

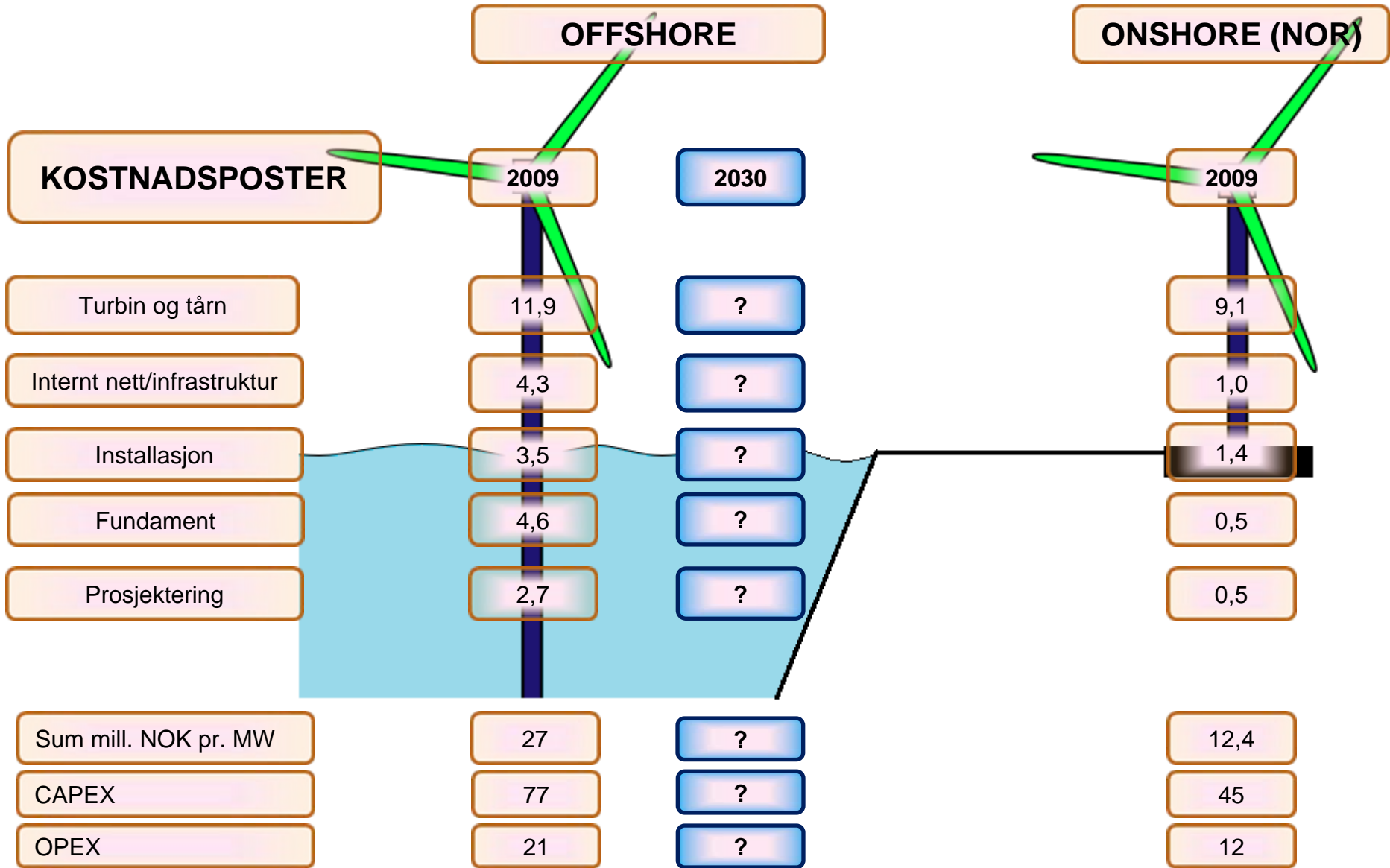
# Offshore Wind Assessment for Norway

*- potensial for kostnadsreduksjon innen 2030*

