



FACULTY OF ENGINEERING AND
ARCHITECTURE

Wave energy

Dept. of Civil Engineering, Ghent University



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Afdeling Weg- en Waterbouwkunde
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9052 Zwijnaarde

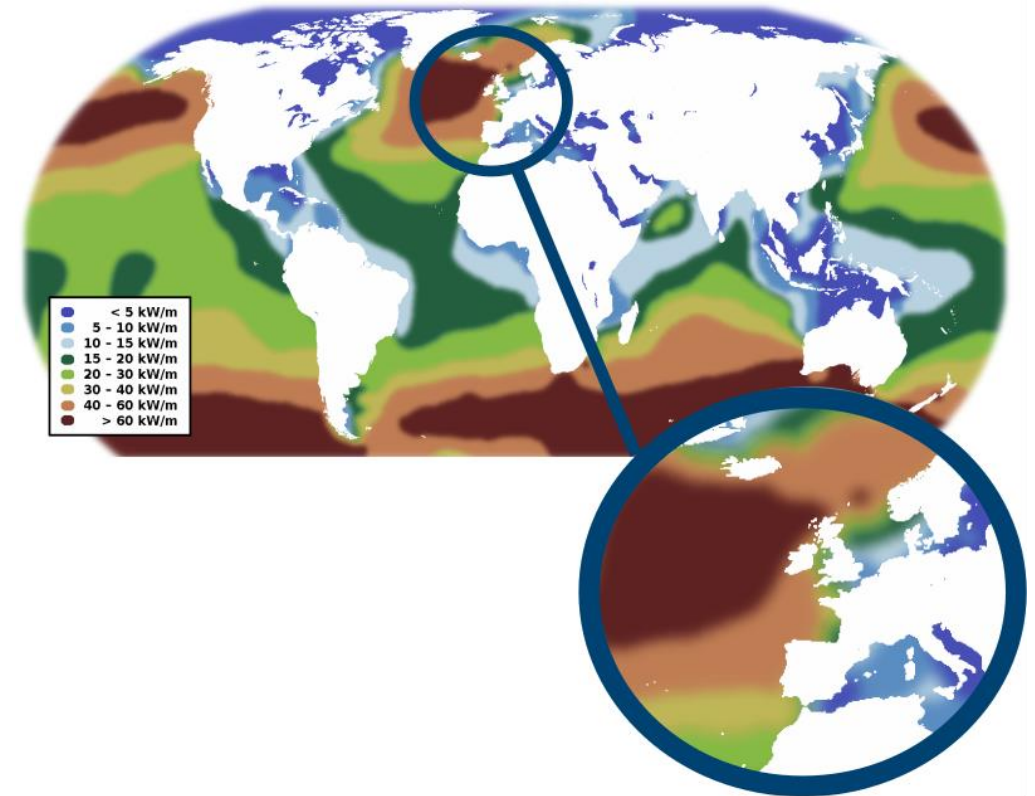
awww.ugent.be

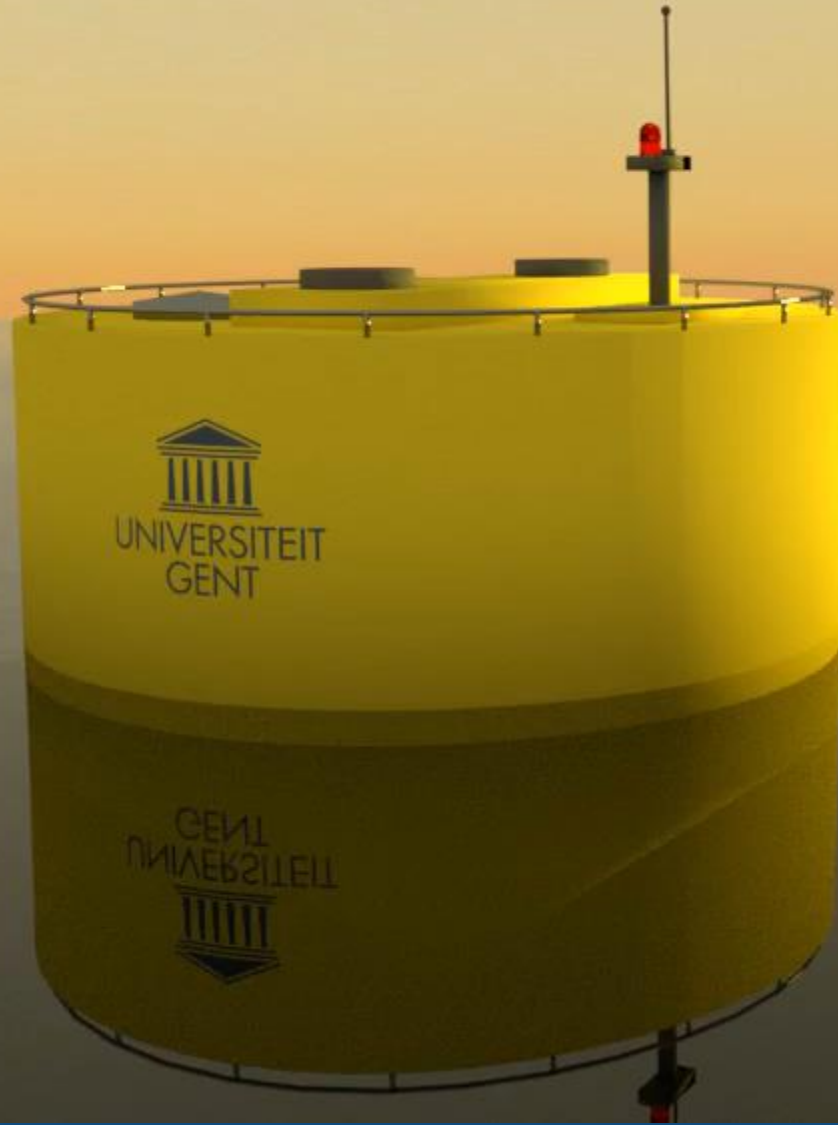
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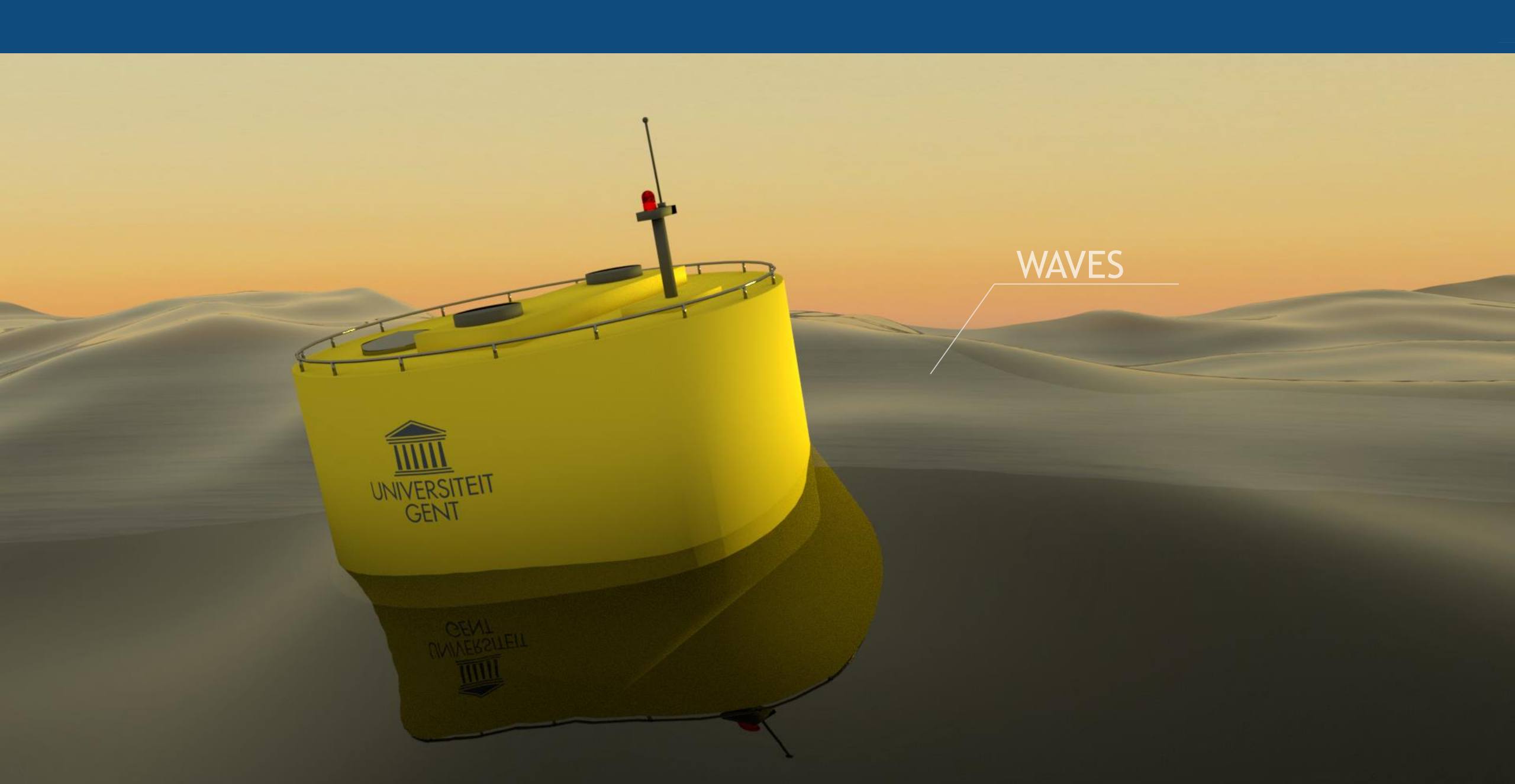
Why wave energy?

