Offshore wind in the UK:

Status and opportunities

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mtc where progress happens

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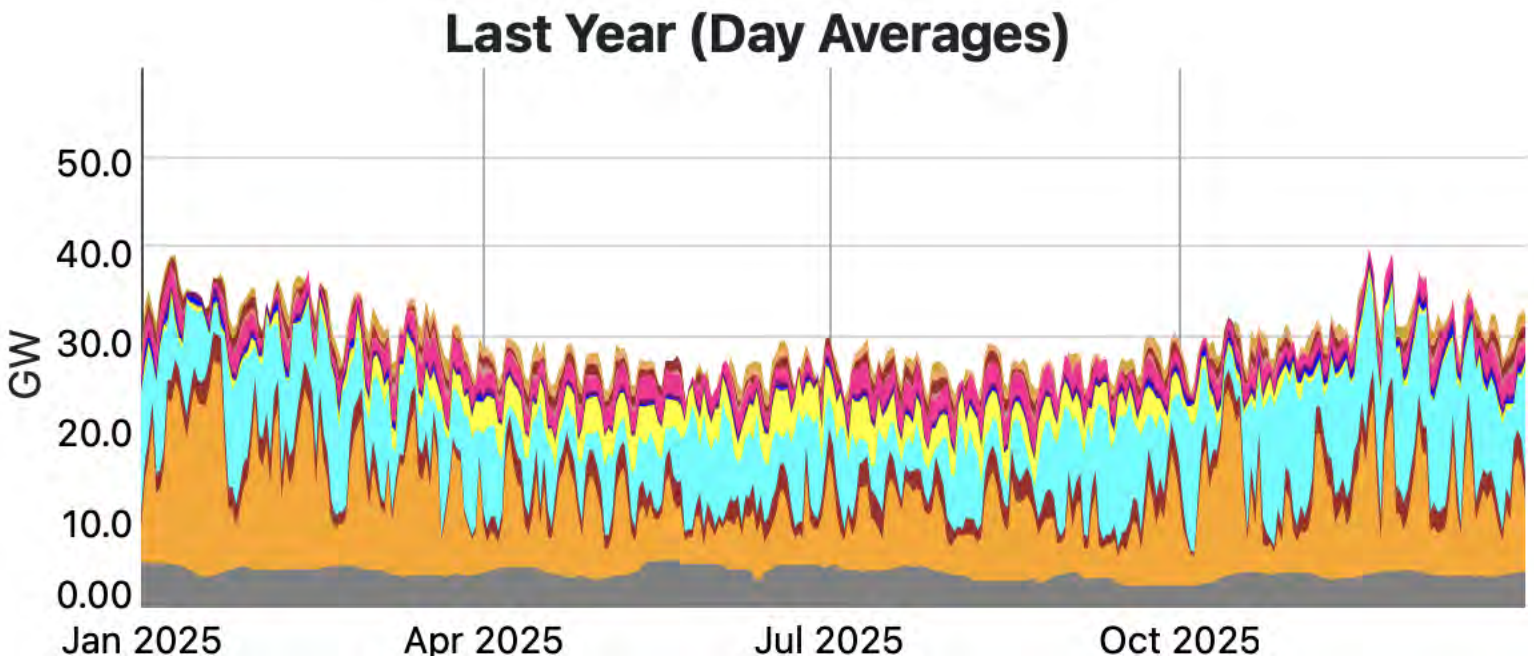
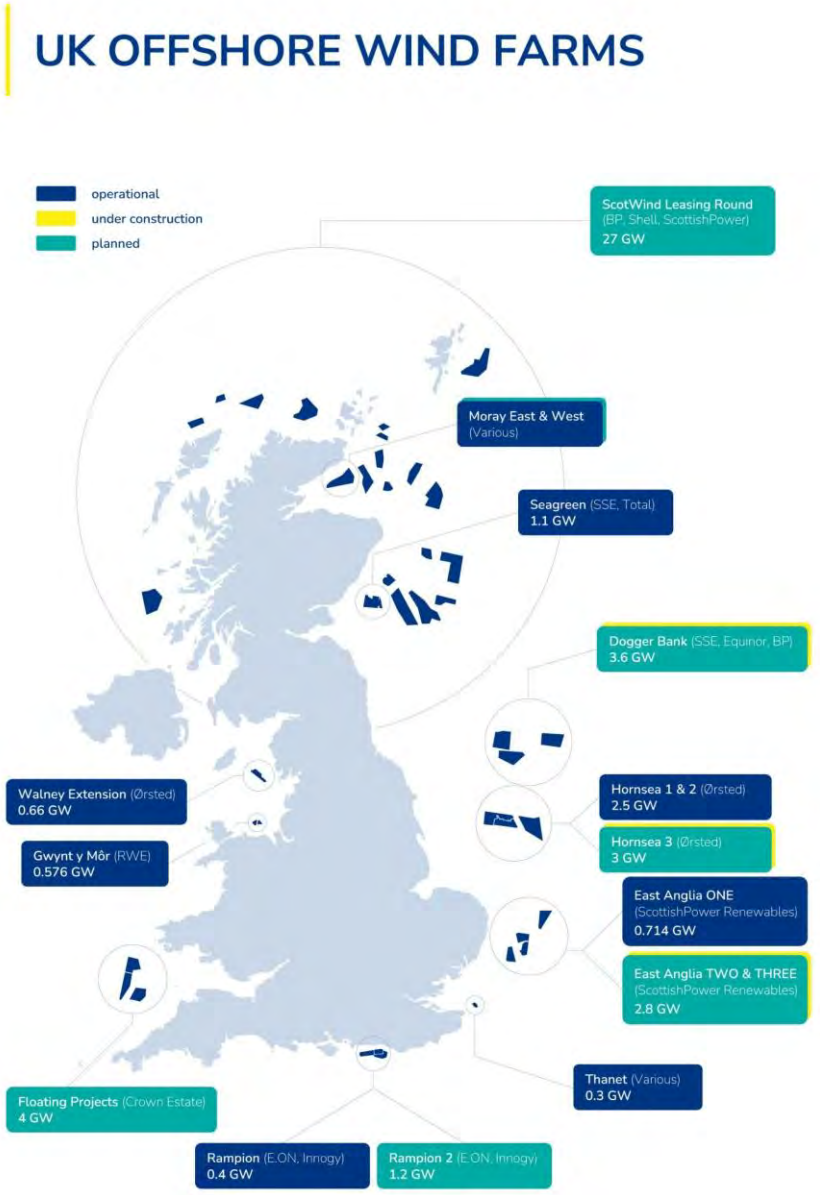
Overview – targets too high

Government target: 43-50GW Offshore wind by 2030

Currently ~16GW of commissioned capacity

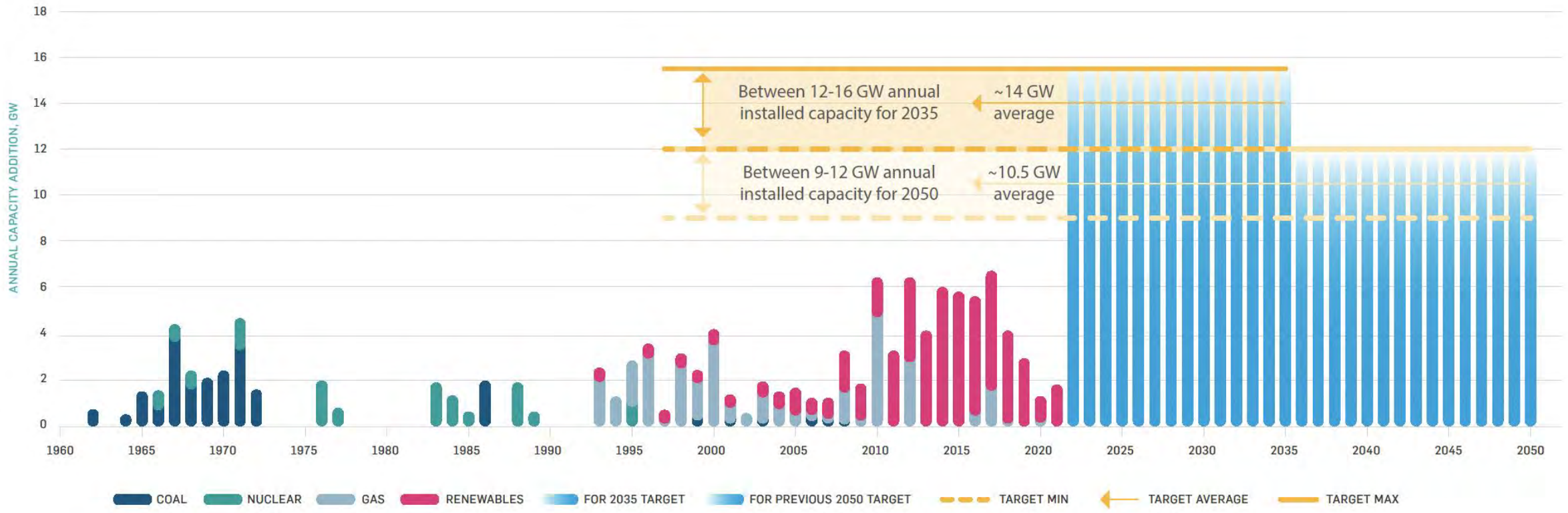


Source: Gridwatch.co.uk



Source: Lumify.com

Target feasibility and Deployment rate



Source: Atkins, 2022, “Towards Net Zero: Are we building fast enough?”