**NVEs Energidager 15.10.2010**

Espen Borgir Christophersen, Norges Forskningsråd



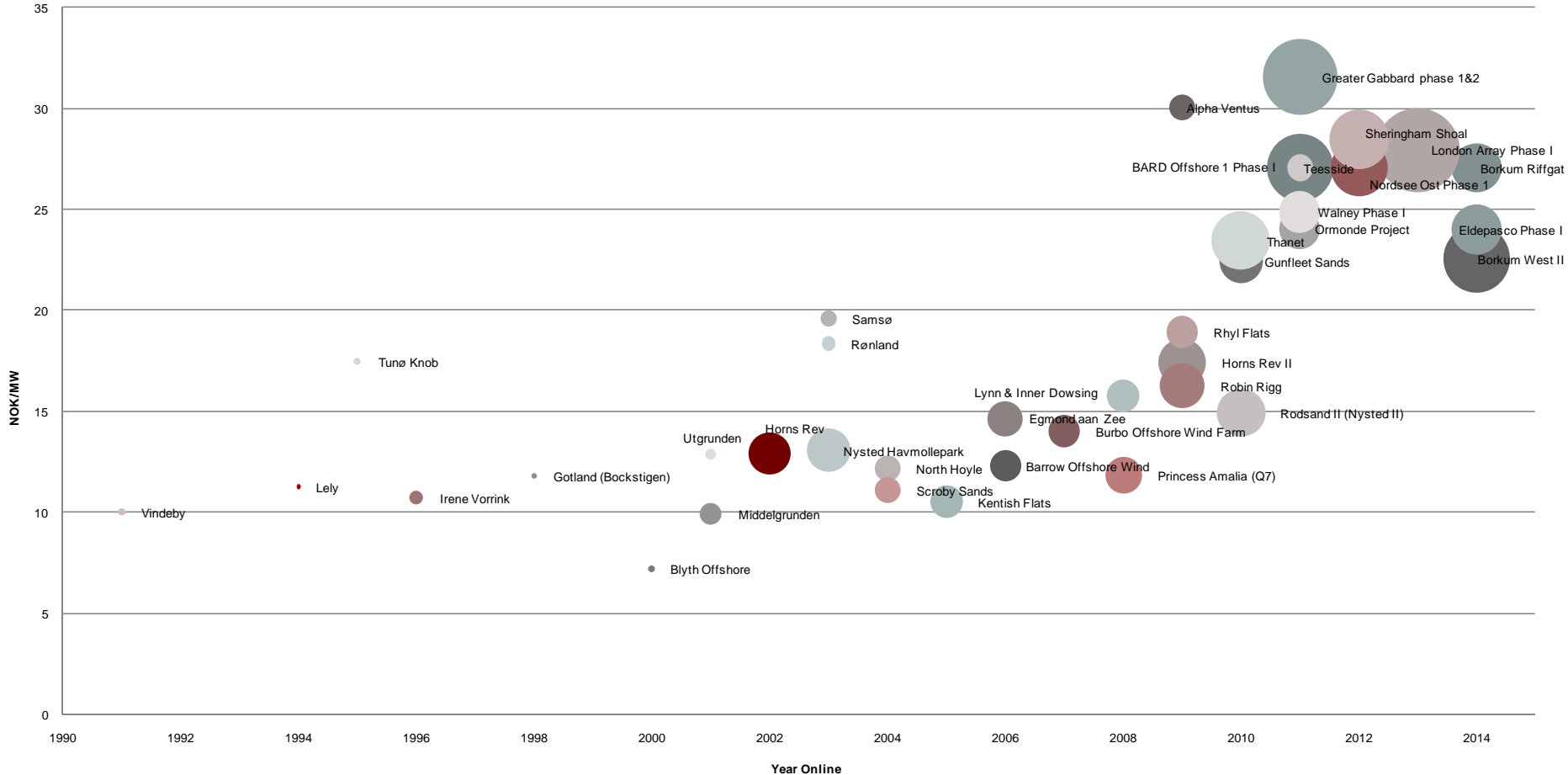


(7 % irr, 20 yr)