An exponential growth in world population, combined with a rapid diminishing of fossil fuel reserves and a growing awareness against polluting energy resources, has kickstarted the need for new clean energy sources. Next to wind, solar, hydro, geothermal and biomass, wave energy is a promising yet challenging option.

Europe has the largest wave power resource of the world. Although Belgium only has a mild sea climate, it is an ideal testing site. By combining multiple Wave Energy Converters (WECs) with existing/new wind turbine farms, a significant contribution to the power supply can be made.







WAVES

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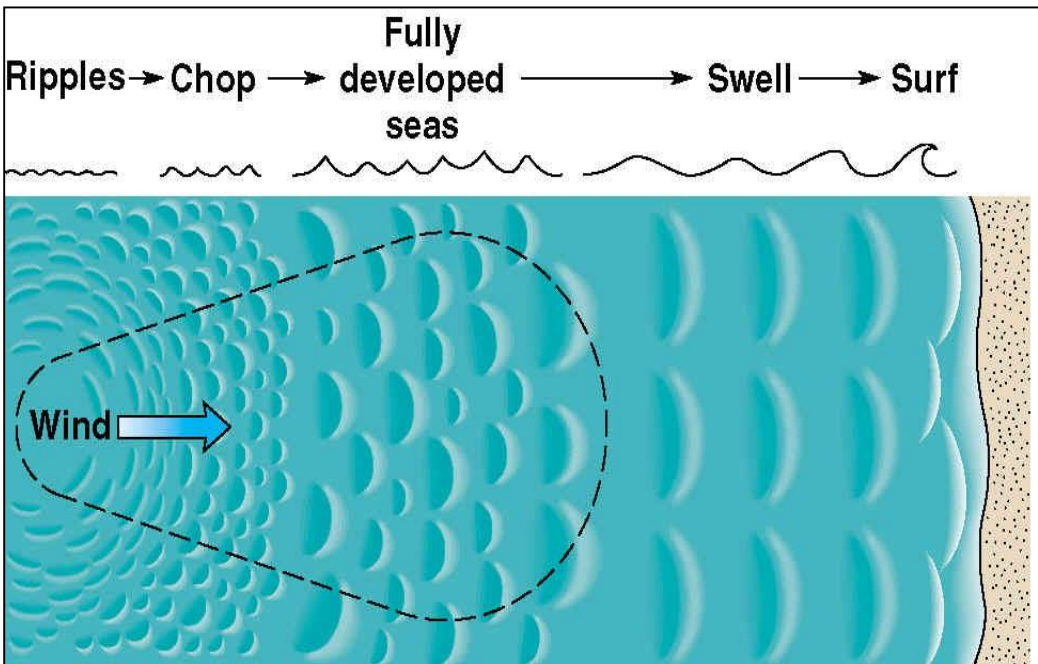
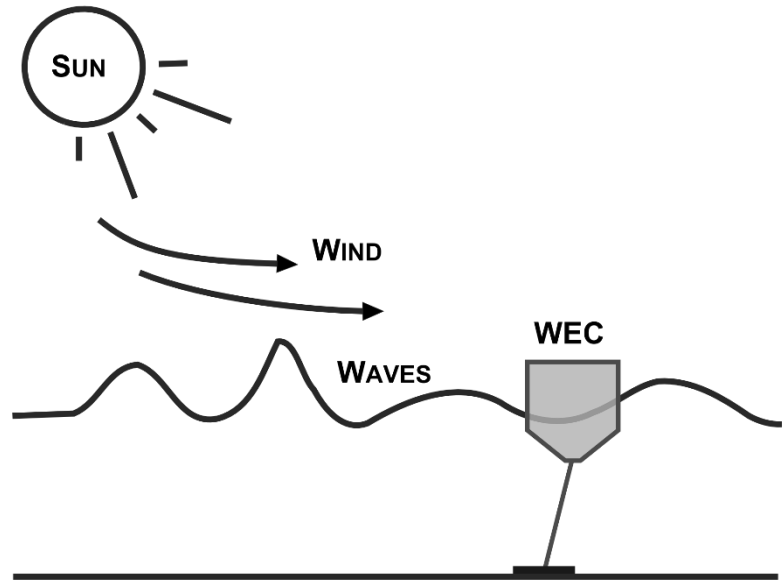