Transition modelling – S curves

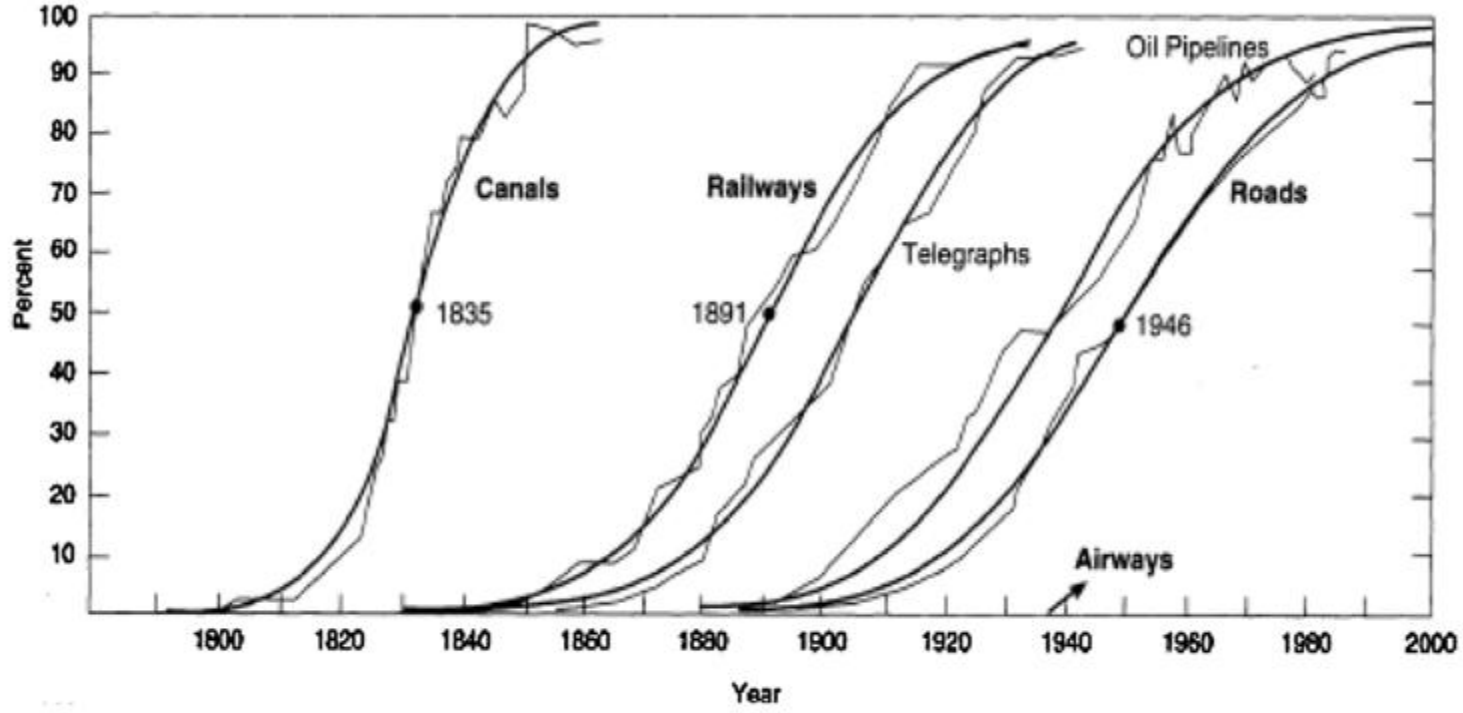
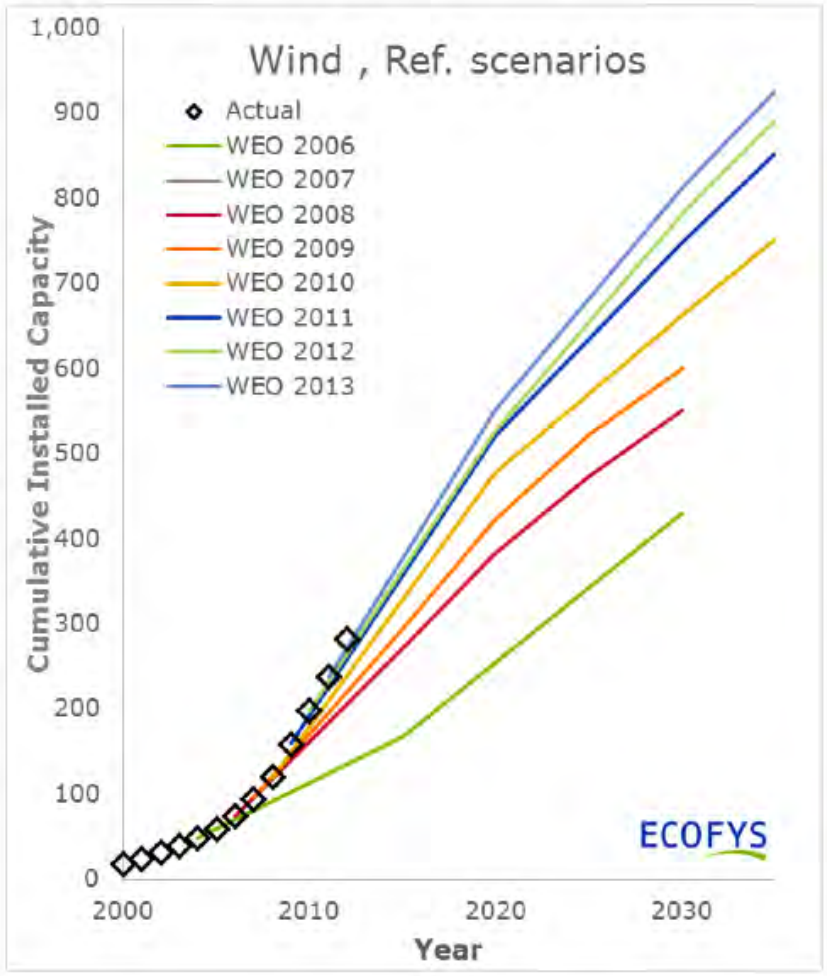
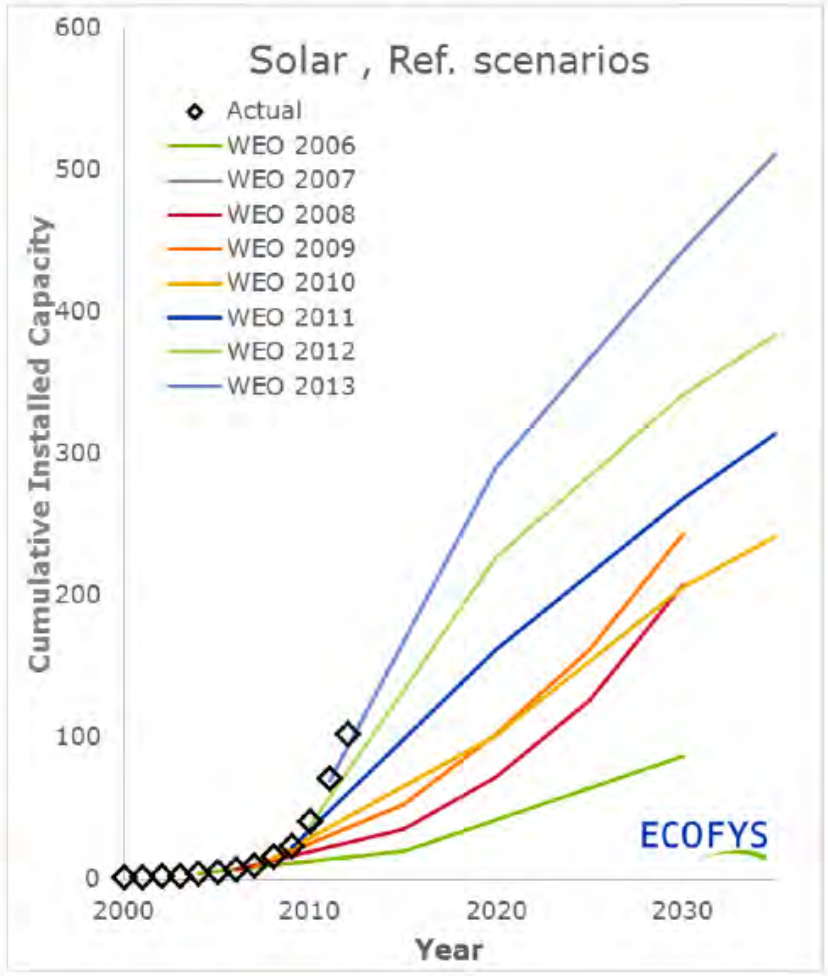


Fig. 1. Growth of Infrastructures in the United States as a Percentage of their Maximum Network Size.

Sovacool 2016, Energy Research and Social Science

IEA – S curve fitting isn't predictive





Source: IEA, World Energy Outlook

Modelling approaches

Top down

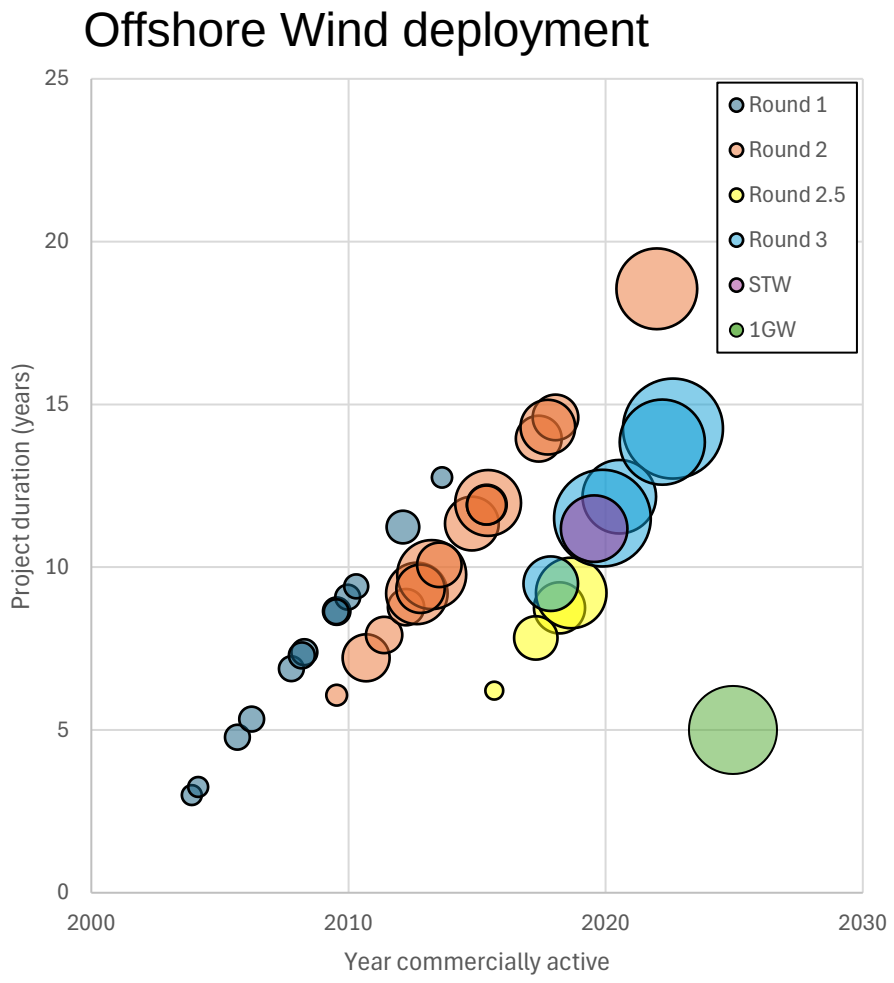
How much do we need? → When? → How fast do we need to go?

