Seoul, 6 December 2010

Seminar on New & Renewable Energy
Netherlands Embassy, Korea
Korea Wind Energy Industry Association

Dynamic Tidal Power

Introduction by:

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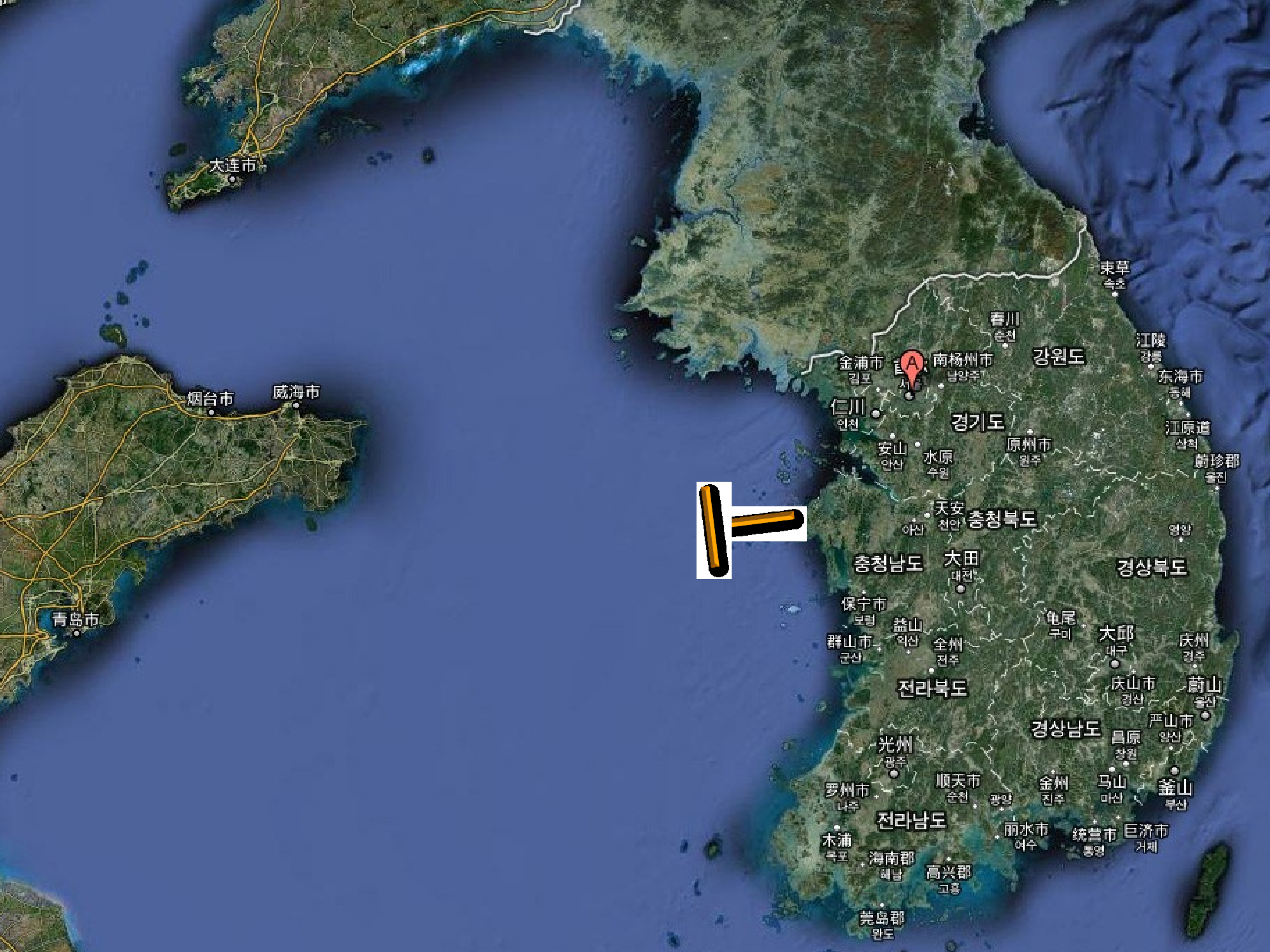
ITPO - China

Revolving Tides in Yellow Sea

- Can Korea generate up to 20% of national power consumption from the tides with a few big projects?



大连市
烟台市
威海市
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江陵
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东海市
동해
강원도
金浦市
김포
南杨州市
남양주
仁川
인천
경기도
安山
안산
水原
수원
原州市
원주
天安
천안
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충청북도
충청남도
大田
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경상북도
保宁市
보령
益山
익산
群山市
군산
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평택
Dangjin
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Cheonan
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Seosan
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Yesan
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Gunsan
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Iksan
익산
Gimje
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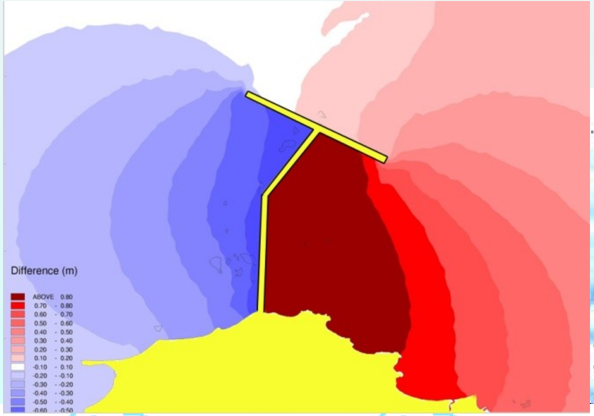
Jeonju
전주
전라북도