Department of Civil Engineering
Ghent University

Wave energy



Where do they come from?



ripples



chop



fully developed sea



swell

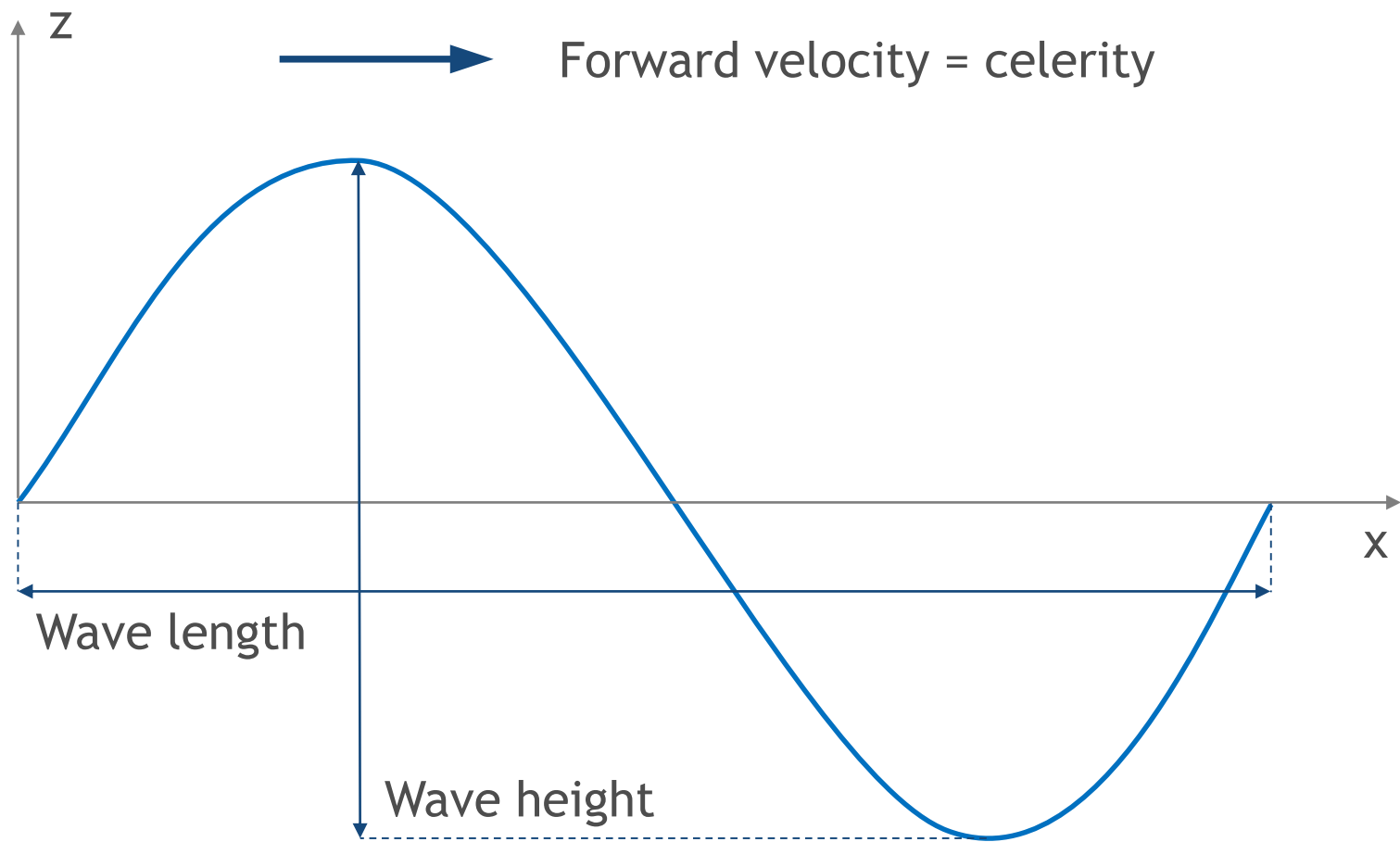
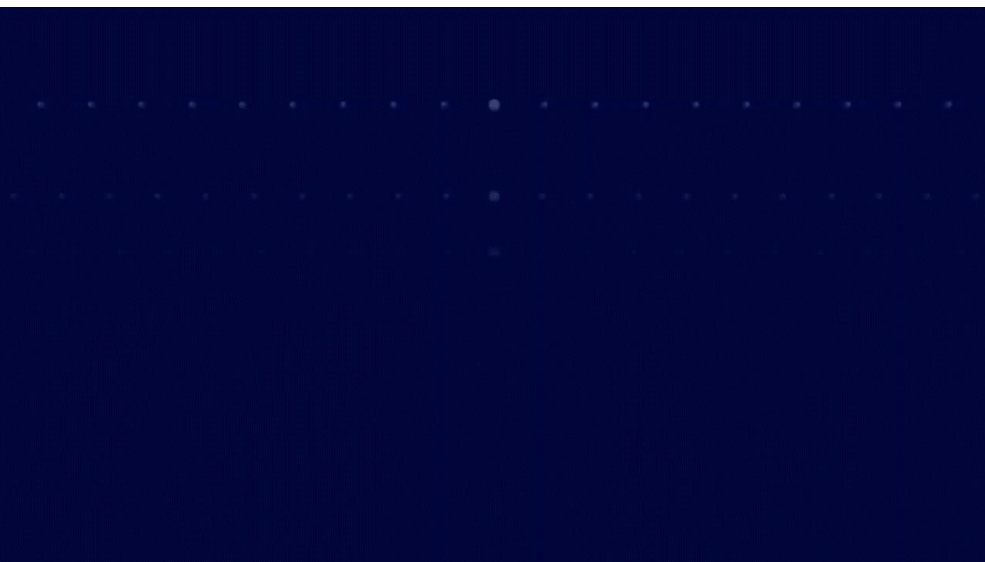


surf



Waves

What do they look like?