38 % efficiency

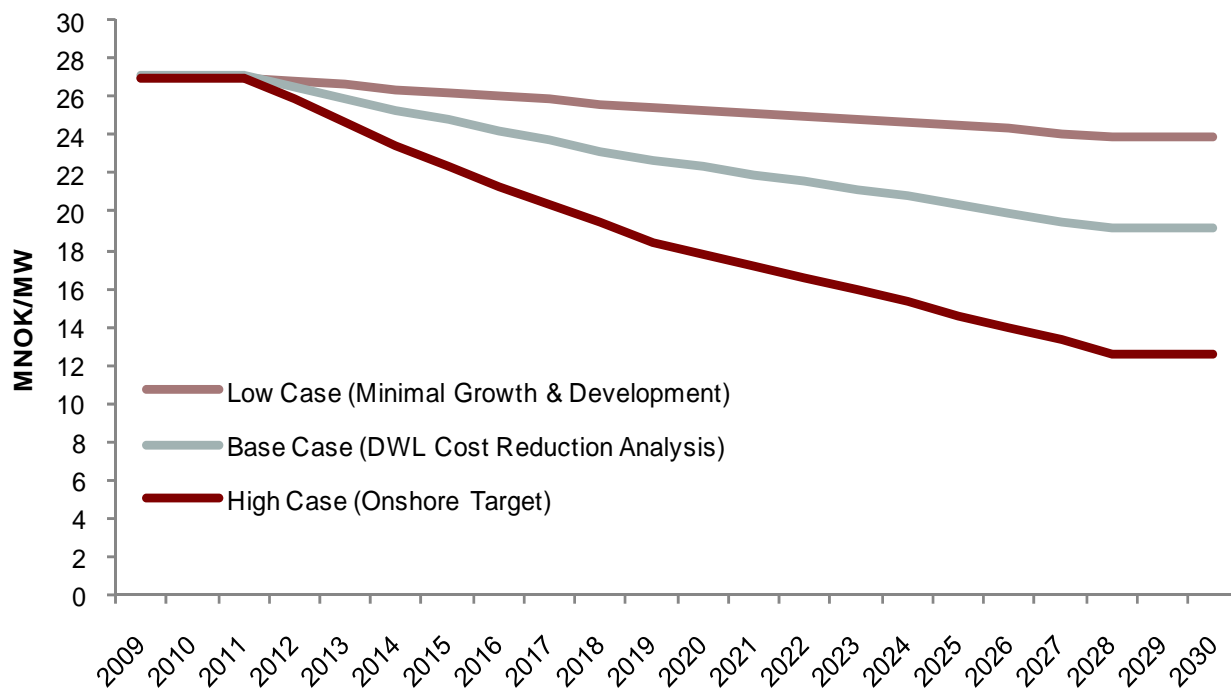
32 % efficiency

# Current Cost of Offshore Wind



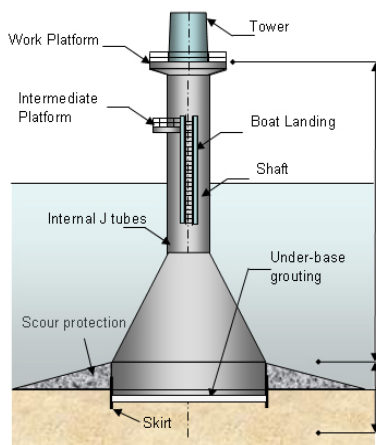
The offshore wind industry has gone against the convention of decreasing costs achieved through learning curves and supply chain improvements. It has seen costs increase dramatically over the last five years.

