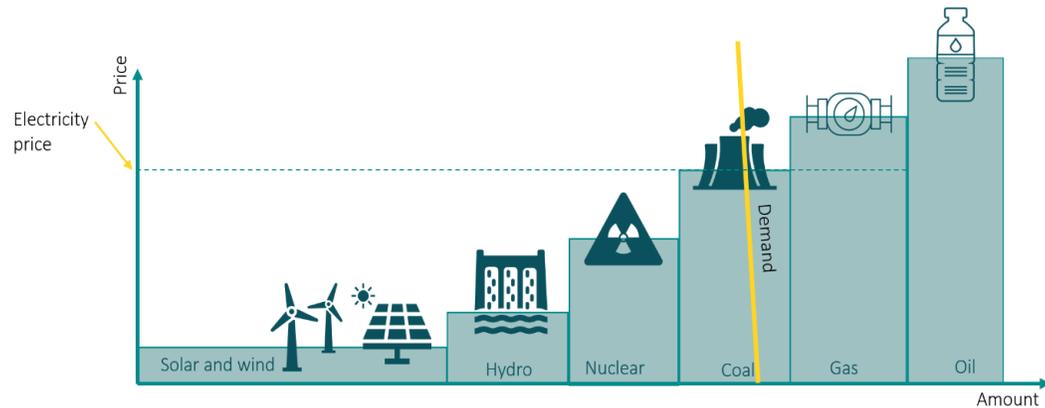


Source: Energinet security of supply report, 2021. Danish Energy Agency: Monthly energy statistics and Assumptions for Energinet, 2021



MARKET CURTAILMENT

# LIMITATION OF (RES) PRODUCTION DURING PRODUCTION SURPLUS



ELECTRICITY PRICING IS BASED ON **MARGINAL** PRODUCTION SOURCE  
(PAY-AS-BID)