How much energy do they contain?

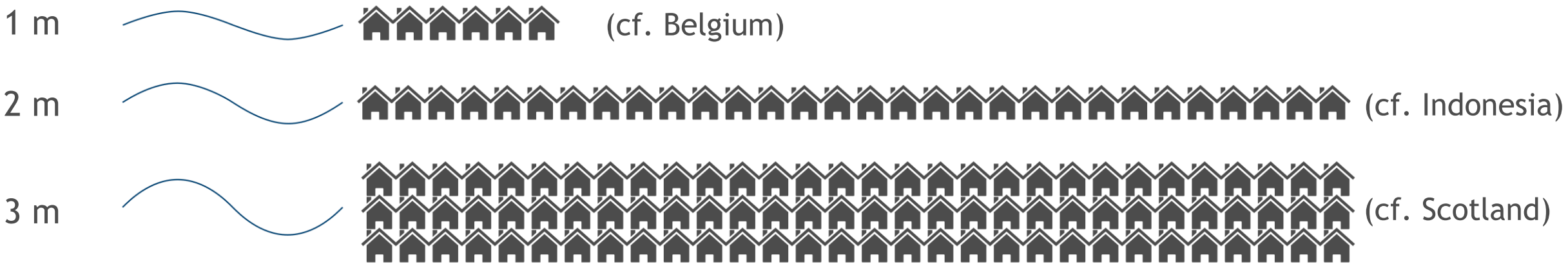


$$\text{wave power} \approx \text{wave celerity} \times (\text{wave height})^2$$

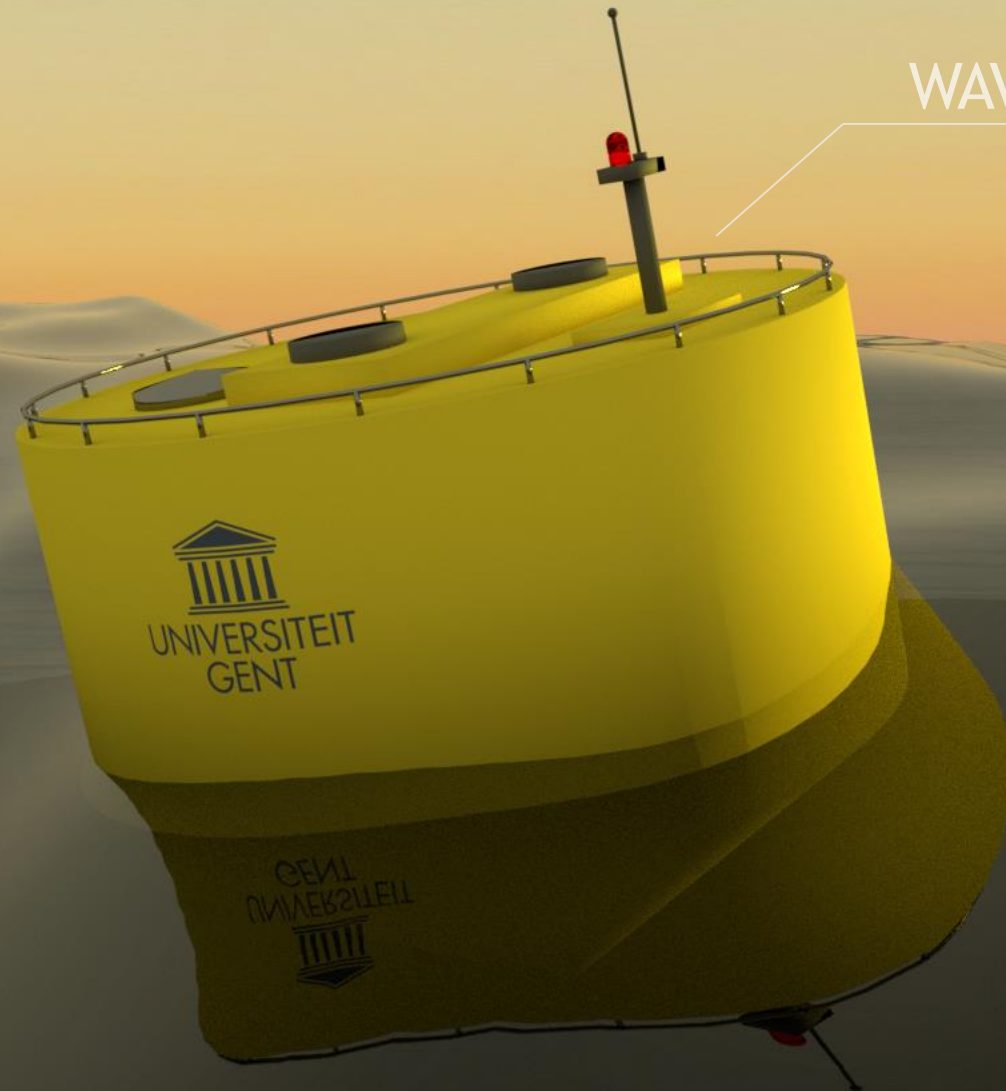


Wave height

Number of households powered

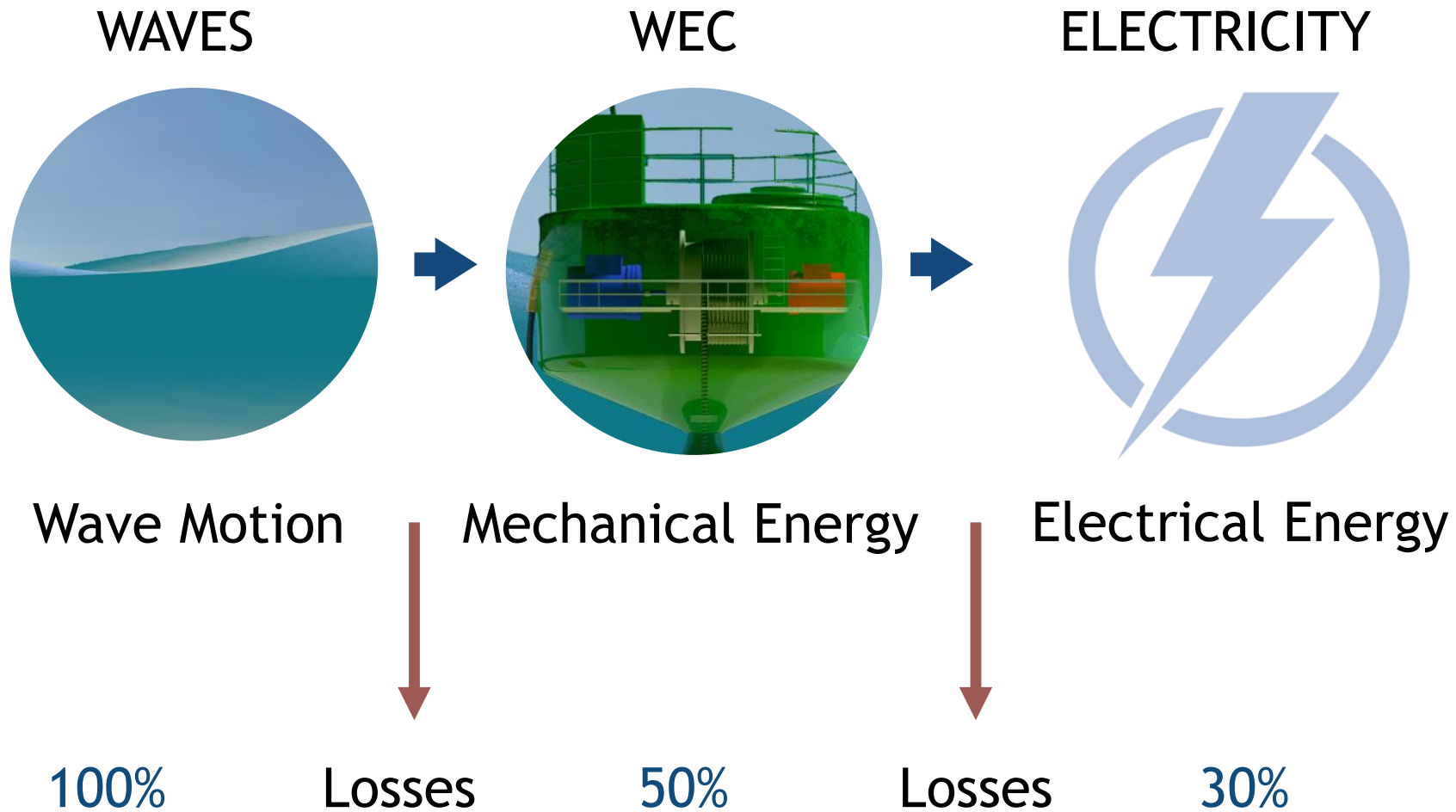


WAVE ENERGY CONVERTER (WEC)