## Scenarier for kostnadsreduksjon frem mot 2030

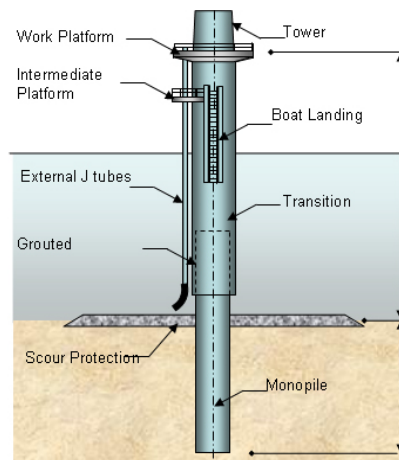


# FOUNDATIONS

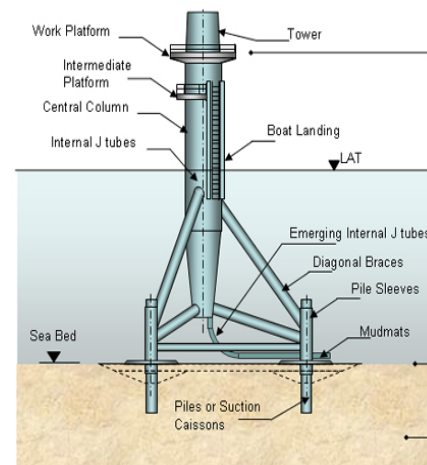
## GRAVITY BASED



## MONOPILE



## TRIPOD



OWEC Tower (Jacket)



Aker Verdal (Tripod)



## FOUNDATION - Floating

Hywind (Statoil)



Blue-H Prototype

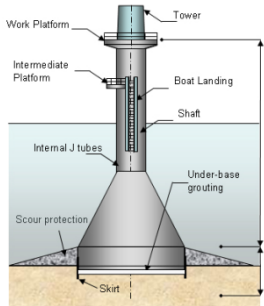


WindFloat (Principle Power Inc.)



# FOUNDATIONS

## GRAVITY BASED



## FLOATING

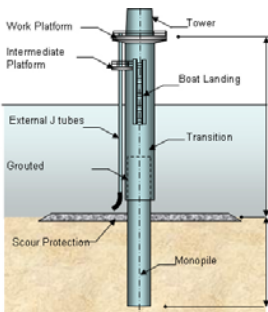


Component	2009	2030 Target	2030 Estimate	Reduction %
Fixed Seabed Shallow	4.33	1.98	3.17	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Fixed Seabed Deep	9.00	1.98	5.90	30%

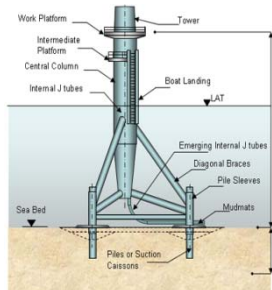
Component	2009	2030 Target	2030 Estimate	Reduction %
Floating	9.00	1.98	4.70	50%

## MONOPILE



No supply problems today, but growing demand might cause critical issues. Scale production is required.

## TRIPOD



Significant cost reduction are unlikely in longer term without savings in the costs of raw materials (primarily steel), as well as reduction in fabrication time.