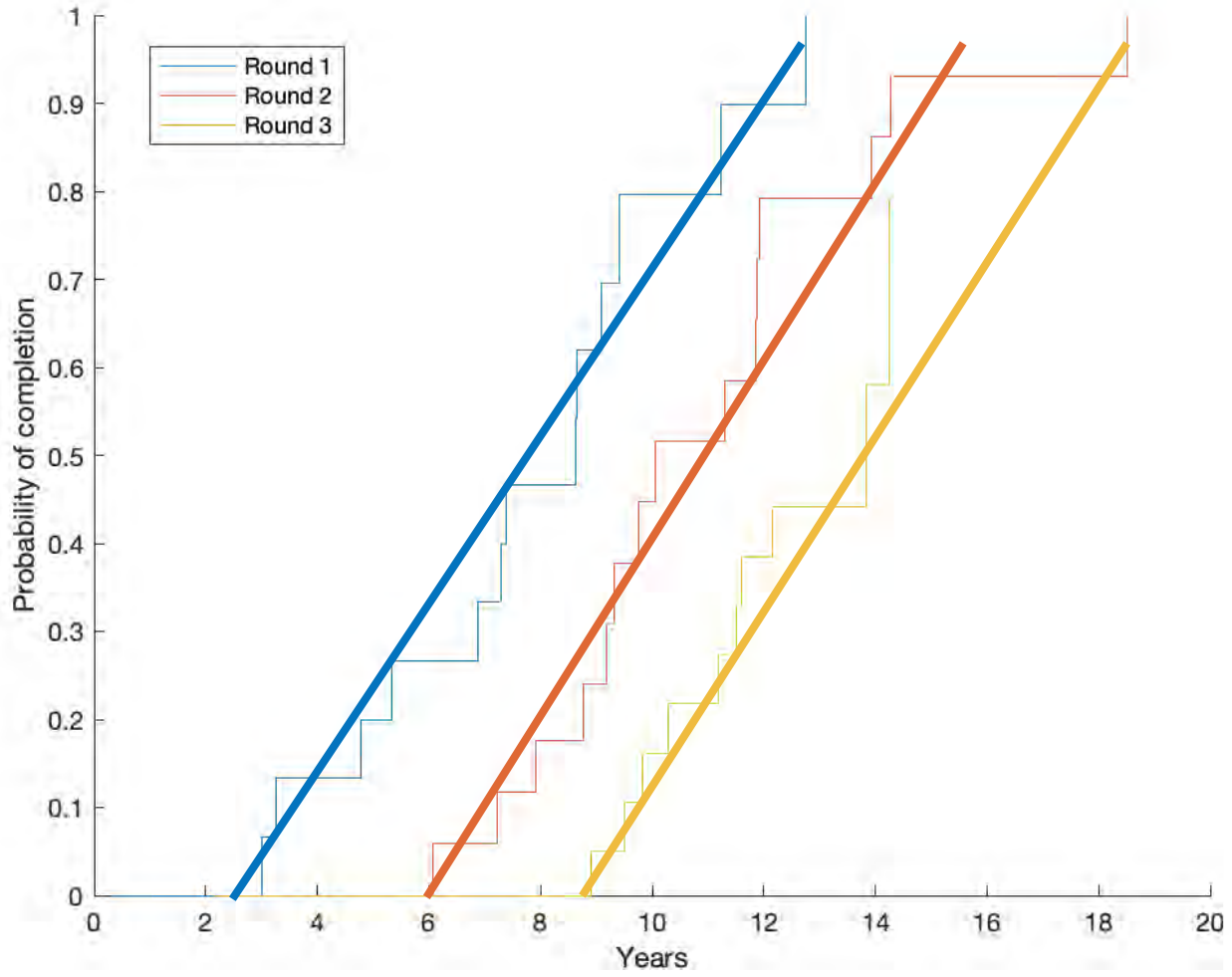
Bottom-up

What are we building? → How quickly? → How much will we have?

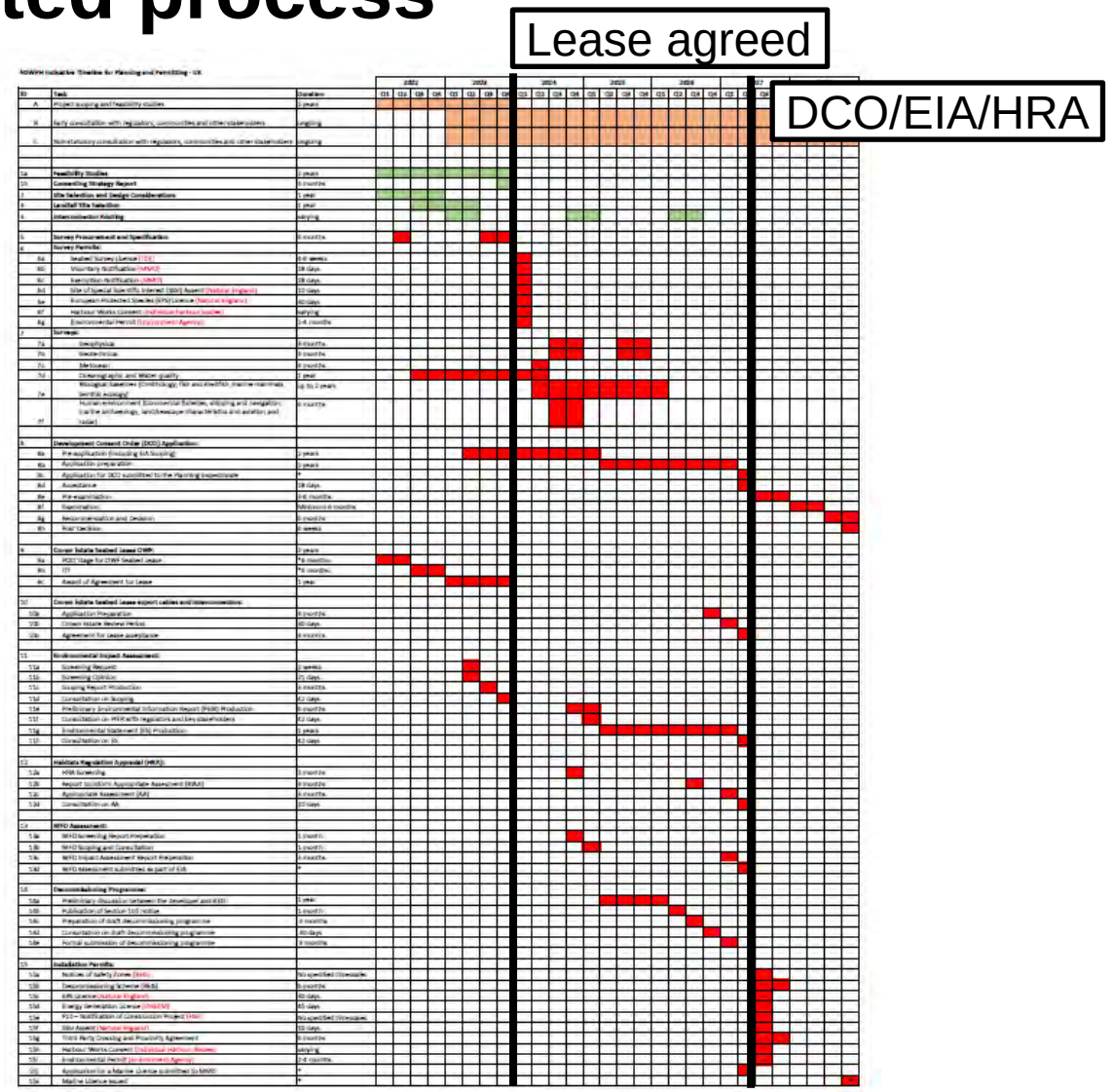
So how do we model an infrastructural transition from the bottom up?