Wave Energy Conversion

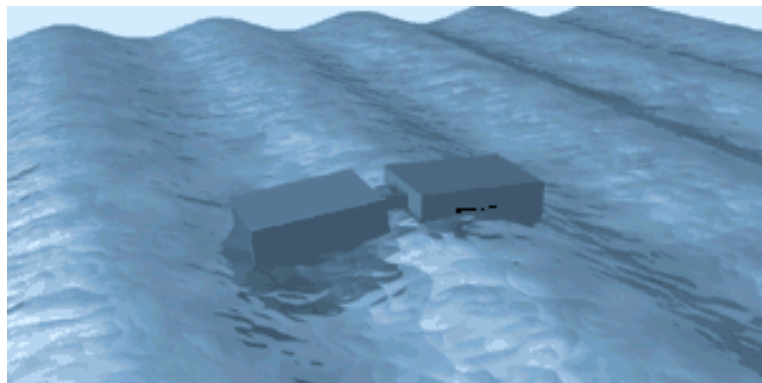
How do we get electricity from waves?



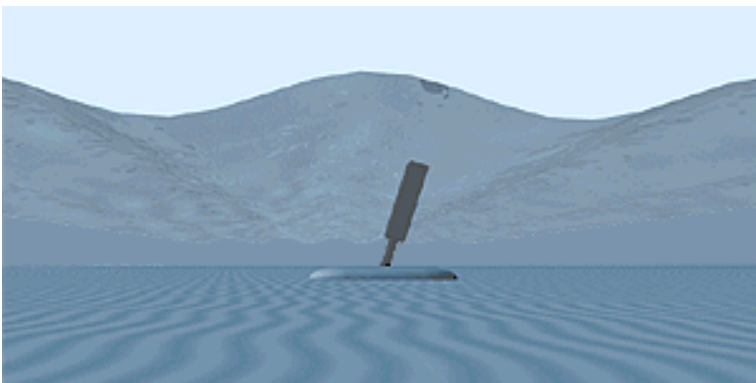
Wave Energy Converters: wave energy \rightarrow mechanical energy



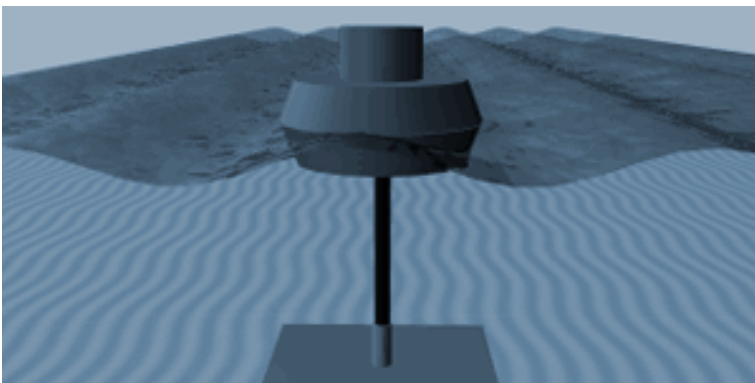
Wave Energy Converters: wave energy -> mechanical energy



