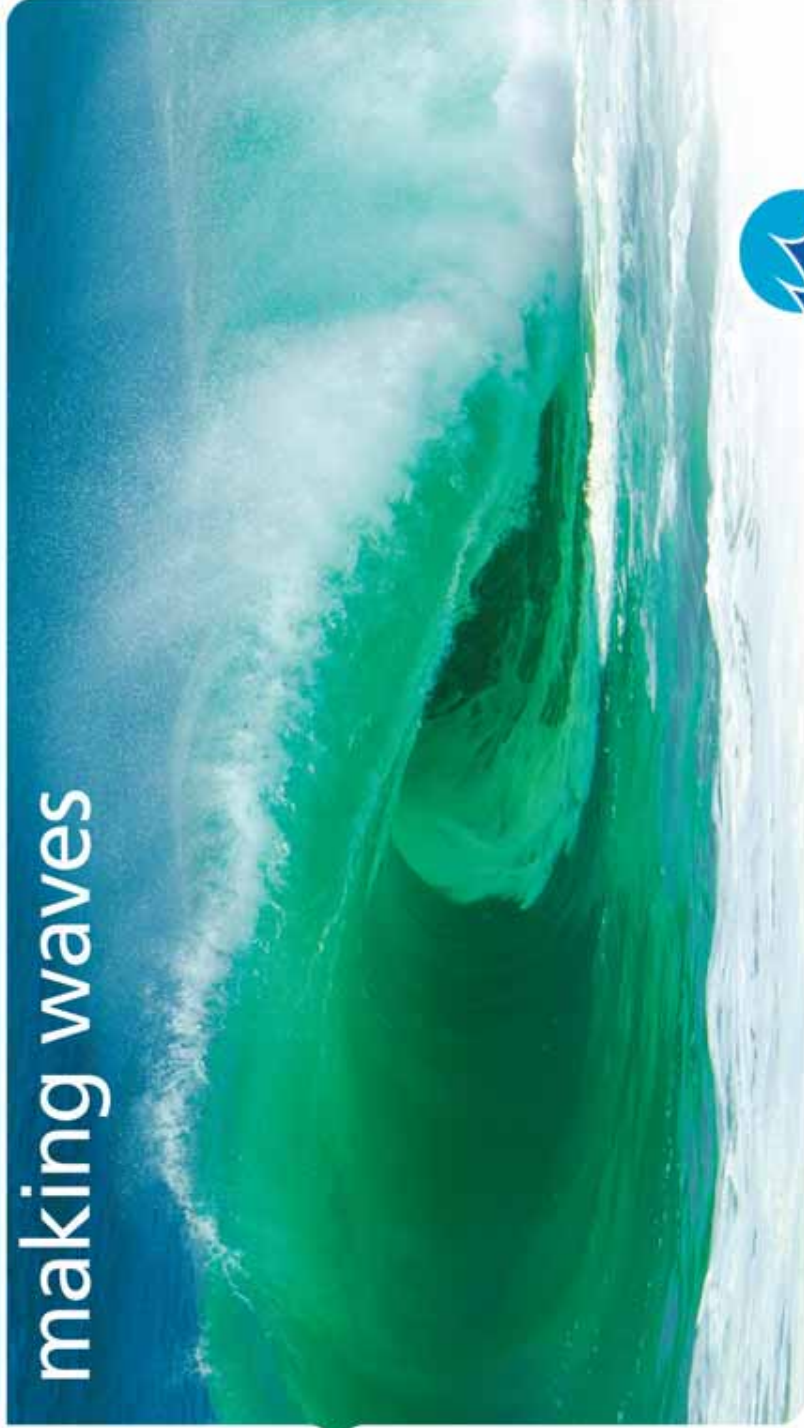


blue energy :

making waves

19 May 2009



Icon Room  
Te Papa Tongarewa  
Wellington





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## **Voith Hydro's Tidal Turbine Technology – Optimized to Achieve Minimal Maintenance Costs**