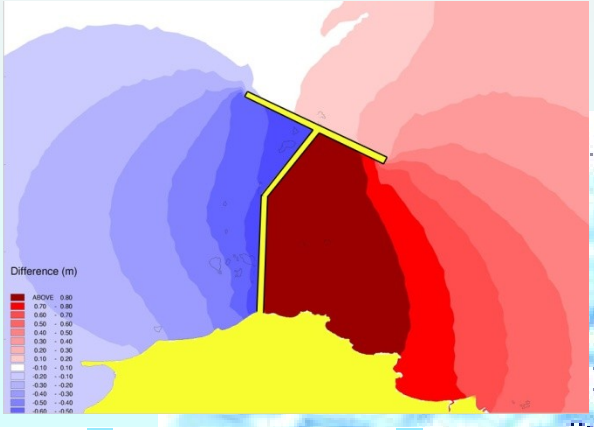
Performance

- 5,000 – 20,000 MW per dam (Sihwa Plant = 254 MW).
- One large plant (15 GW):
  - Equal to 60 Sihwa dams
  - Could power 6 million Koreans with renewable energy
  - More than 10% of total South Korea consumption



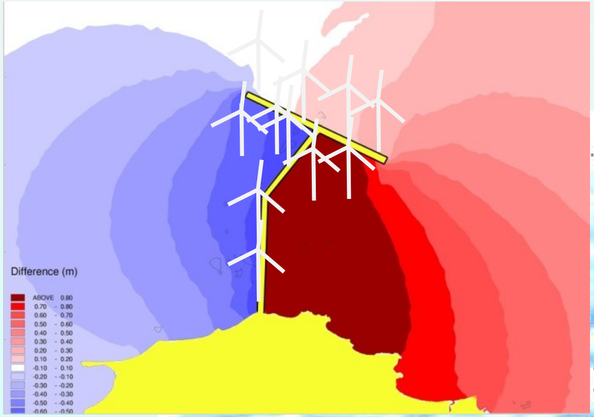
Benefits to Korea

- Milestone national project
- Achieve and exceed renewable energy targets
- Reinforce Korean position as innovation leader
- Major economic boost



Combine with Offshore Wind

- Easier Installation and Maintenance
- Reduced Exposure to Wave Action
- Improved Accessibility -> Reduced Downtime
- Wind Turbines on Dam

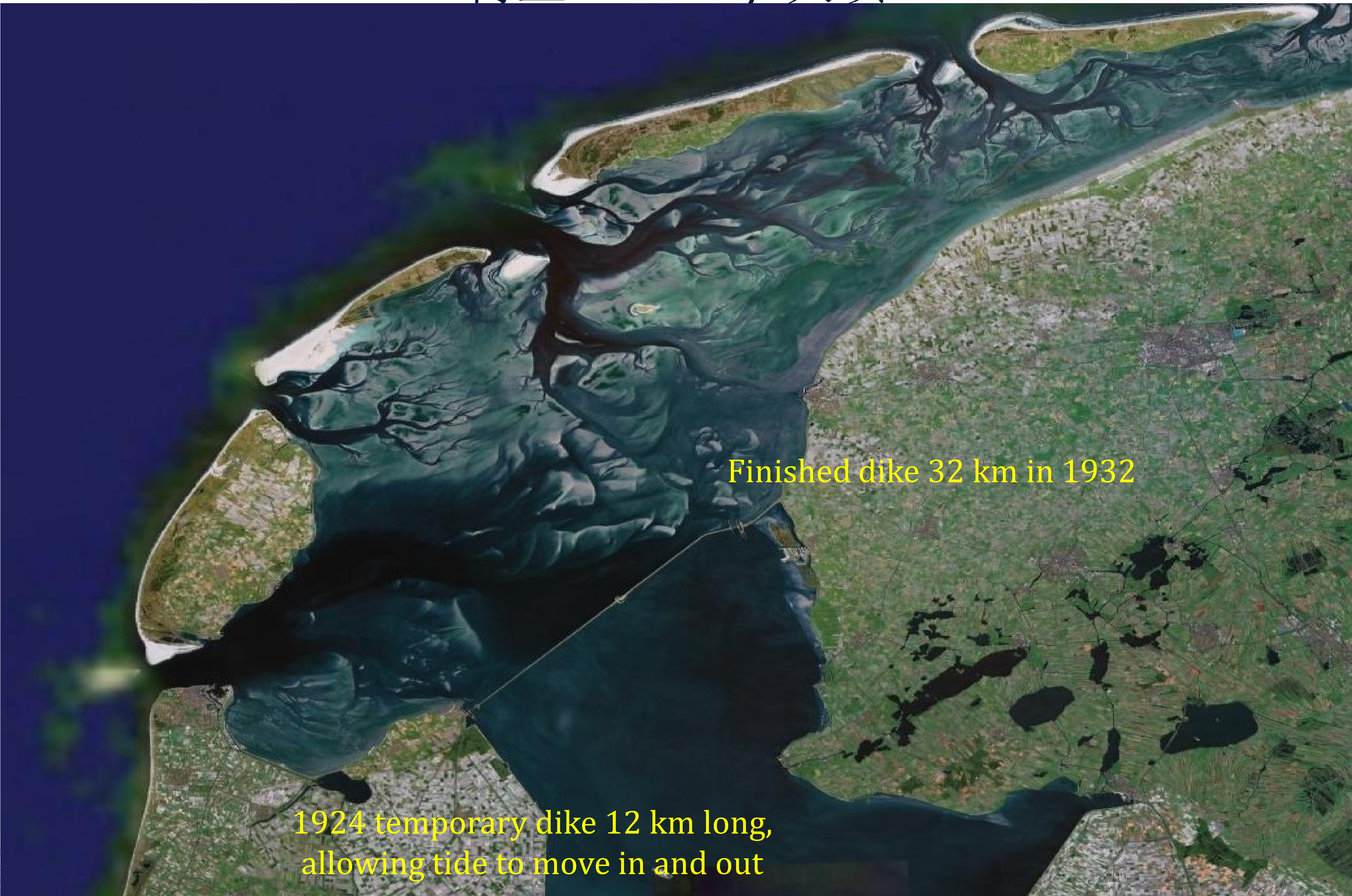


Are You Sure?