Project duration – historical





Project stages – gated process



Generalised project timeline

Pre-development

- Siting
- Leasing rounds
- Technical design

Planning

- Public consultation
- Planning permission
- Development consent order (DCO)
- Environmental impact assessment (EIA)

Finance and Tendering

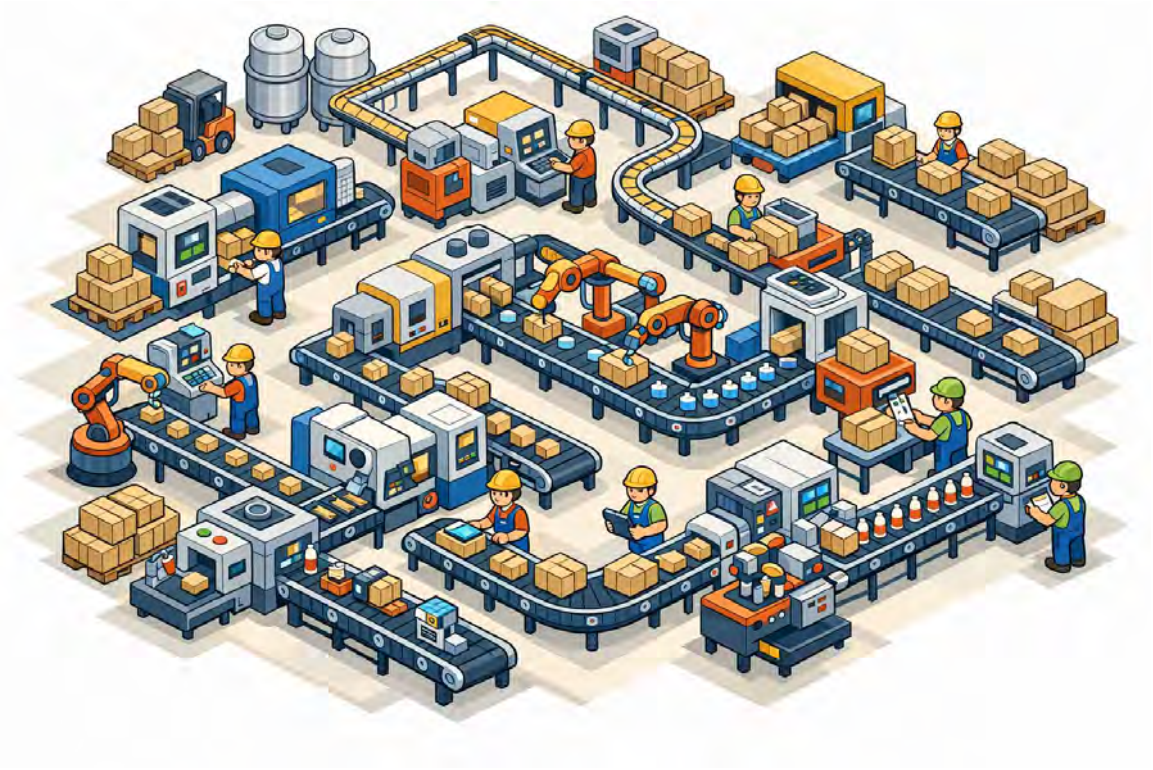
- Tendering
- Supply chain
- Contract for difference (CfD)
- Arranging debt
- Final investment decision (FID)

Construction

- Construction
- Grid connection
- Commissioning

The factory model

We simulate the pipeline of projects like a factory scheduling problem.



Project Duration:

- Siting → Planning → Finances → Construction

National capacity to deliver:

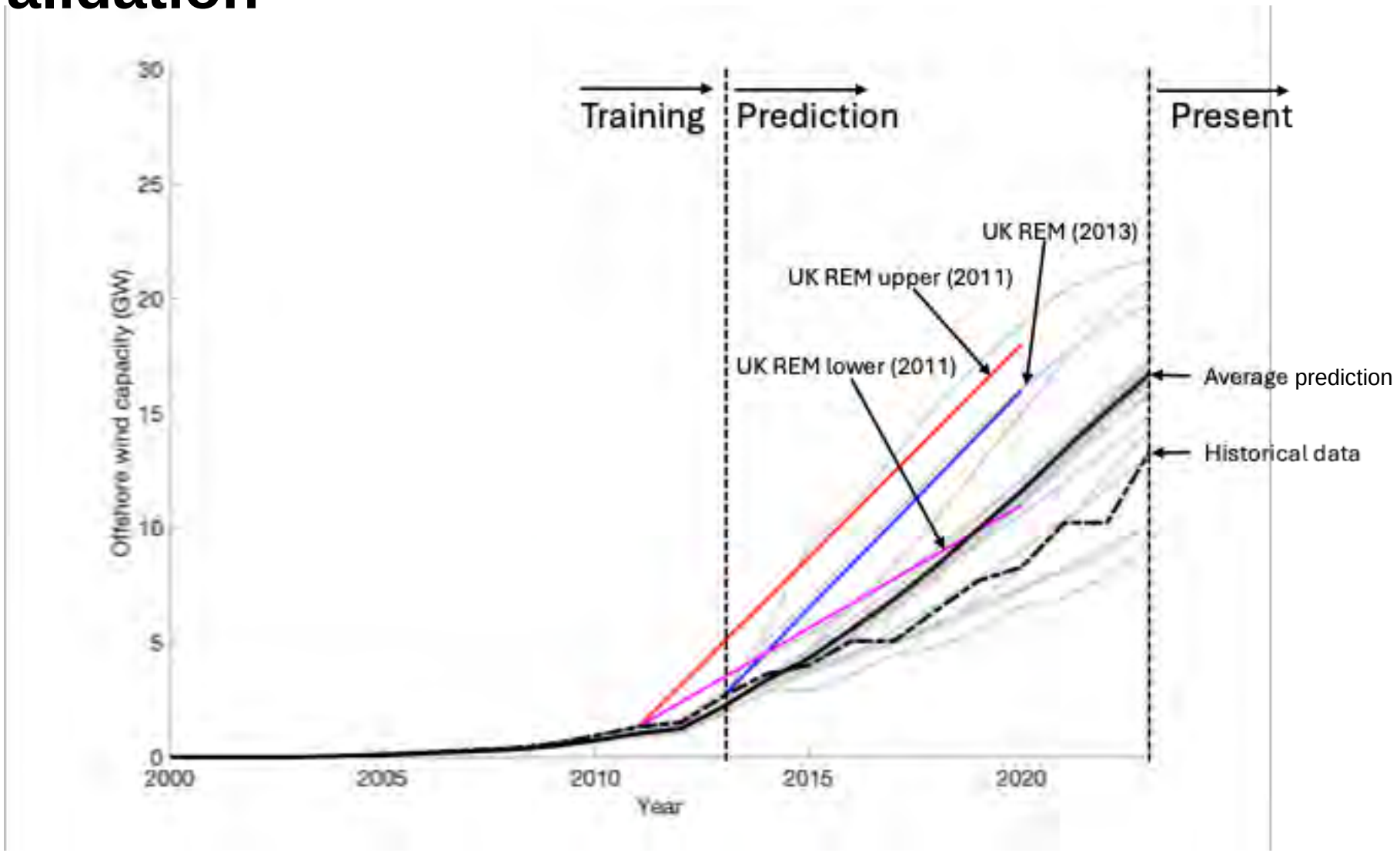
- Bottlenecks restricting concurrent projects

Attrition:

- Risks of project failure

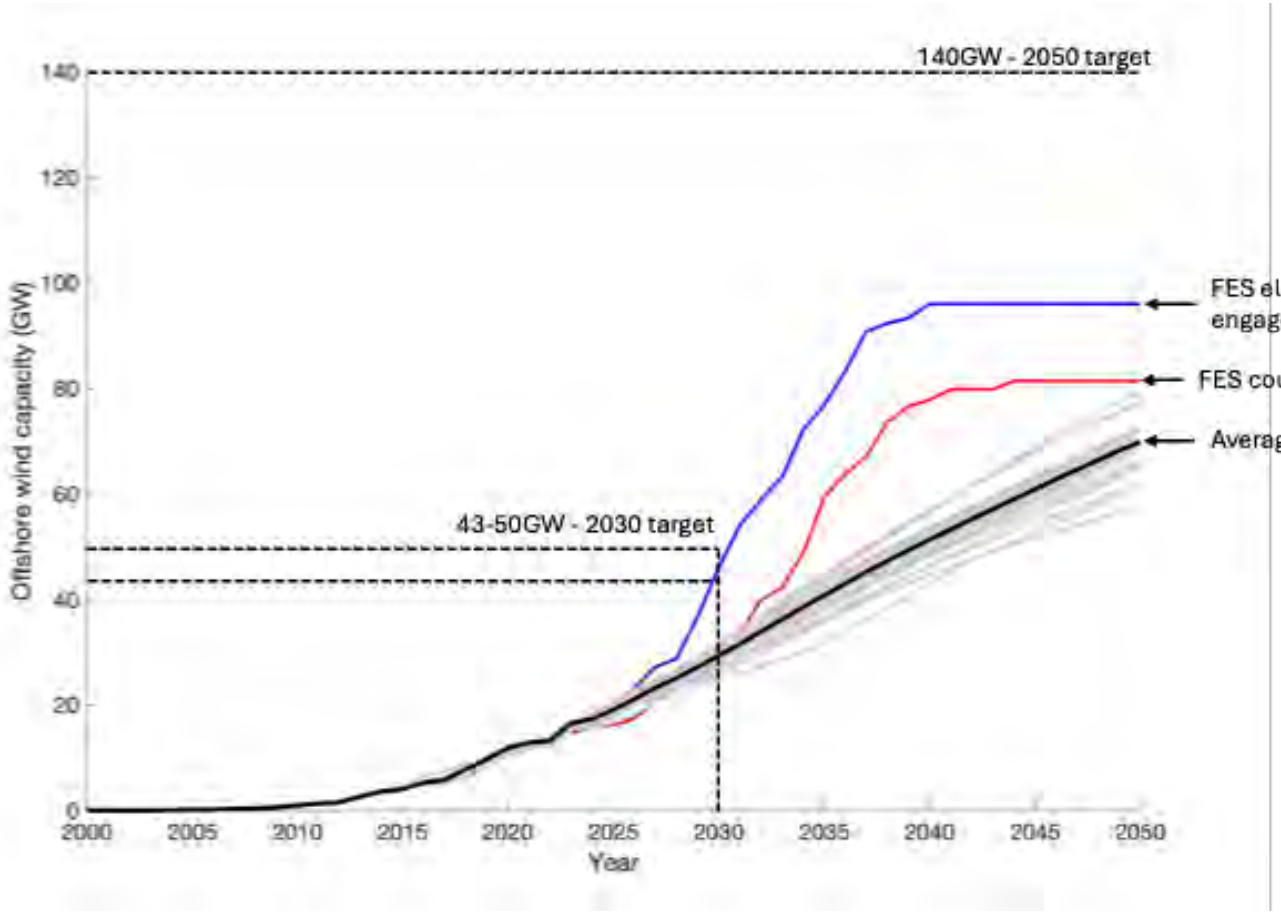
(This technique is also used for production planning and CPU scheduling)