## INSTALLATION COSTS – Electrical, turbine and foundation installation

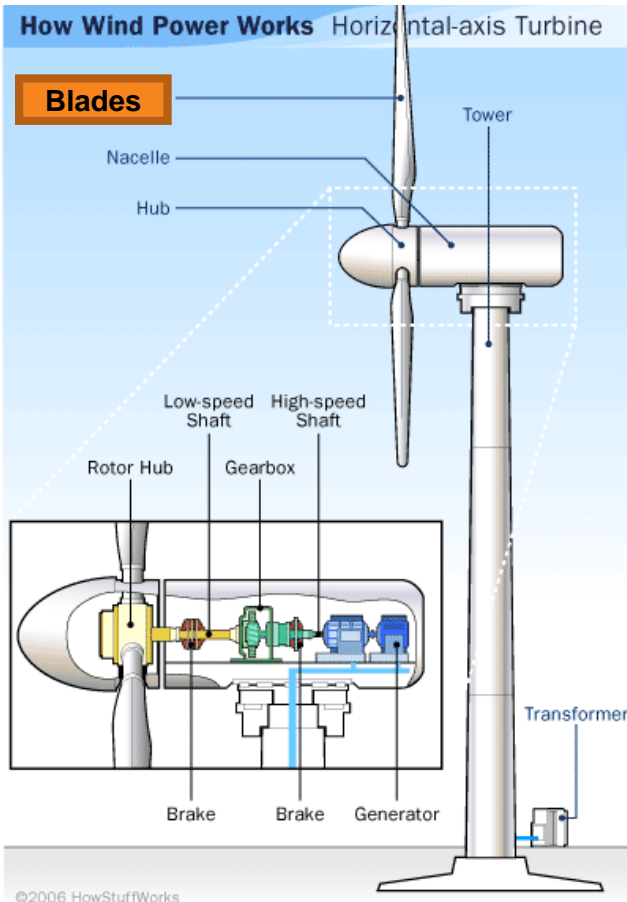


Component	2009	2030 Target	2030 Estimate	Reduction %
Electrical Installation	1.05	0.48	0.86	20%

Component	2009	2030 Target	2030 Estimate	Reduction %
Turbine Installation	0.70	0.32	0.51	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Foundation Installation	1.76	0.80	1.29	30%

## BLADES

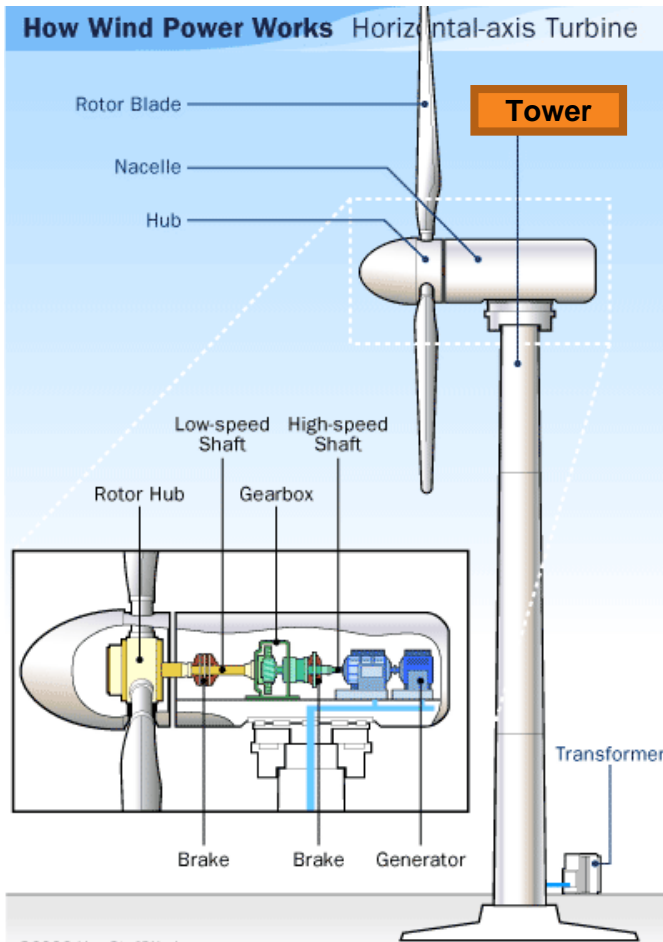


Component	2009	2030 Target	2030 Estimate	Reduction %
Blades	2.38	1.09	1.40	40%

Growing trend of using carbon fiber. This will reduce weight and increase strength in the blades (Fiberglass is used today).