- Advanced, calibrated numerical tidal model , accuracy of predicted head within 10%
- Physics of DTP have been proven in natural peninsula and civil projects (Afsluitdijk, Delta Works)
- Entire dam can be built using existing technology

* Tidal model used: Delft 3D, considering Mass conservation, Gradients in the water levels, Convective acceleration, Coriolis force, Exchange of horizontal momentum through eddy viscosity, and Bed friction

Afsluitdijk 1920-1924-1932, NL
荷兰Afsluitdijk大坝

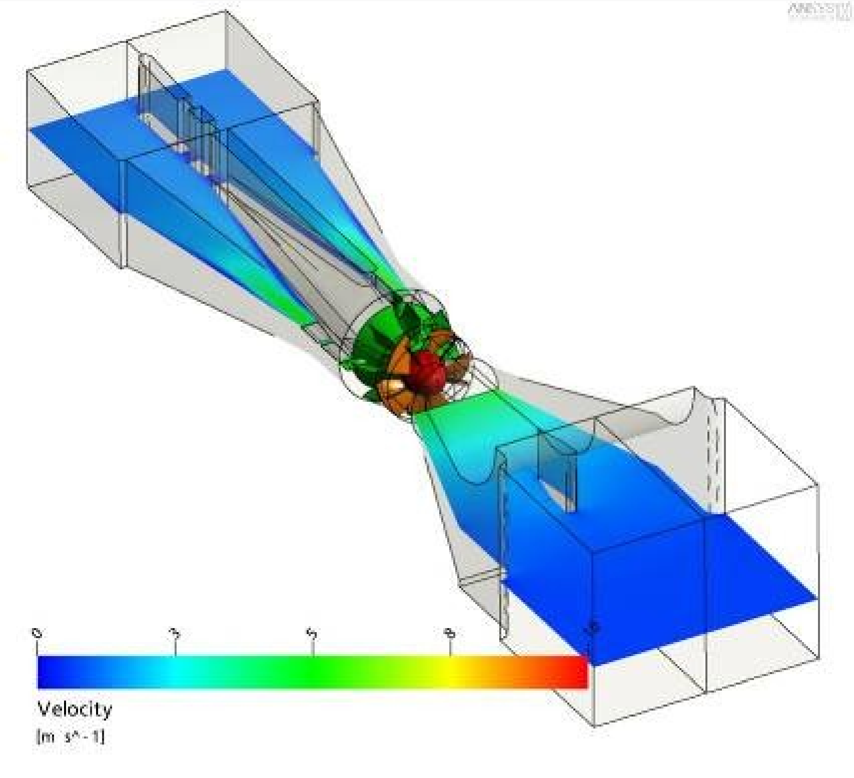


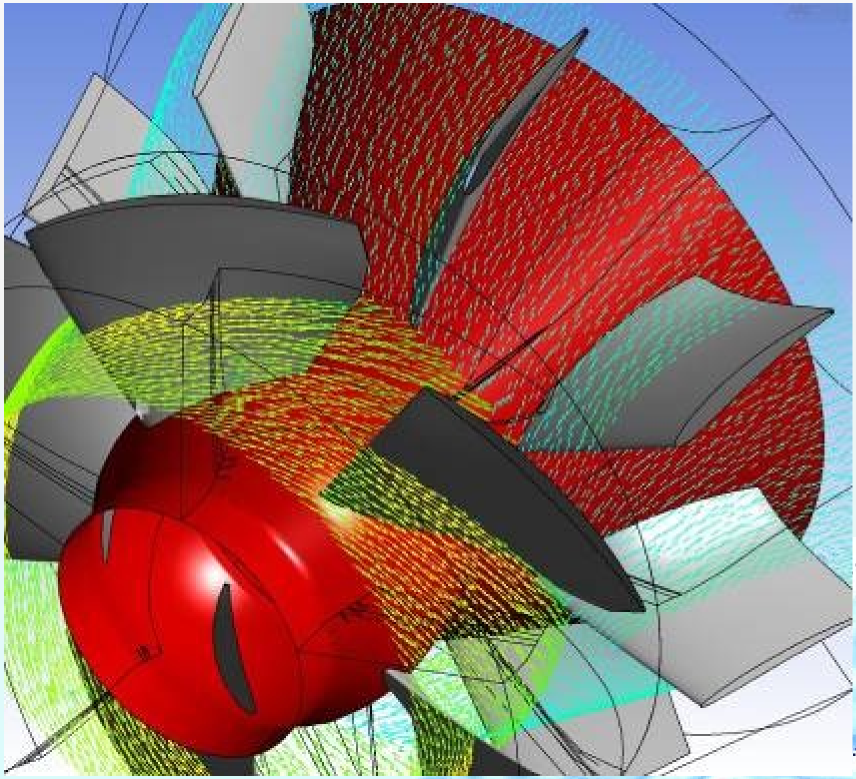
Floating-in caissons Veersegat dam 1961, NL 荷兰的模块桥坝