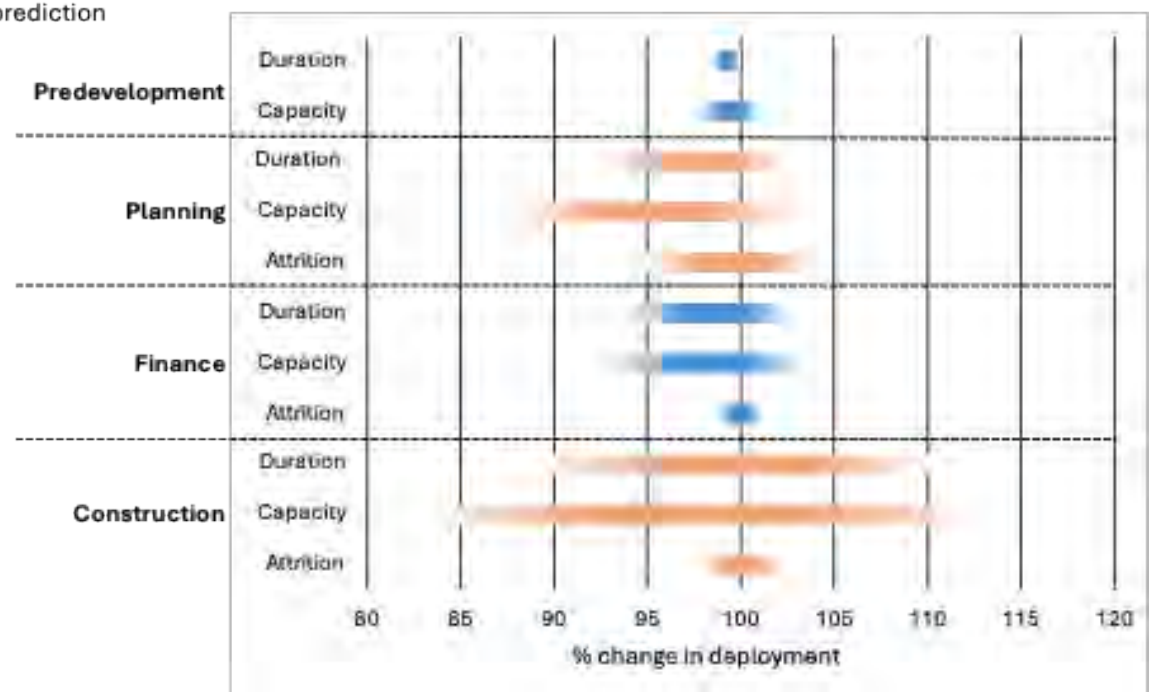
Model Validation



Garrick, Andrew J. H. and Stephenson, Samuel D. and Allwood, Julian M., Why Aren't We Going Faster? A Flow-Shop Model of National Infrastructure Deployment Dynamics Applied to UK 2050 Zero Emissions Targets. SSRN: https://ssrn.com/abstract=5196542

Offshore Wind predictions

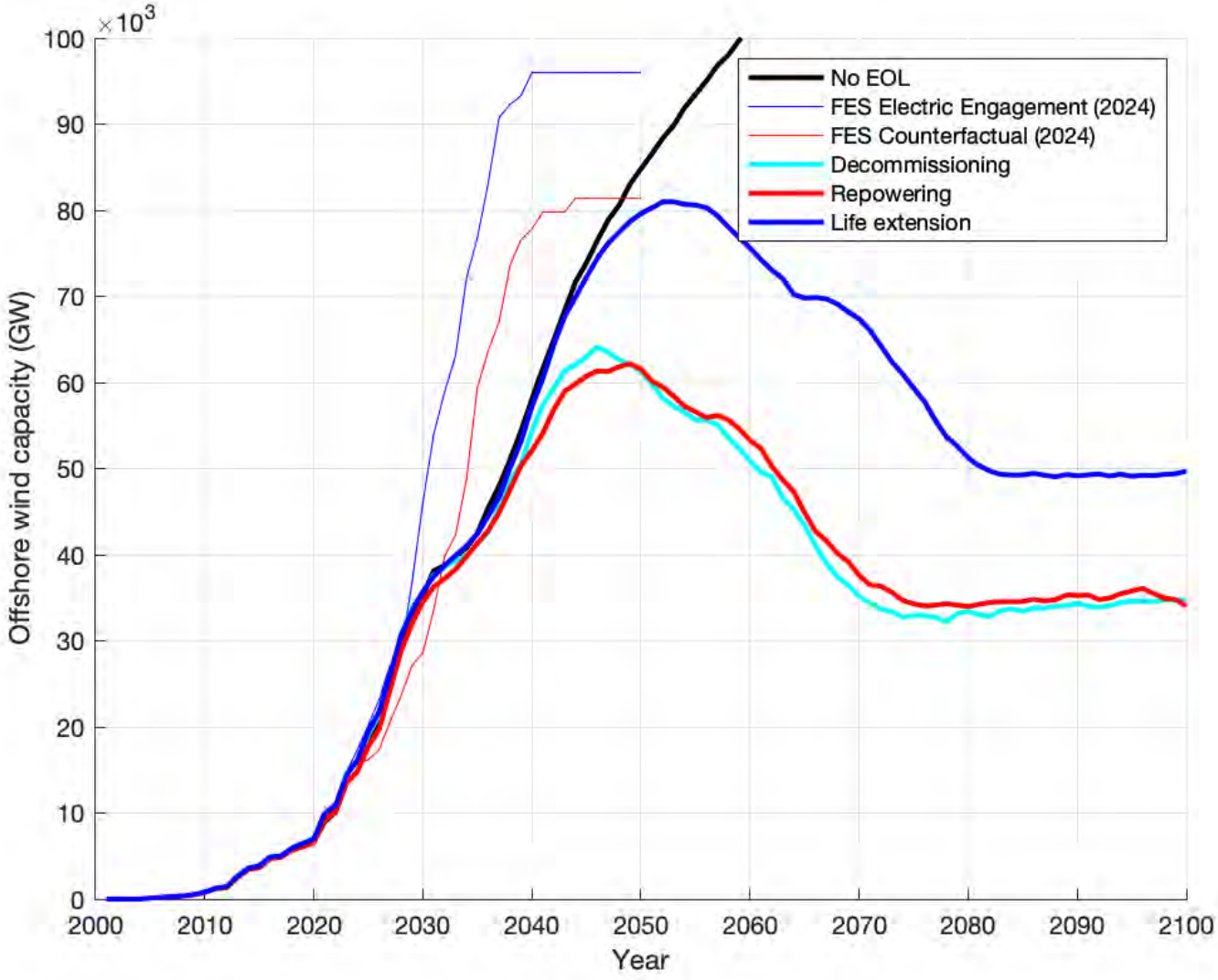




Making matters worse…
Deployment vs end of life bottlenecks

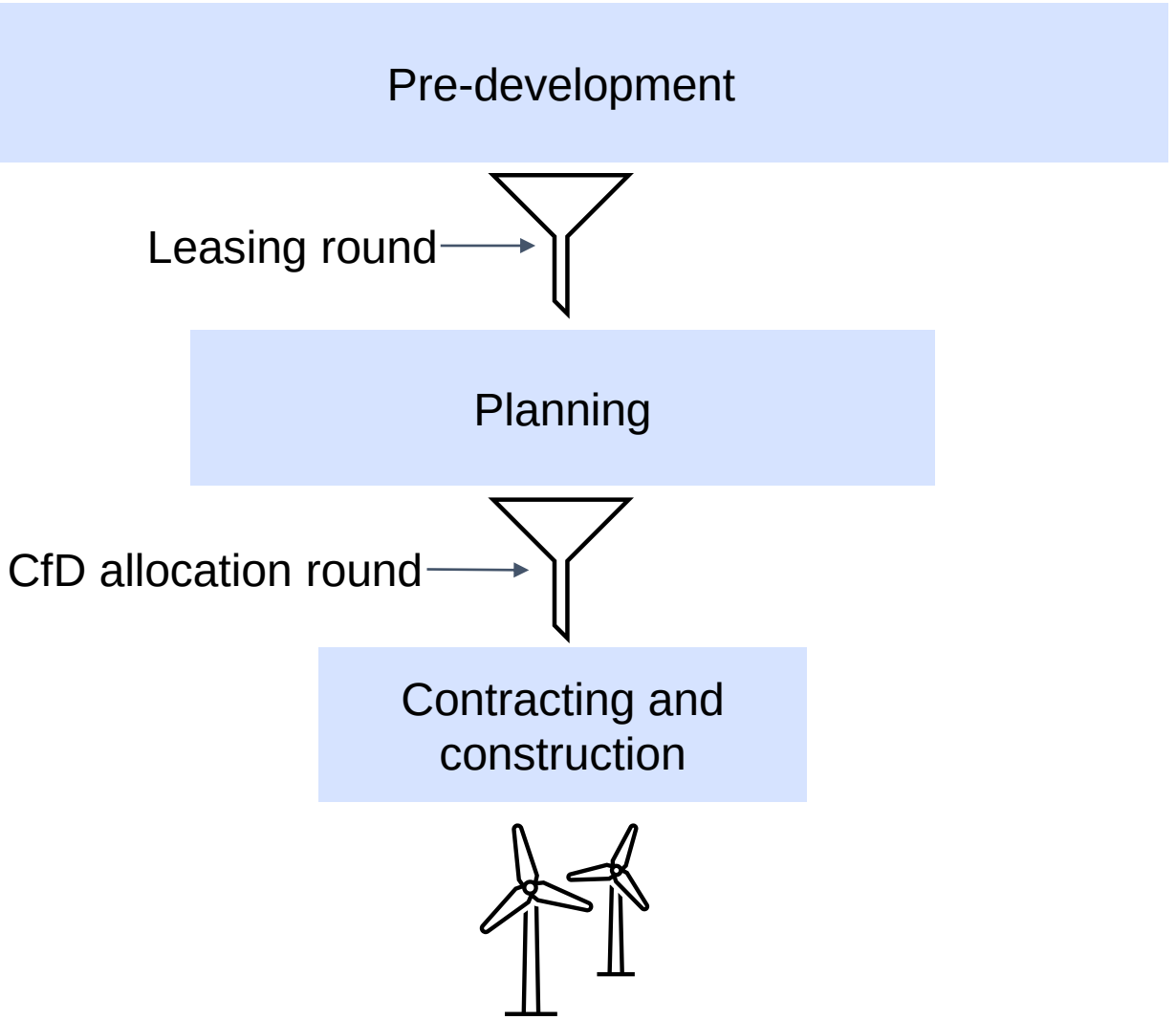
Image: https://trellis.net/article/circular-economy-meets-decommissioned-wind-turbine-blades/