PRICING HAPPENS IN **15-MINUTE** MARKETS

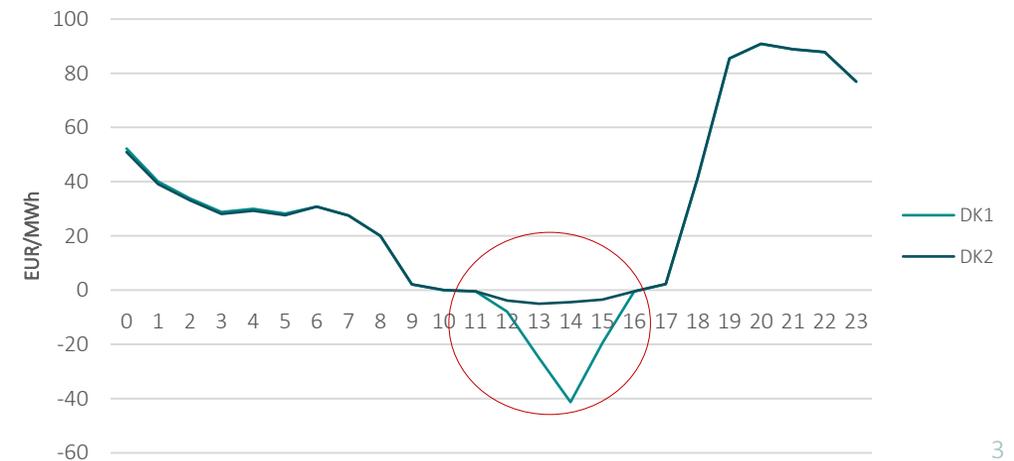


**NEGATIVE PRICES** OFTEN OCCUR WITH LARGE PRODUCTION SURPLUS,  
SUBSIDISED PRODUCTION AND PRODUCTION FROM CHP-PLANTS



NEGATIVE PRICES SIGNALS A CURTAILMENT NEED TO MARKET ACTORS

Day-ahead prices 21st May 2023



# CURTAILMENT OF WIND AND SOLAR

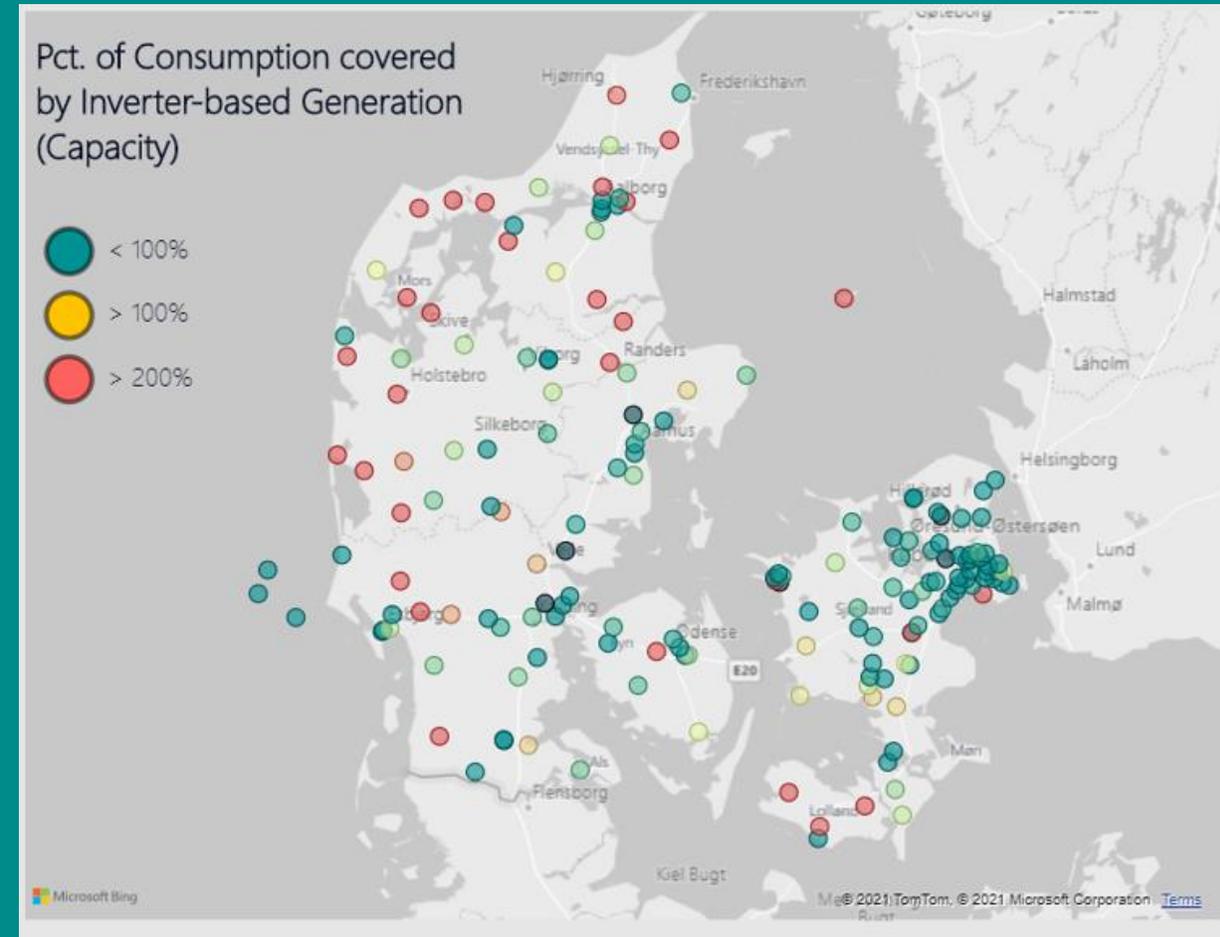
Forced curtailment of wind and solar: < 1% of VRE production

By law ENERGINET is today obliged to:

- Compensation of curtailment of connected production if unplanned grid congestions
- Connect new production in reasonable time – and compensation if connection not ready as agreed.
- Curtailment compensation is based on market price and forecasted production
- Technology neutral regulation based on EU network codes

ENERGINET actions to reduce curtailment and costs:

- Pro-active grid planning – also with distribution grid operators (DSO)
- Optimize utilisation of grid with digitilization and forecasts
- Use of market based tools to curtail lowest cost units and reduce administrative costs



# HISTORIC DEVELOPMENT

- Before 2008: Renewable electricity is prioritized production (EU regulation) and balanced by TSO. Full compensation if curtailed.
- 2008: new and existing wind and solar own balancing responsibility and introduction of negative electricity prices. VRE production voluntarily reduced, when negative prices are below premium (subsidy).
- 2010: As part of tender conditions, Anholt offshore wind park (400 MW) obliged to curtail without compensation if prices below zero. For existing offshore wind parks no restrictions.
- 2012: wind participate in energy balancing market with voluntary down regulation
- 201x: Cooperation with DSO (<110 kv) on grid congestion planning, as VRE build out in DSO area can also influence Transmission grid.
- 2020: first wind turbine installed without subsidies and incentive to stop production when electricity price below zero
- 2021: updated rules for compensation from curtailment for non-firm connected wind turbines and use of market based downregulation (cheapest unit from energy balancing market will be down regulated)
- 2021: Development of public capacity map with DSO to incentivize investment where, there is excess grid capacity (reduce future need for curtailment)
- 2022: geographical differences in connection costs and production tariffs to incentivize location with high demand and low VRE production