Delta Werken, NL, 1950 - 1997

Power Generation: Turbines

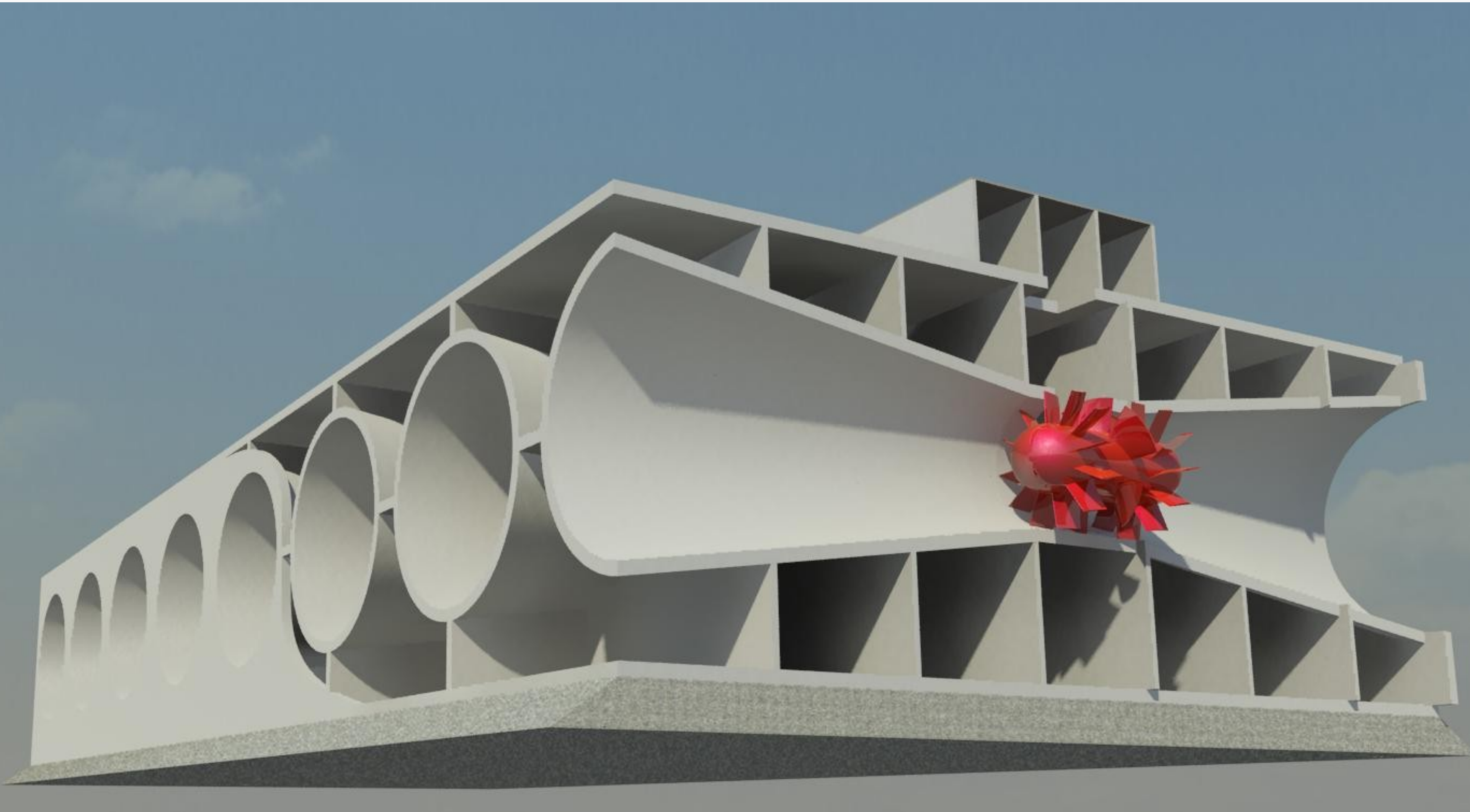
- Bi-directional, low head turbines
- 1000 – 2500 units, 4 MW – 8 MW per unit

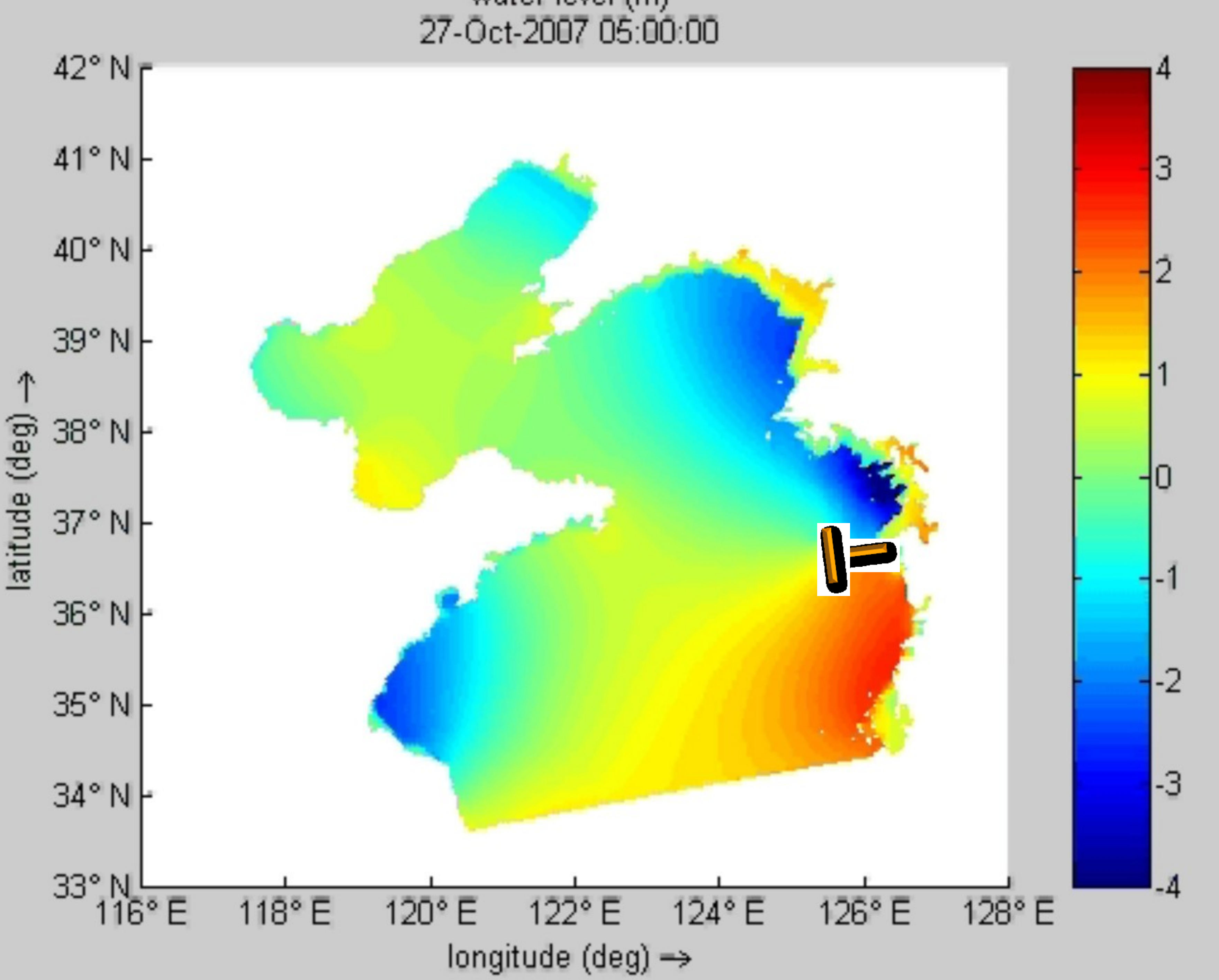




3D Cut-out of Dam Caisson

(Artist Impression)