Decommissioning will limit capacity

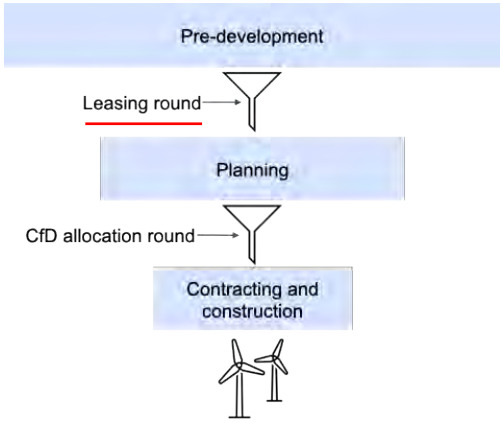


Carrying capacity is determined by underlying resources

Alternative view: Funnel model



Leasing round structure and deployment rate

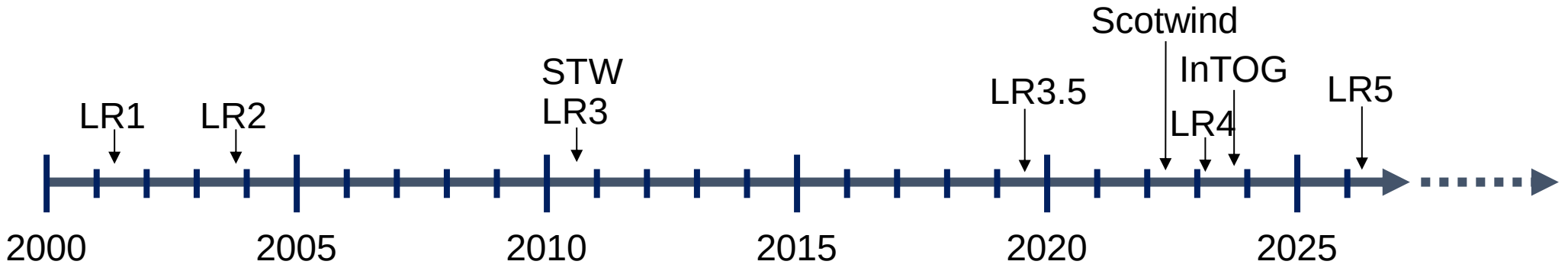


Leasing is lumpy – throttling projects joining queue

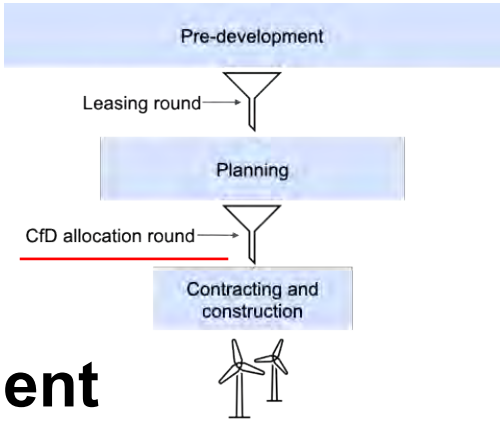
Round structures are longer, with more included at AfL

Shorter intervals

Grid connections are pre-considered for LR5



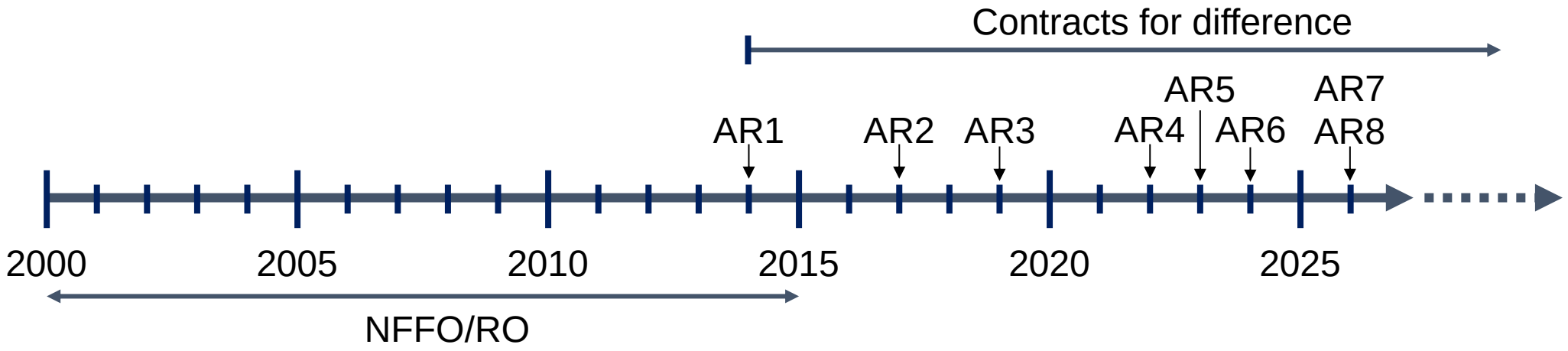
Auction round structure and deployment rate



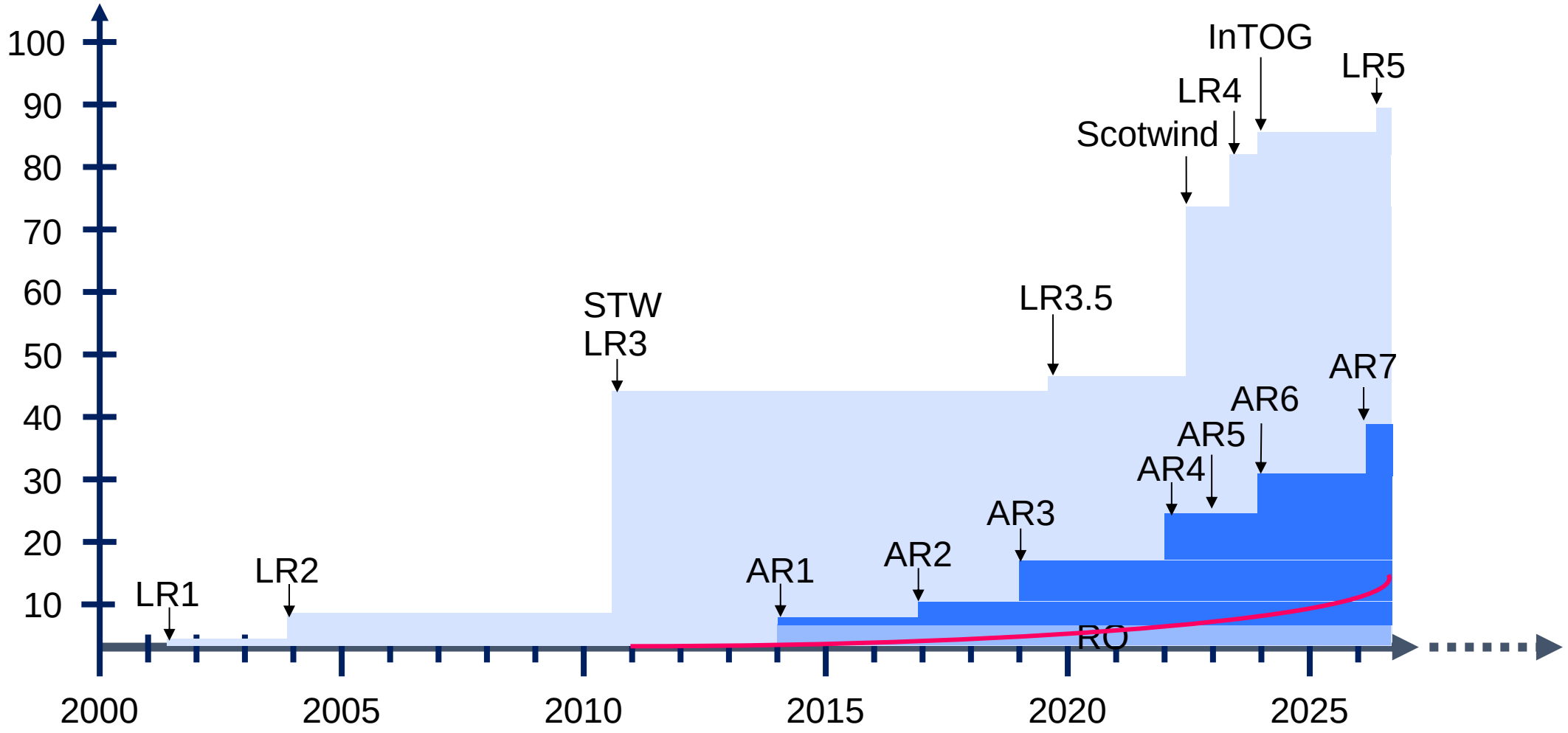
Contracts for difference now the standard funding model