Attenuator



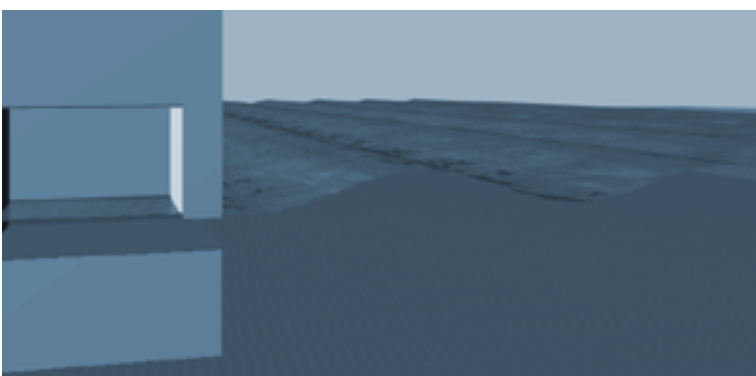
Oscillating Wave Surge Converter



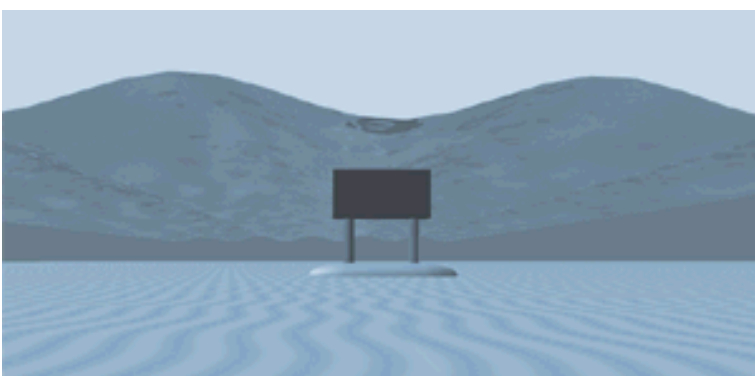
Point Absorber



Overtopping Device



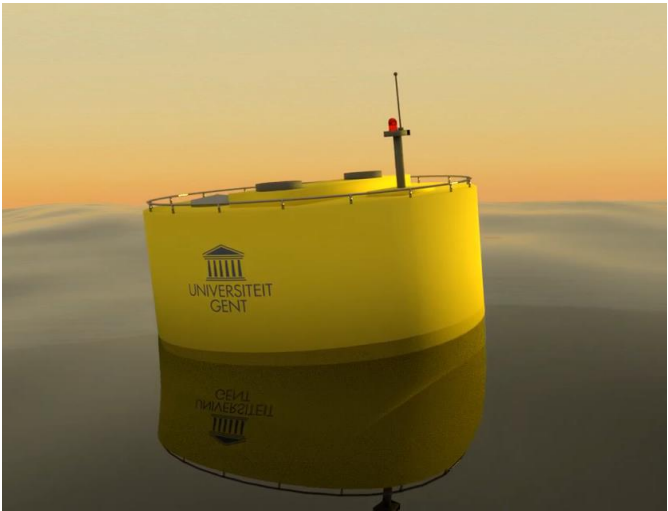
Oscillating Water Column



Submerged Pressure Differential

Wave Energy Conversion

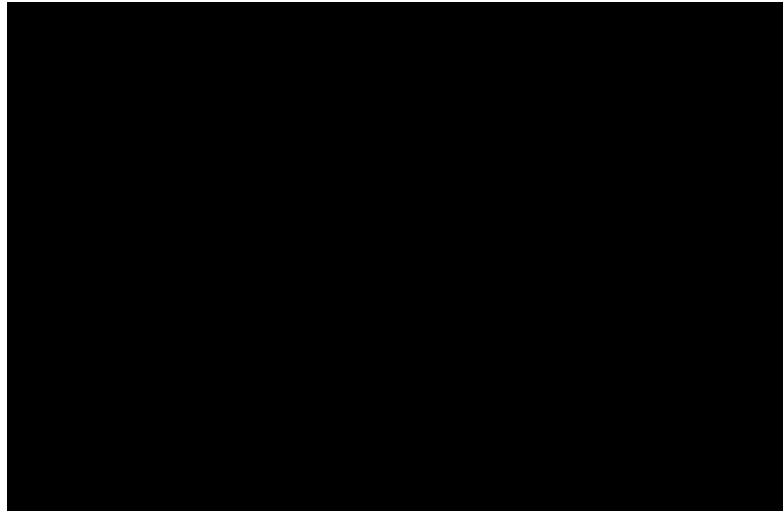
Wave Energy Converters: wave energy -> mechanical energy



Point-absorber (animation)



Attenuator (Pelamis)



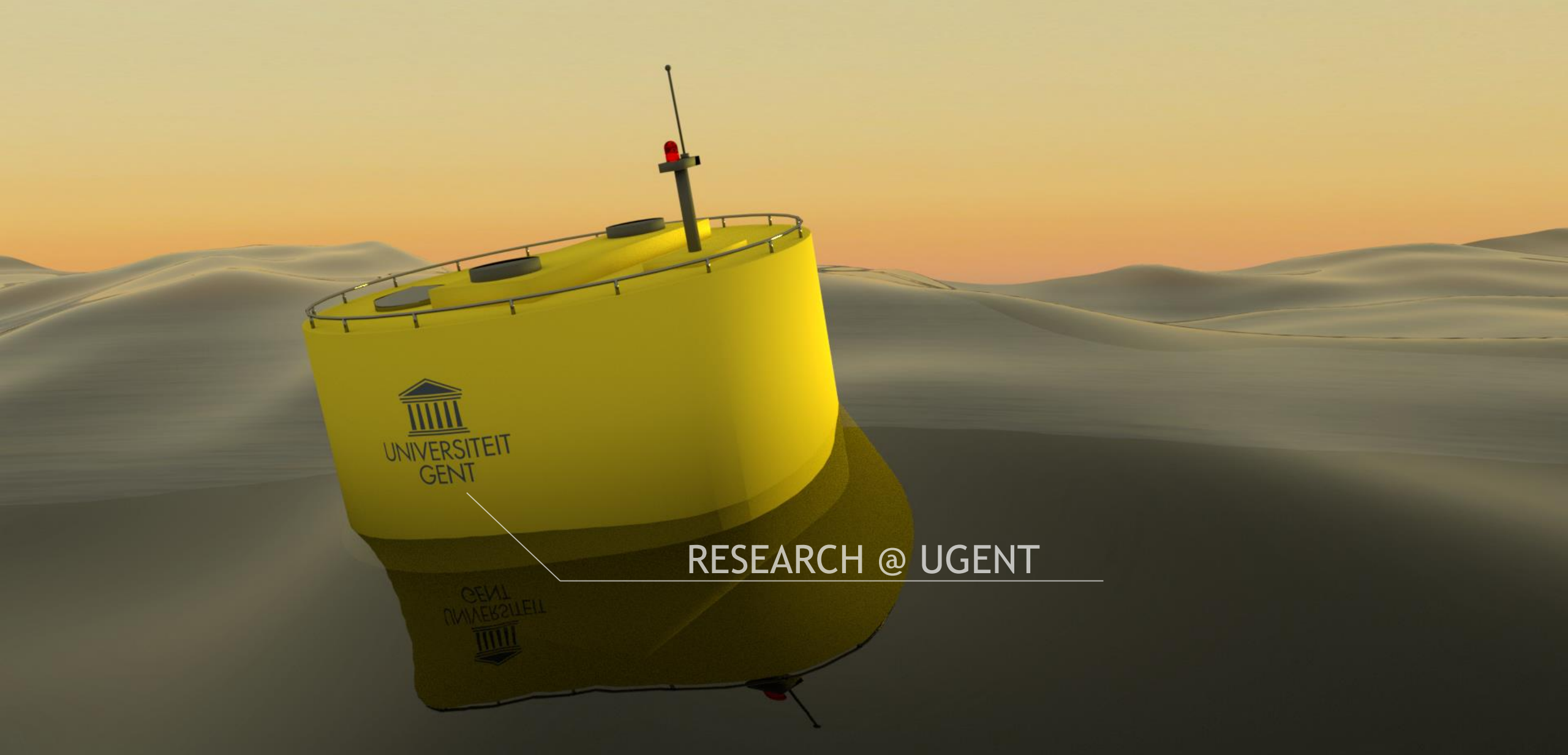
Overtopping (Wave Dragon)