Lower weight reduces load on associated equipment

## TOWER

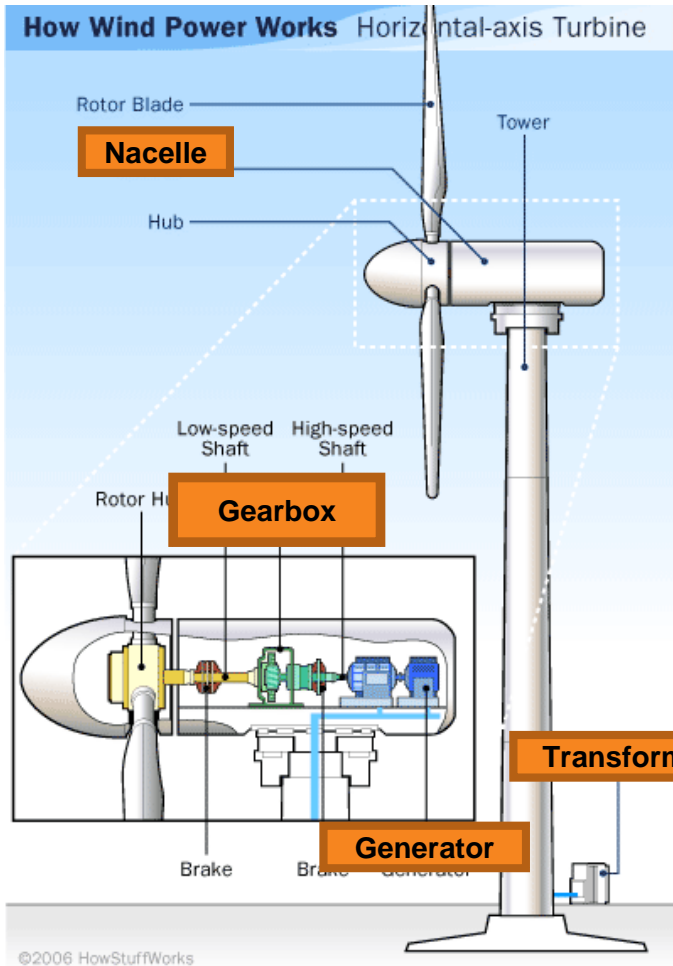


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Component	2009	2030 Target	2030 Estimate	Reduction %
Tow er	2.98	1.36	2.42	20%

Any cost reduction attributed to towers is likely to primarily be associated with increases in capacity and more market competition rather than significant innovation in the marketplace.

## WIND TURBINE - Gearbox, generator, nacelle, controller, transformer)



Component	2009	2030 Target	2030 Estimate	Reduction %
Gearbox	1.79	0.82	1.17	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Generator	0.48	0.22	0.31	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Nacelle	0.24	0.11	0.17	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Controller	1.19	0.54	0.87	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Transformer	0.48	0.22	0.35	30%

## ELECTRICAL INFRASTRUCTURE

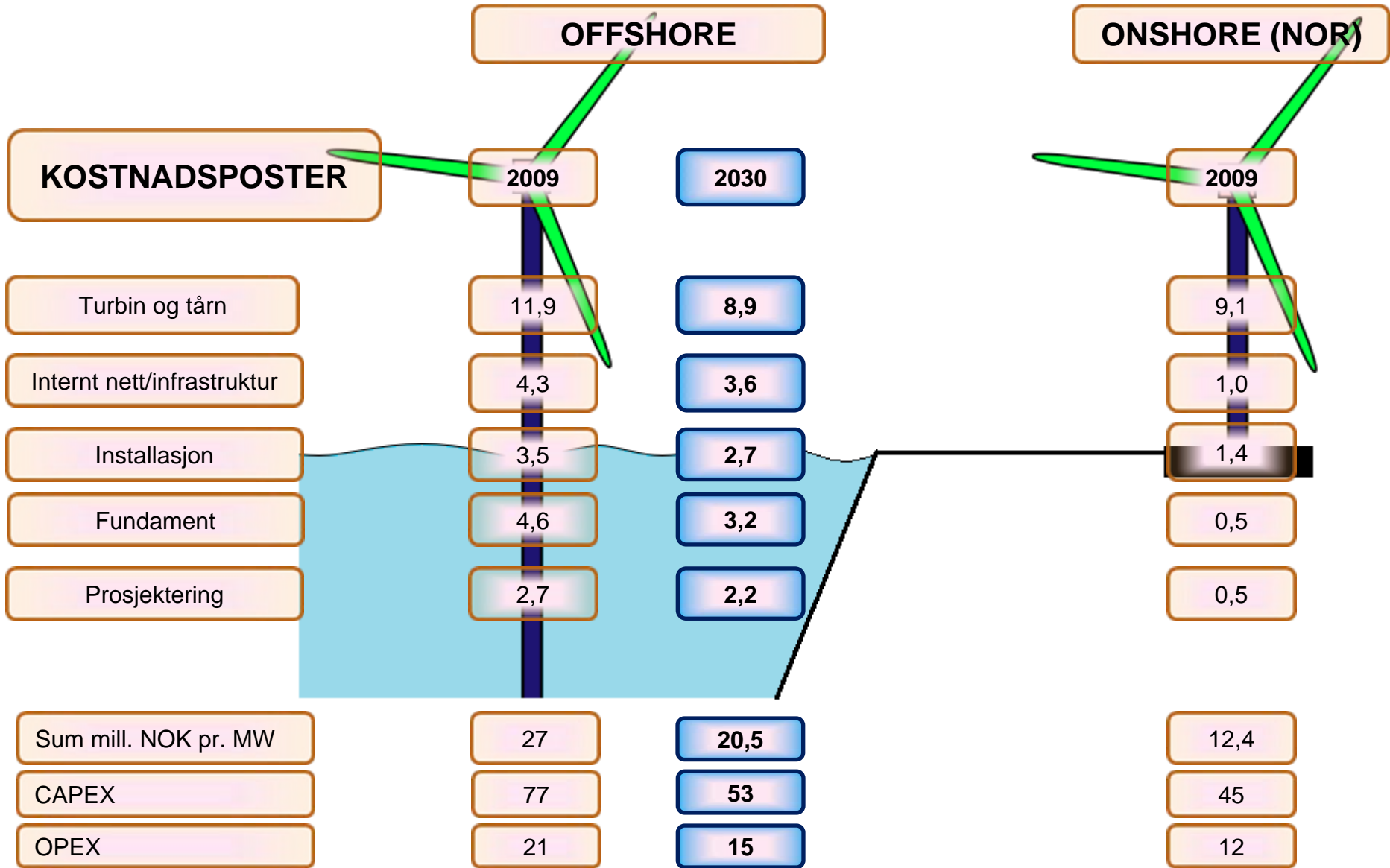
Component	2009	2030 Target	2030 Estimate	Reduction %
Offshore Substation	1.94	0.87	1.42	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Onshore Substation	1.89	0.85	1.54	20%