27-Oct-2007 05:00:00
42° N
41° N
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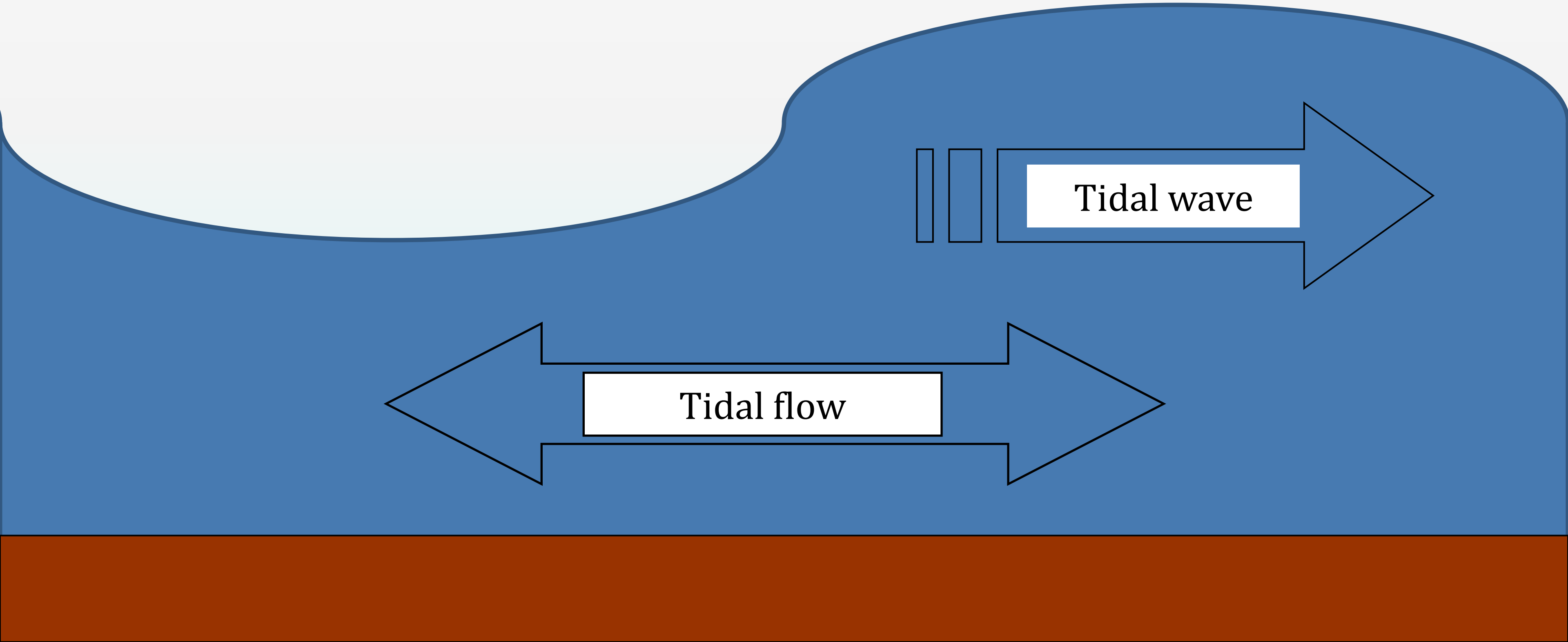
37° N
36° N
35° N
34° N
33° N
latitude (deg) →
116° E
118° E
120° E
122° E
124° E
126° E
128° E
longitude (deg) →
4
3
2
1
0
-1
-2
-3
-4