Uncertainty and “lumpy” round approach has slowed deployment

- Consider AR5



Acceleration? Leasing round structure and deployment rate



Viking Energy – project mistiming

440MW located in Shetland

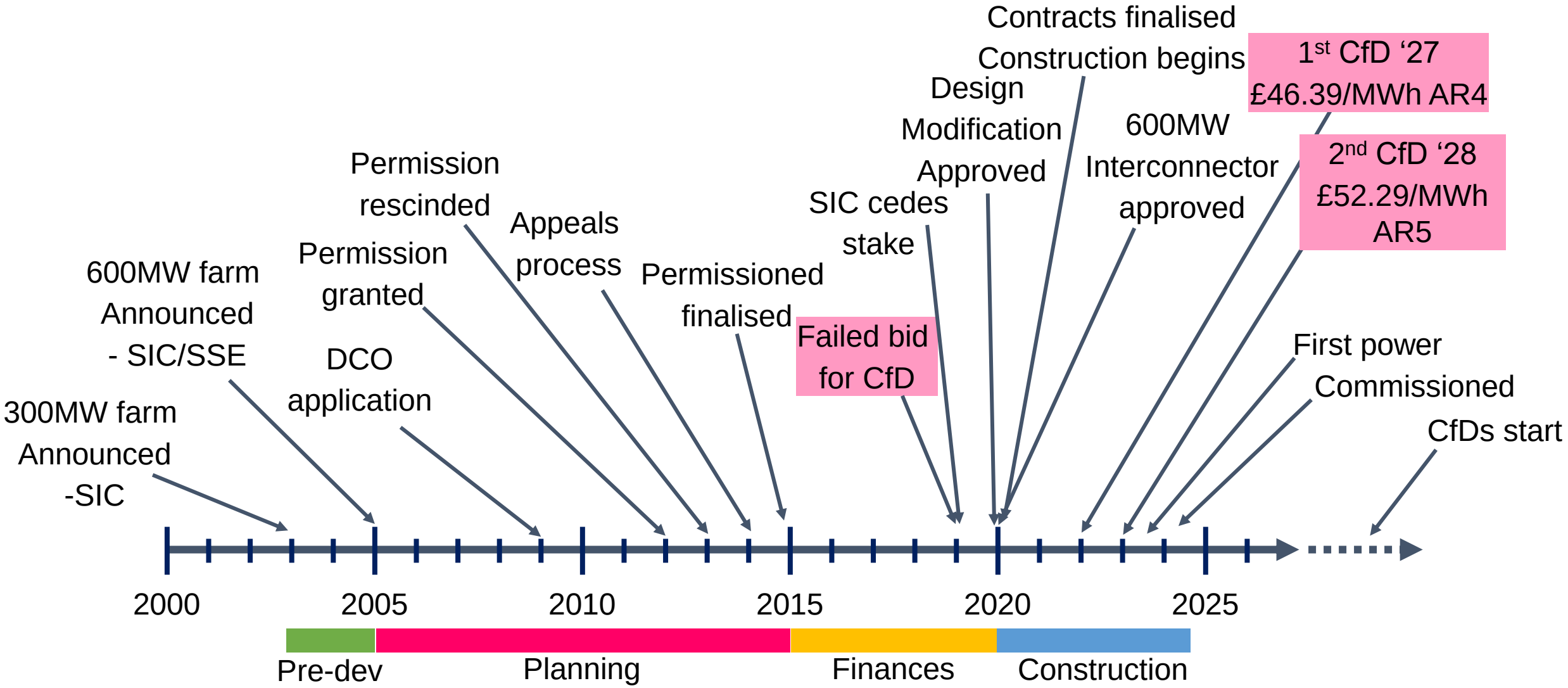
“Offshore resource – onshore costs”

Proposed 2003, commissioned 2024

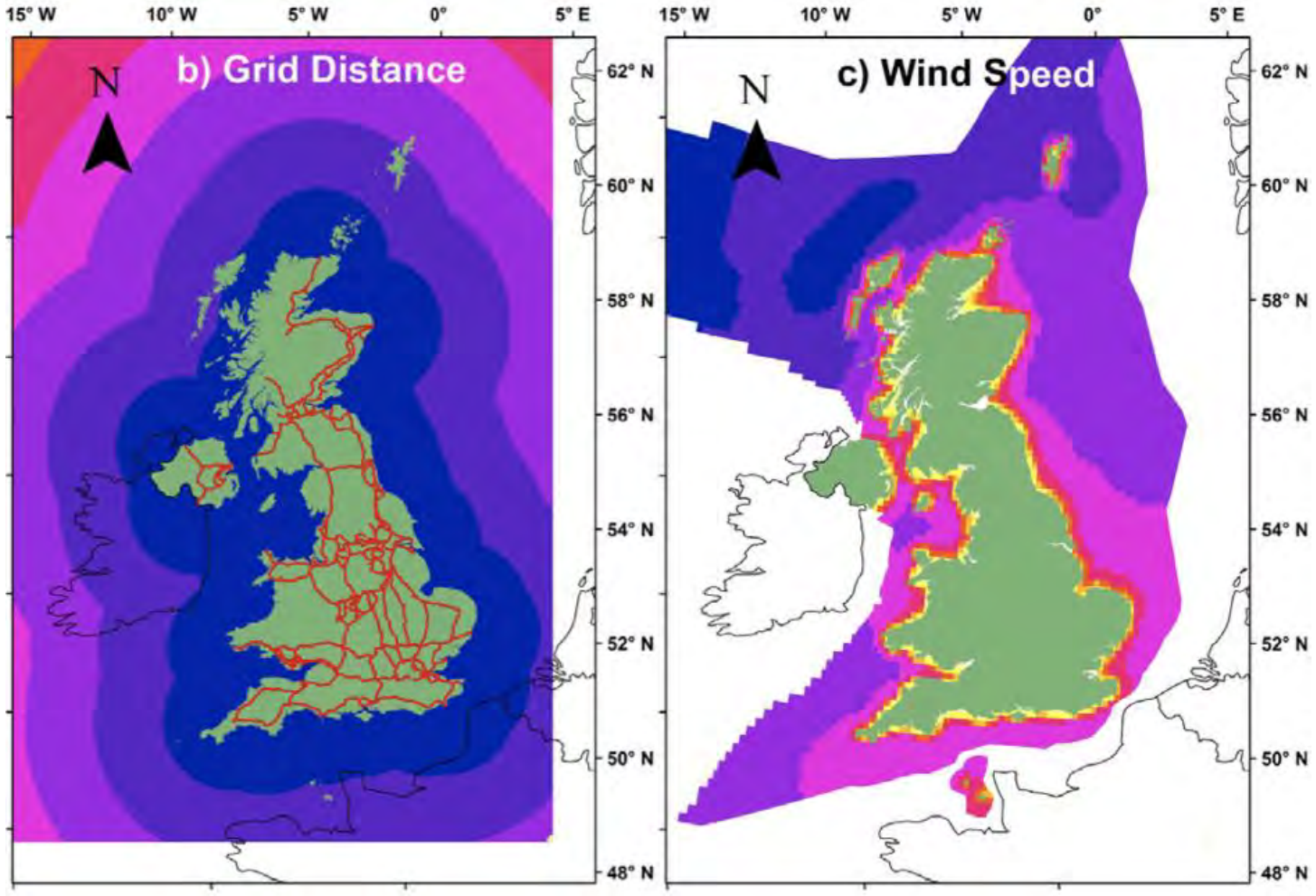
Intended to achieve >50% capacity factor – much less in practice (~15%)

600MW interconnector built

Viking Energy Timeline – CfDs and FID?

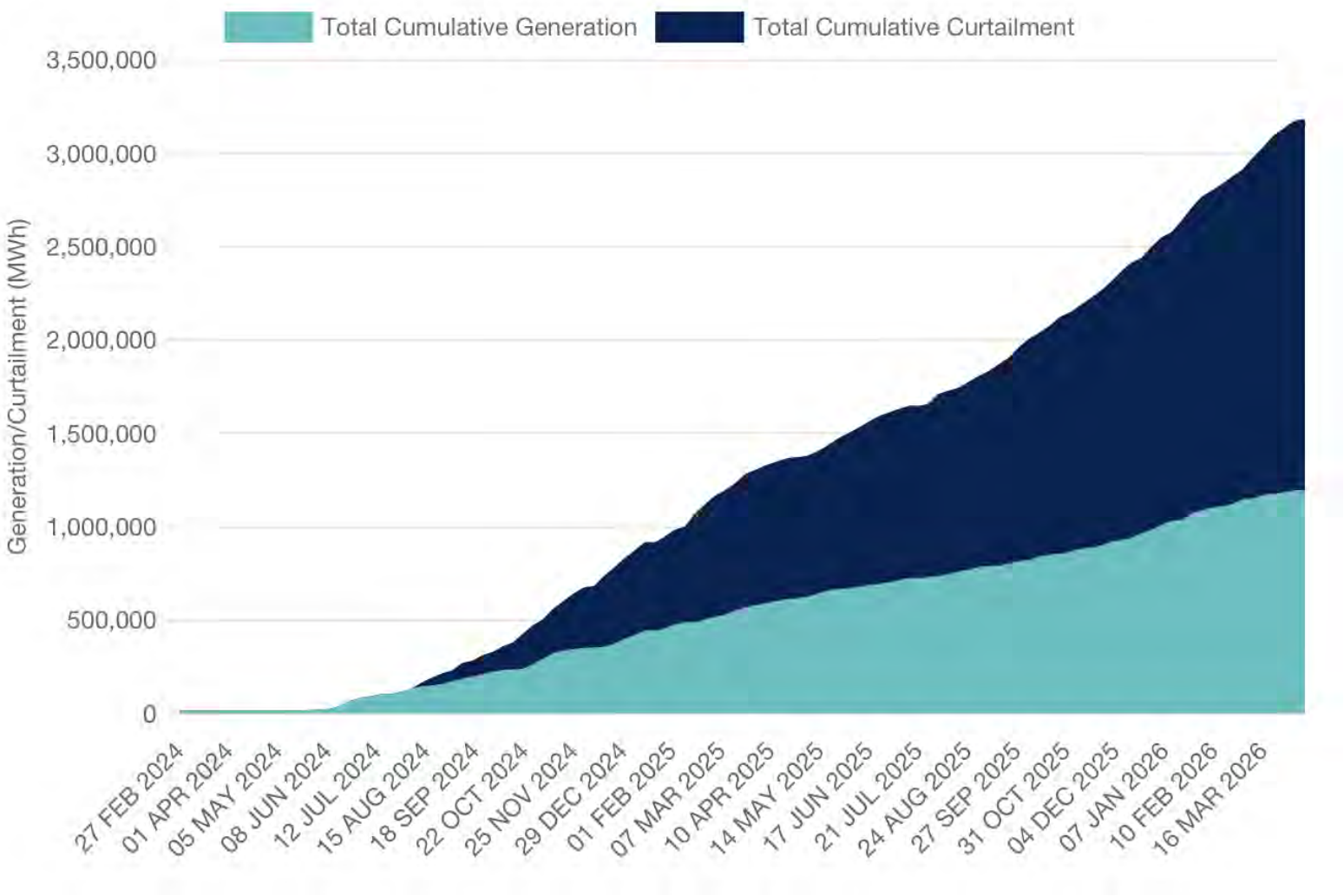


Wind resource vs grid bottlenecks



Bahaj et al. (2020)