Oscillating water column (Voith Hydro)



Oscillating wave surge (Aquamarine)



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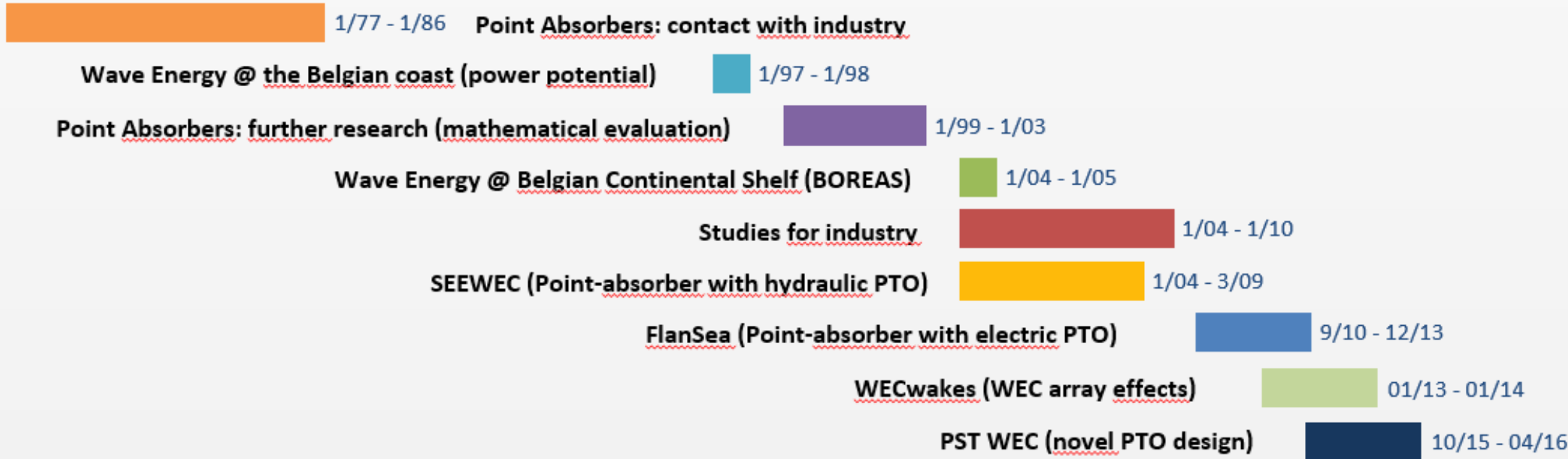
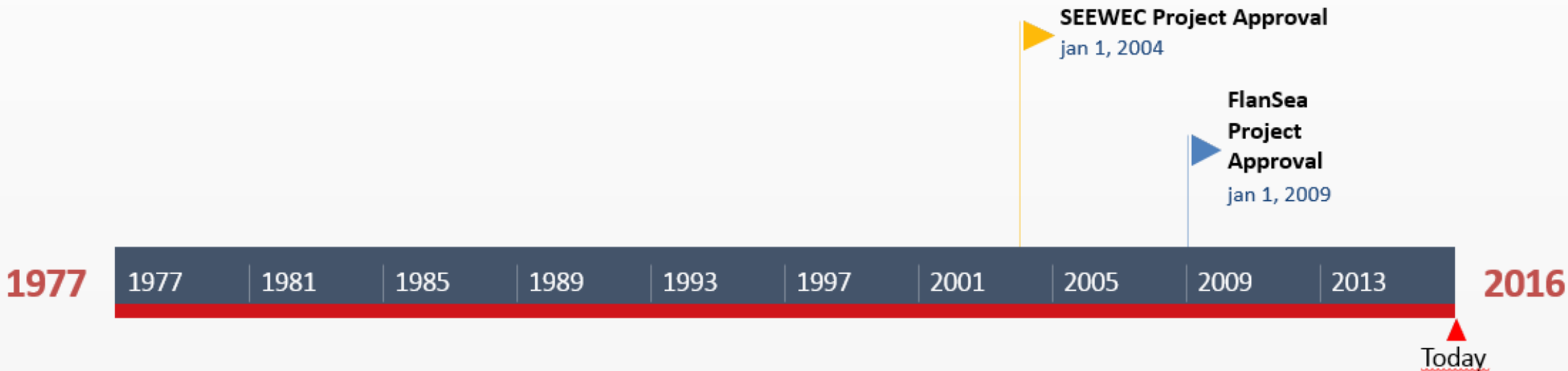
RESEARCH @ UGENT



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Wave energy





SEEWEC

Sustainable Economically Efficient Wave Energy Converter

Co-ordinator: J. De Rouck (october 2005 - march 2009)



SEEWEC

Sustainable Economically Efficient Wave Energy Converter



Laboratory tests (Fred Olsen)



FO3 Prototype (Fred Olsen)



SEEWEC B1



FlanSea

Flanders electricity from the Sea



DBE

Wave & Tidal Solutions



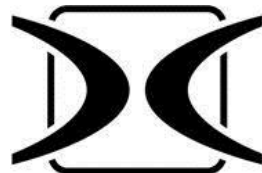
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Port
Oostende



electrawinds
POWERED BY NATURE



CLOOSTERMANS



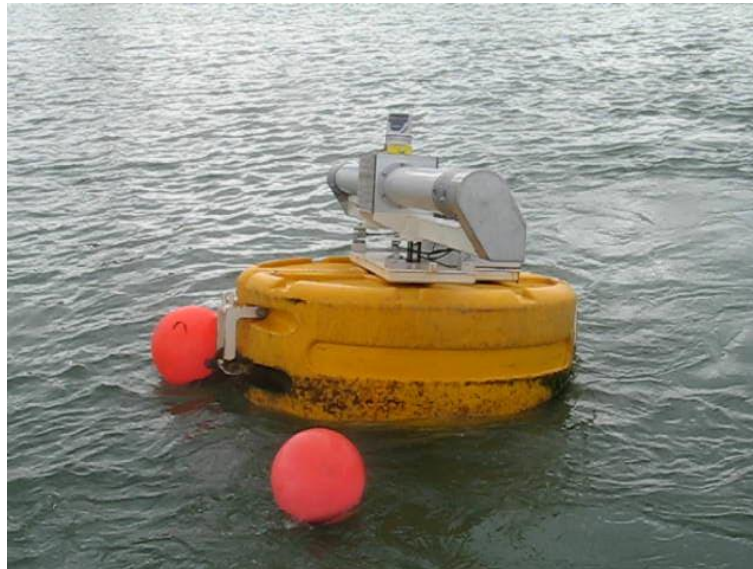
CONTEC



spiromatic

FlanSea

Flanders electricity from the Sea



Laboratory tests (Flanders Hydraulics)