# CURRENT AND FUTURE ACTIONS TO REDUCE NEED FOR NEW GRID AND CURTAILMENT TO ACCELERATE AFFORDABLE GREEN TRANSITION

## Construction Solutions:

- Direct lines – relevant for offshore wind and electrolyzers
- Pooling of projects to establish new substations
- Temporary masts and direct connection

## Planning solutions

- Technology neutral grid planning – separate identification of needs with solutions
- Electricity price and solar/wind/storage/hydrogen optimized hybrid grid connections
- Market dialogue on expected new investments in solar and wind
- Digitilization of connection process for improved transparency

## Market solutions:

- Tariff reform to give location signal and reflect on actual costs for connection
- Local flexibility markets for congestion handling
- Storage based on technology neutral market incentives

## Operational solutions

- Forecast based dynamic line rating
- New digital tools in control center for improved real time information and forecasts

# COMPENSATION FOR CURTAILMENT

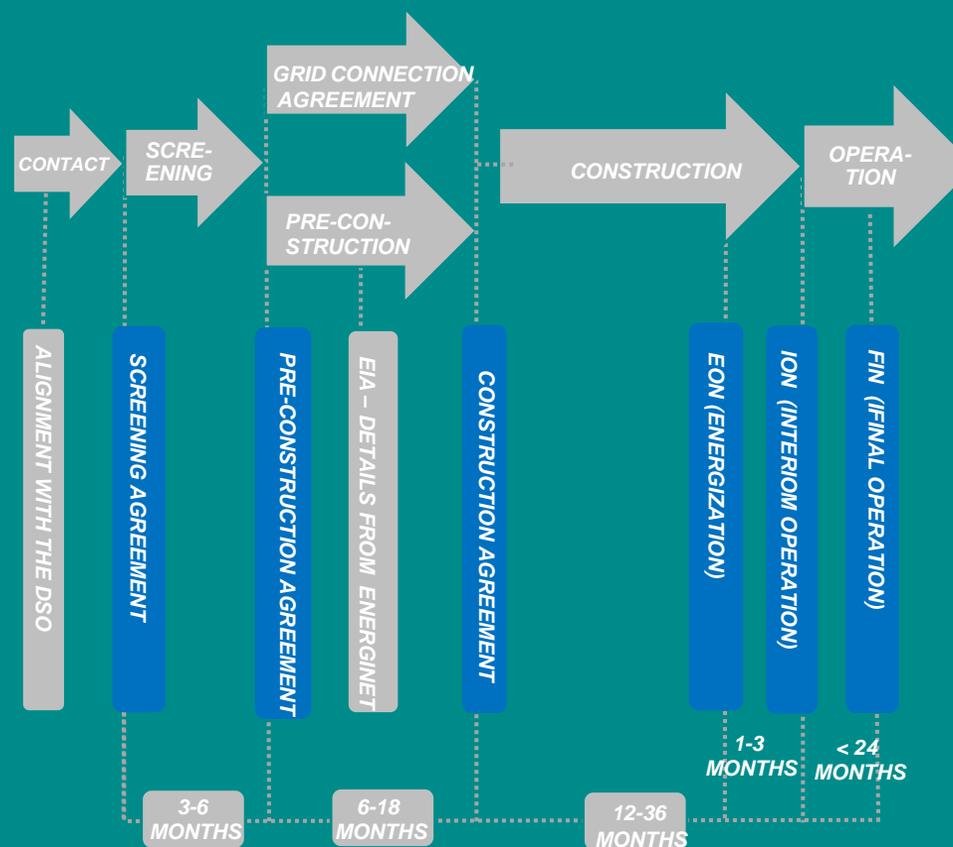
	Connection agreement with full grid access*	Connection agreement with limitations in grid access**
Connection delayed	Compensation, spot price for expected production	Compensation, spot price for expected production
Planned outage	Compensation, spot price for expected production	No compensation
Non planned outage	Compensation, down regulation price for expected production***	No compensation

Less than 1% of wind production are curtailed annually due to to grid congestions  
*\*in offshore wind tenders always full grid access. Not possible to choose limited grid access.*

*\*\*investor can choose limited grid access for faster connection and with risk of curtailment.*

*\*\*\*down regulation price is normally lower than spot price. From 2022 curtailment will be based on lowest costs bids in energy balancing market.*

# PROCES FOR GRID CONNECTION



# ENERGINET RECOMMENDATIONS TO REDUCE CURTAILMENT AND COSTS FOR FAIR VRE INTEGRATION

- **Transparency** in curtailment compensation and expected volume important for investors to develop projects and business case
- Optimize use of existing grid with **operational solutions** – incl. digitization for real-time operation
- Dialogue with **stakeholders** on location and connection solutions to reduce future need for curtailment
- Use of **market solutions** to reduce costs for curtailment and efficient administration
- Adapt tariff, grid planning and connection regulation to **reflect future energy system** needs and technology neutral solutions

## A BALANCING ACT