Component	2009	2030 Target	2030 Estimate	Reduction %
Export Cable	0.16	0.07	0.12	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Large Array Cabling	0.50	0.23	0.37	30%

Component	2009	2030 Target	2030 Estimate	Reduction %
Small Array Cabling	0.16	0.07	0.12	30%



(7 % irr, 20 yr)

(38 % efficiency)

(42 % efficiency)

(32 % efficiency)

## Utdrag fra rapportens konklusjoner

- Kostnadene for offshore vind vil innen 2030 kunne reduseres med 30 %, og ha en forventet produksjonskostnad på om lag 70 øre/kWh
- Høyt potensial for kostnadsreduksjon innen «flytende teknologier» kan gjøre flytende vindkraftverk konkurransedyktige med bunnfaste innen 2030
- Det er lite sannsynlig at offshore vind vil kunne utkonkurrere onshore vind innen 2030

## Utdrag fra kommentarer på rapporten fra norske aktører

- *Manglende dokumentasjon på konklusjon på hvilke type fundamenter som vil være lønnsomme i fremtiden*
- *Manglende dokumentasjon på hvordan man regner seg frem til den reelle kostnadsreduksjonen*
- *Potensialet for kostnadsreduksjon er for konservativt*
- *Potensialet for økt brukstid er for konservativt*
- *Rapporten er for lite spesifikk ift hvilke områder Norge kan utvikle og bruke sin kjernekompetanse på*
- *Tar ikke hensyn til utvikling av nye (og langt større) enheter, og hvordan dette kan påvirke installasjonskostnadene*

# Takk for meg!

**Espen Borgir Christophersen**

Seniorrådgiver RENERGI - Offshore Vind

Avdeling for Energi og Petroleum

Divisjon for store satsinger

Tlf. (dir) : +47 90 16 41 72

E-post: [ebc@forskningsradet.no](mailto:ebc@forskningsradet.no)

**Norges Forskningsråd**

Stensberggata 26

Postboks 2700 St.Hanshaugen

0131 Oslo

Sentralbord: 22 03 70 00

Faks: 22 03 70 01