Quick & Dirty tests @ Ostend

Wave Pioneer @ North Sea

WECwakes

Wake effects and WEC interactions of large wave energy converter arrays



A HYDRALAB-IV TRANSNATIONAL ACCESS PROJECT (EC 7TH FRAMEWORK PROGRAMME-CONTRACT NO. 261520)
AT DHI SHALLOW WATER BASIN, HØRSHOLM, DENMARK (PROJECT NO. HYIV-DHI-08)



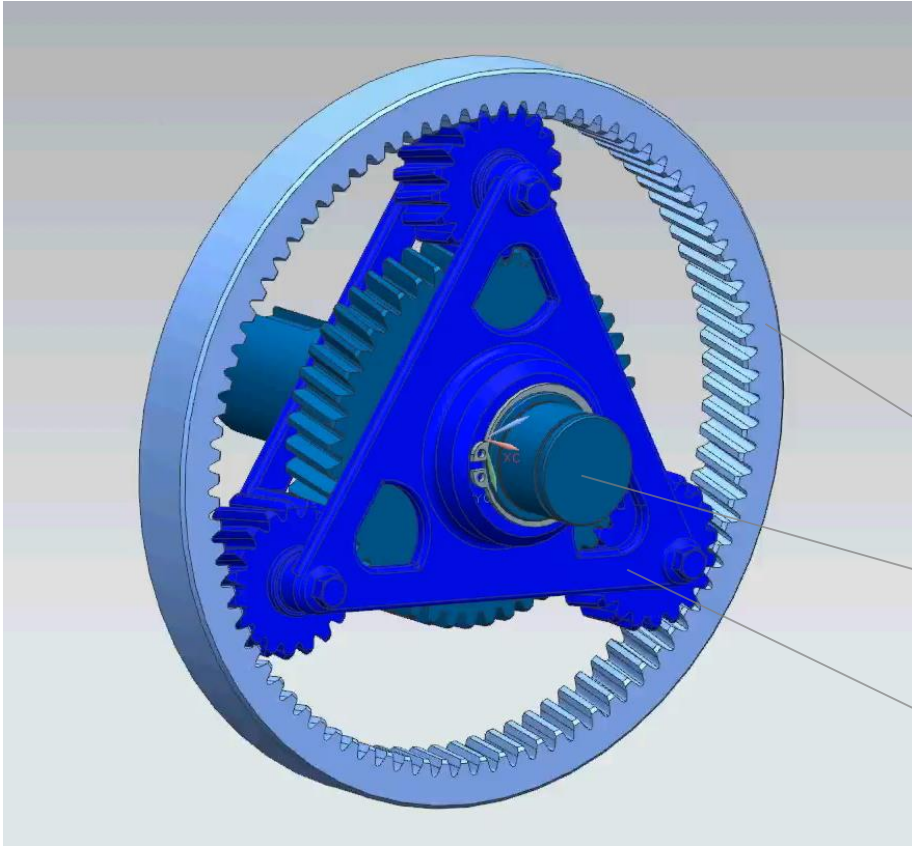
WECwakes

Wake effects and WEC interactions of large wave energy converter arrays



PST WEC

Power Sharing Transmission



Ring gear ~ Generator: always turns in the same direction

Sun gear ~ WEC: rotation direction changes constantly

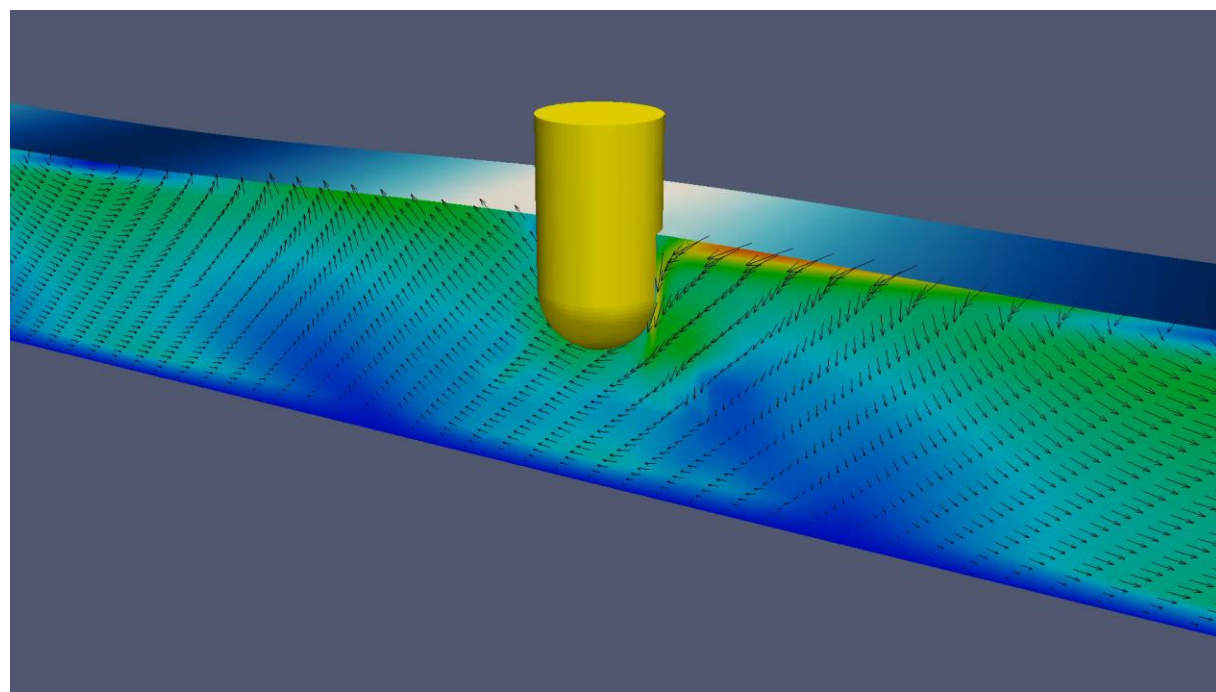
Carrier ~ Auxiliary machine to control the gearbox



Numerical Modelling

Single WEC

WEC Farm



waves →