Theory: Wave Mechanics

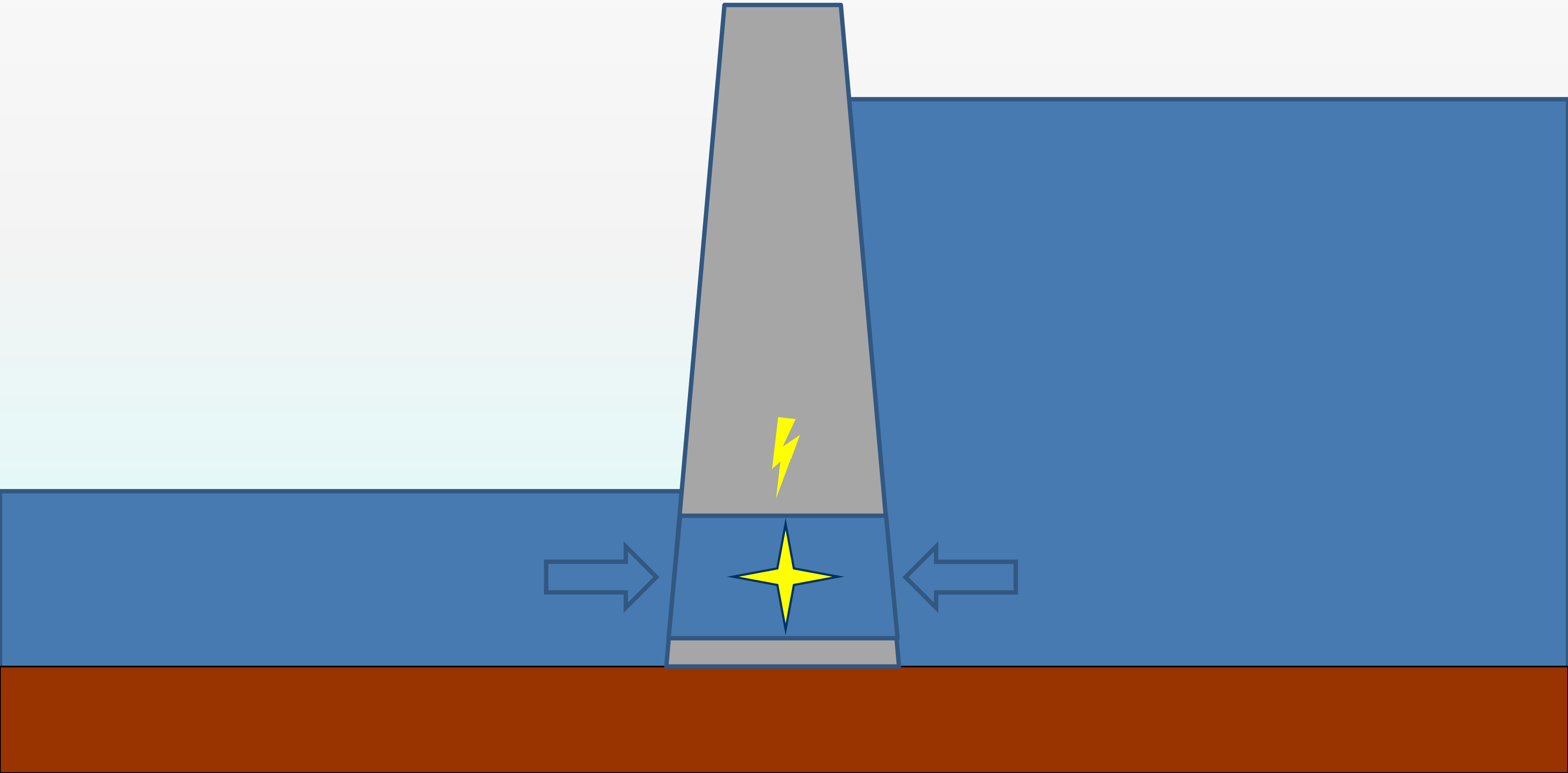
The **tidal wave** moves in one direction, from left to right along the coast,

But the **tidal flow** oscillates, from left to right and back

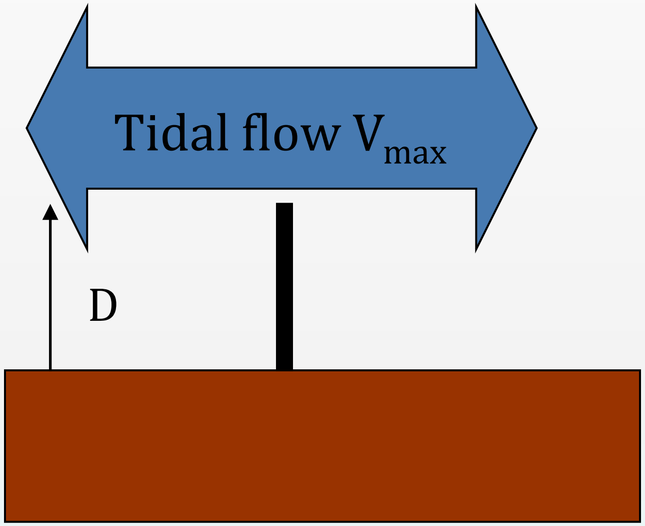


Power Generation

High and low tide occur simultaneously north and south of the dam. Hydraulic head drives bi-directional turbines installed along the length of the dam.



Theory: Simplified Analytical Model



Oscillating tidal flow around fixed dam

Head* – H over straight dam:

$$H = 0{,}05 \times D \times V_{max}$$

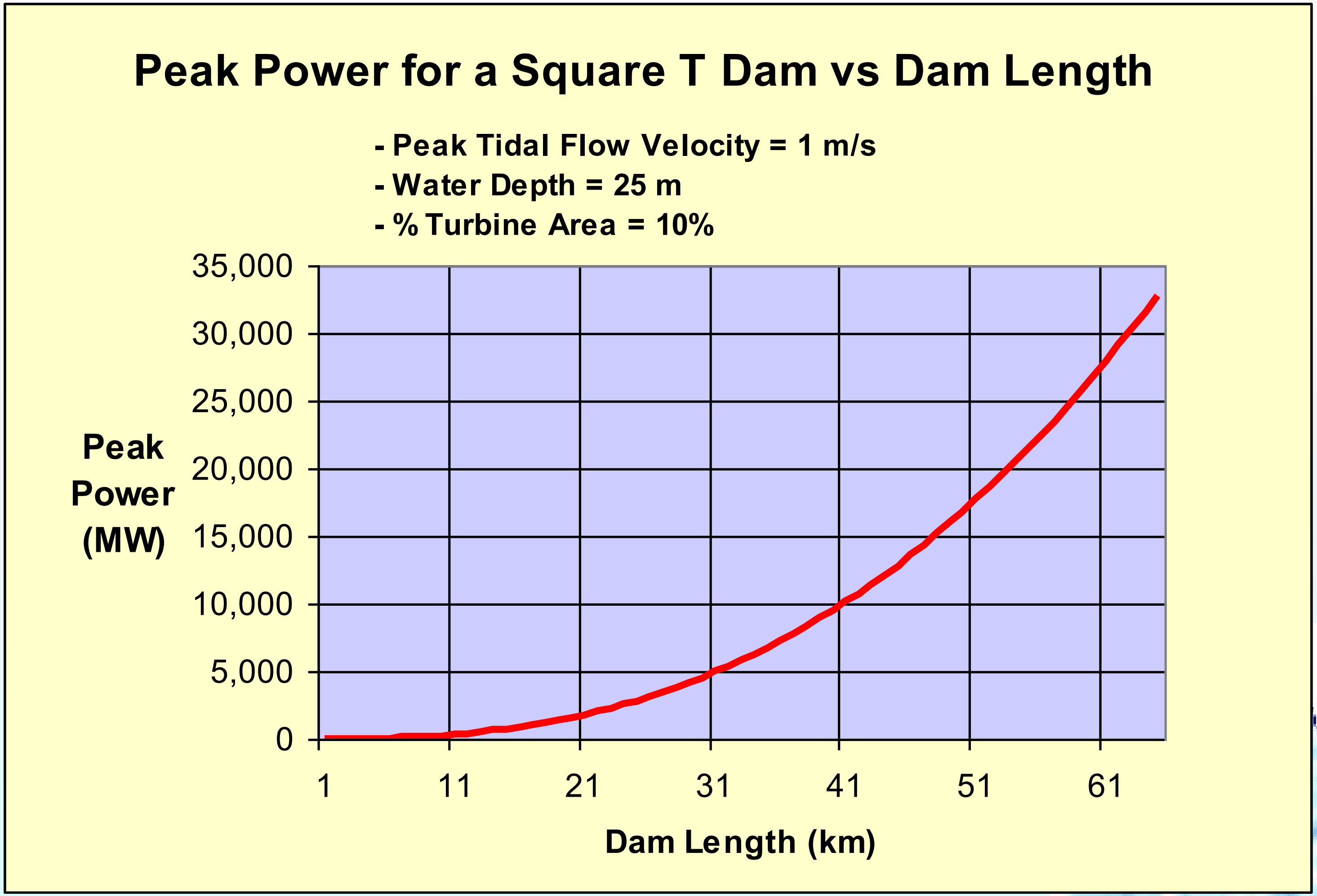
D = Length of the dam

V_{max} = Maximum velocity of tidal flow (as approximation of maximum acceleration)

* Hydraulic head: Water level differential between the sides of the dam. The level of head determines the power generating potential of the dam

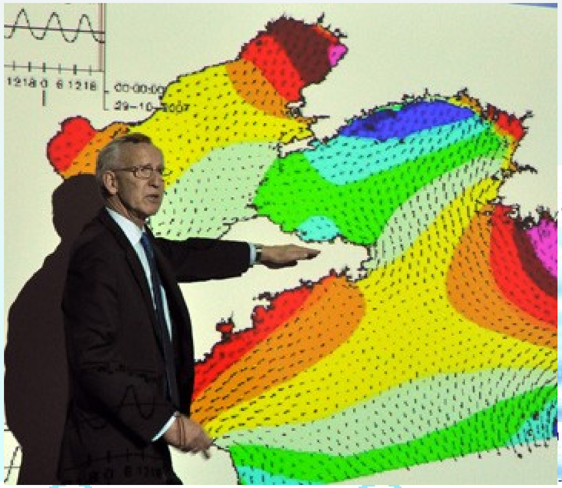
Source: Kolkman

Power Generation for T Dam



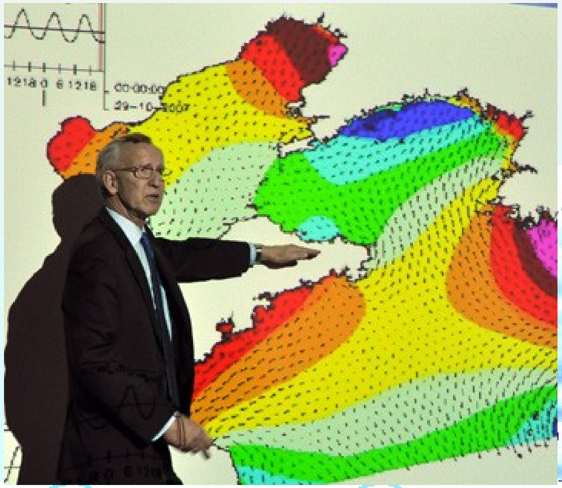
Research Needed

- Social and Environmental Impacts and Mitigation
- Integration with Grid
- Seabed Morphology
- Coastal Protection



Research Needed (cont.)