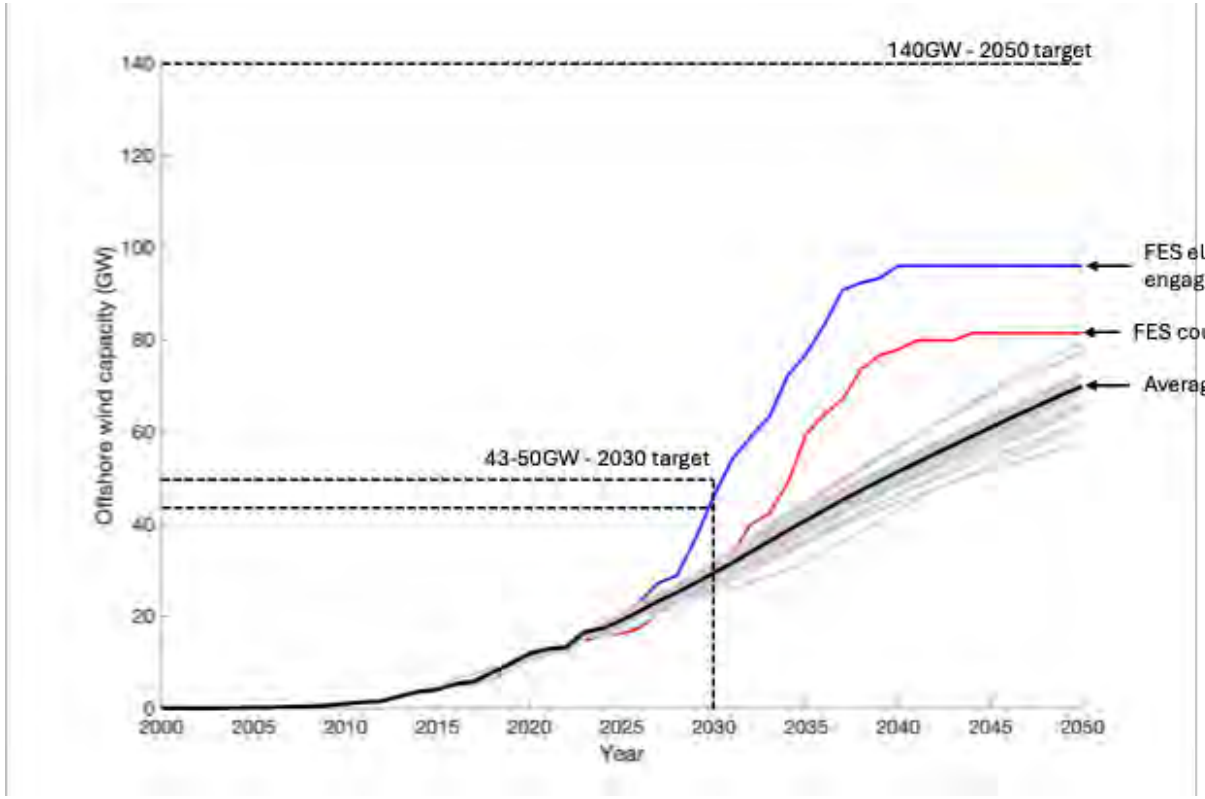
Lumpy CfDs and Curtailment

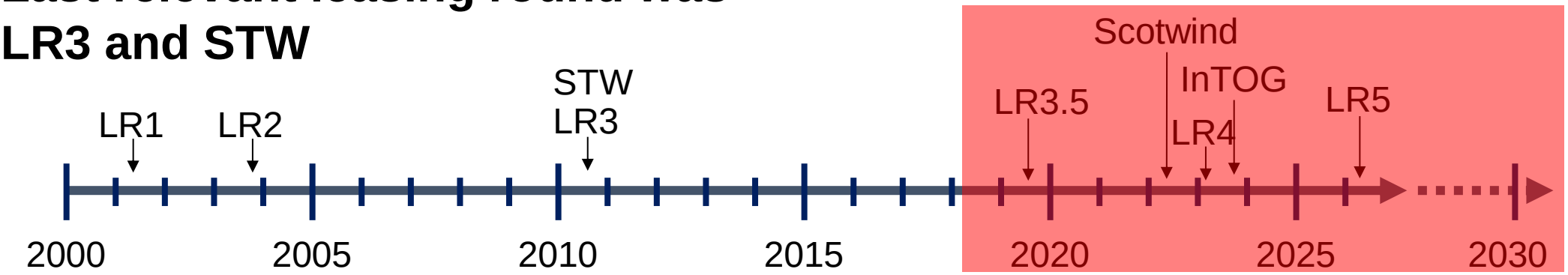


(figure: Windtable.co.uk)

Outlook 2030

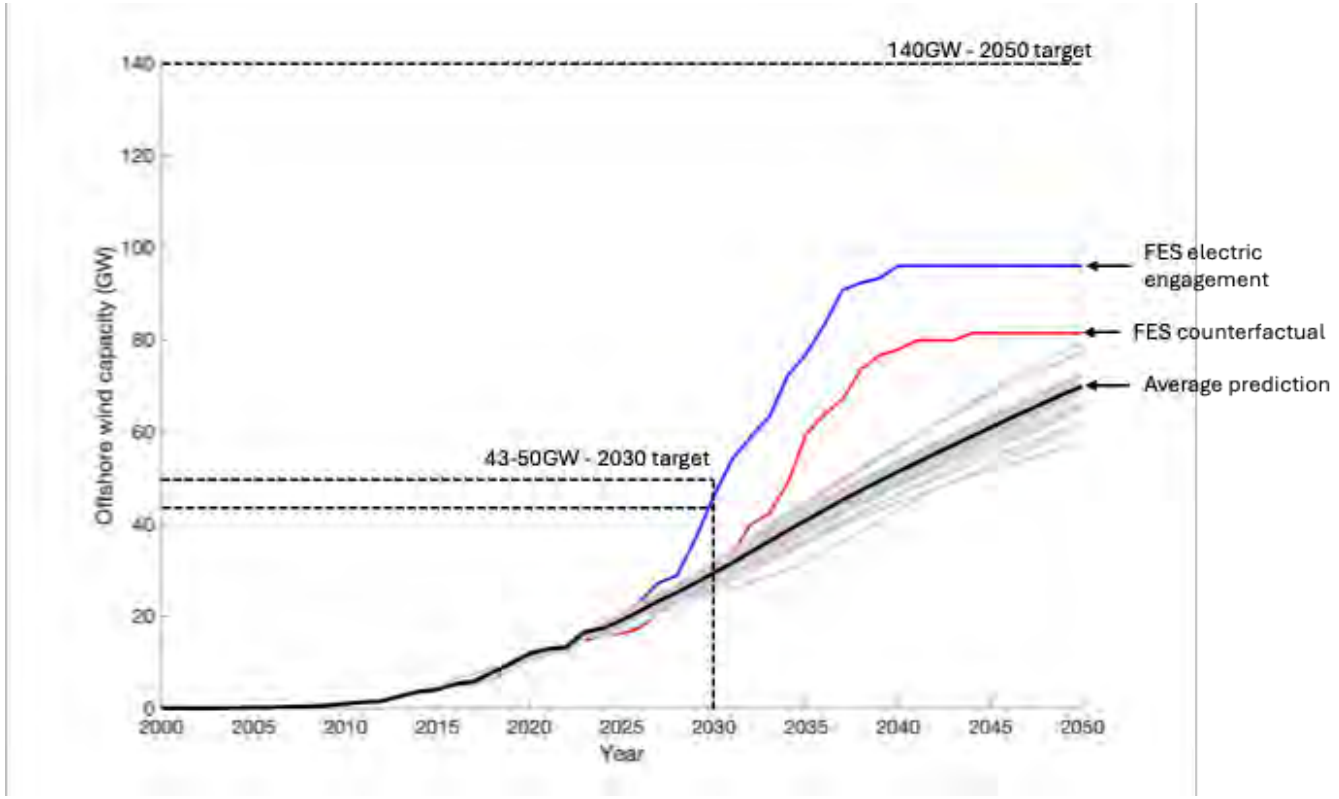
- **Target 43-50GW**
- **Model predicts ~30GW**
- **Timelines are too long to change trajectory**
- **Last relevant leasing round was LR3 and STW**

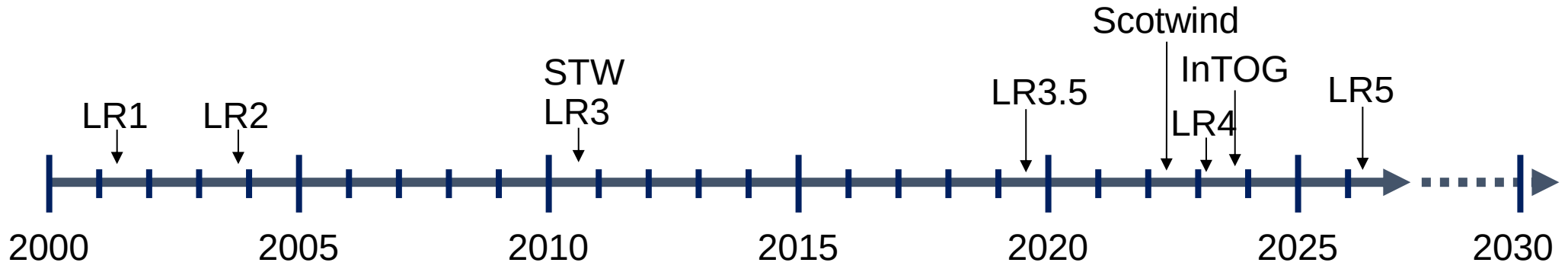




Outlook 2040

- **Model predicts 45-55GW**
- **Potential for acceleration (parallelisation, delumping)**
- **Likely rescale of Scottish wind**





Discussion

Our targets are not achievable:

- Deployment rates still unprecedented, look ahead to physical bottlenecks

For faster deployment: parallelise or delump the planning and finance stages

- This is done in NL by leasing fully developed projects not seabed

Scottish wind is oversubscribed:

- Viking is a cautionary tale of constraint payments
- Previous Scottish rounds had high attrition rates
- Consider behind the meter arrangements with data centres, battery storage, chemical production

Thank you!

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