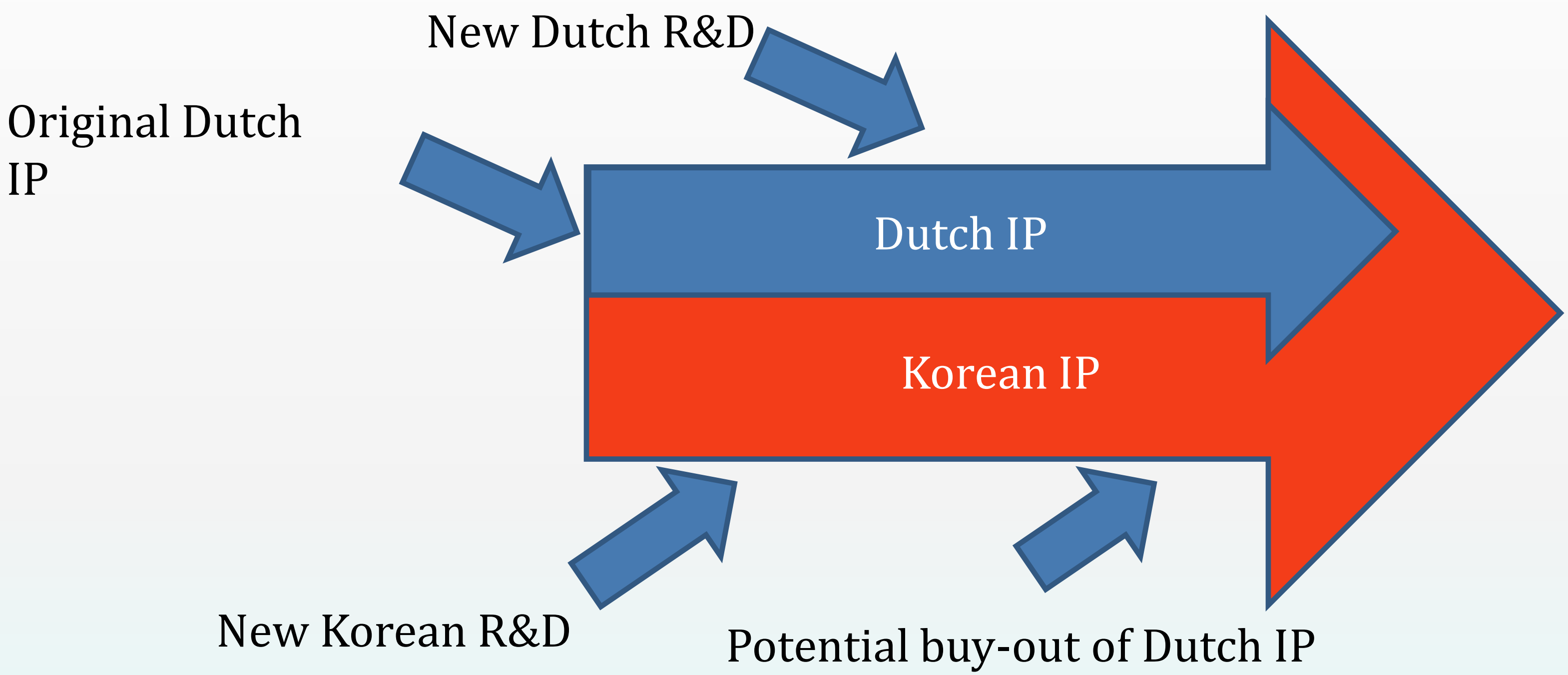
- Detailed Site-Specific Numerical Modelling
- Power Generation / Turbine Design
- Construction Methods
- In-Depth Economic Analysis



Korean – Dutch Joint Development

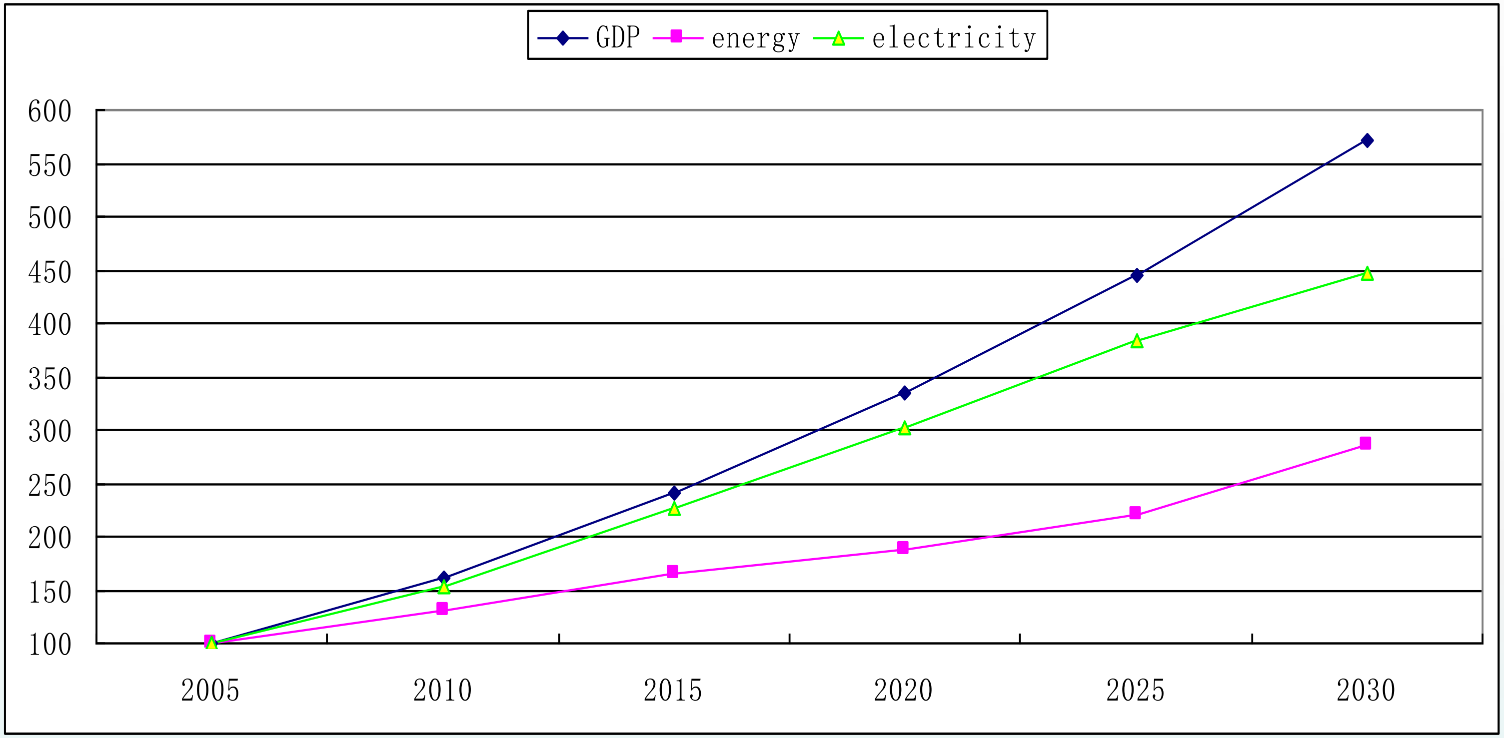
- Powerful Steering Group
- Top Research Institutes
- Pioneering Companies

Intellectual Property



In time, Korean endogenous innovation + potential buy-outs of IP would result in Korean majority or full ownership of related IP

China GDP-Energy-Electricity Growth



- Electricity demand has grown over tenfold between 1980 and 2010
- The rate of growth is forecast to decline, but overall electricity demand is still expected to triple up to 2030

Source: State Grid Corporation of China

Thank You!

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