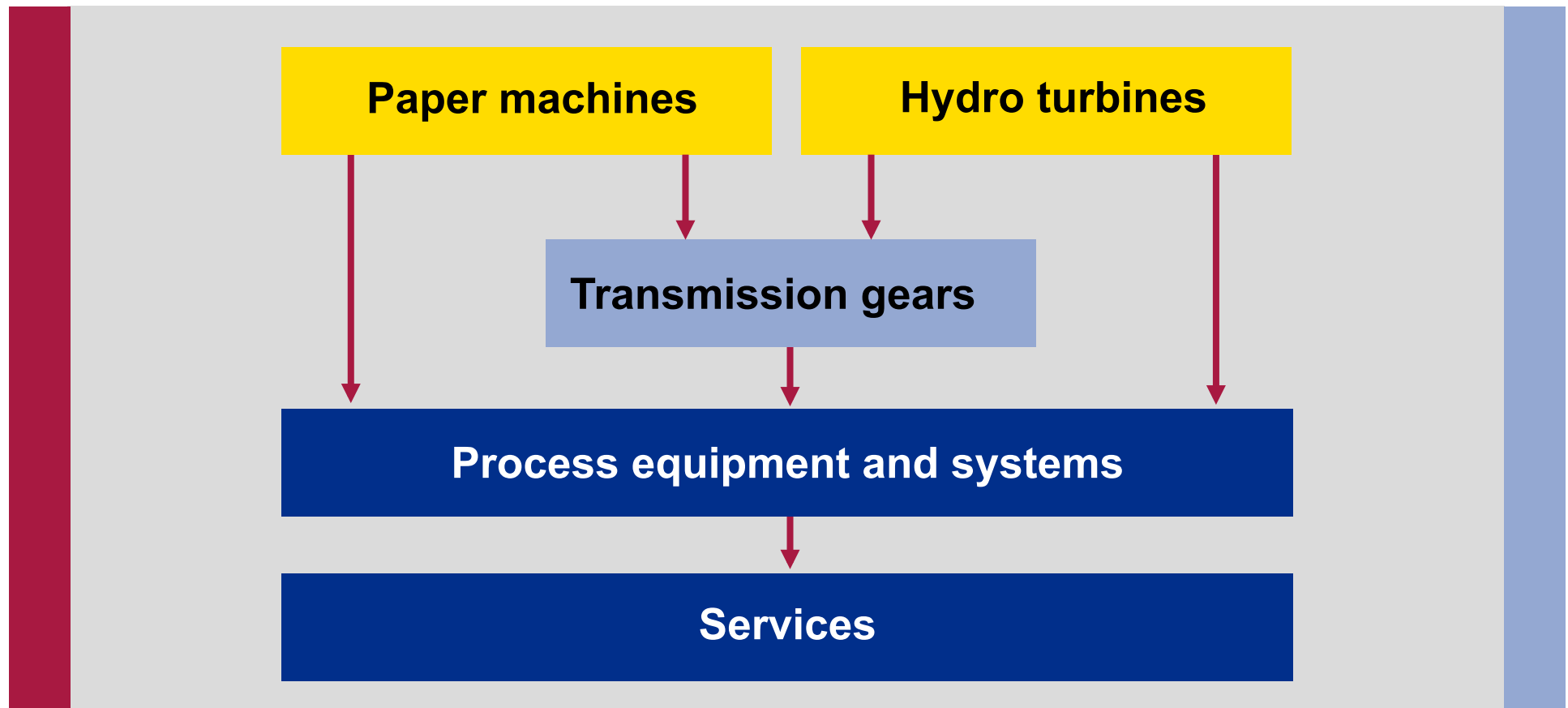
**Jochen Weillepp,  
Head of Ocean Energies**

Wellington May 19, 2009

## Agenda

- Introduction to Voith Hydro and to our approach to enter the Wave and Tidal Sector
- Our reliability maximizing Tidal Current Technology
- Some words on the costs of tidal current power

## Our evolution over time – starting in 1867

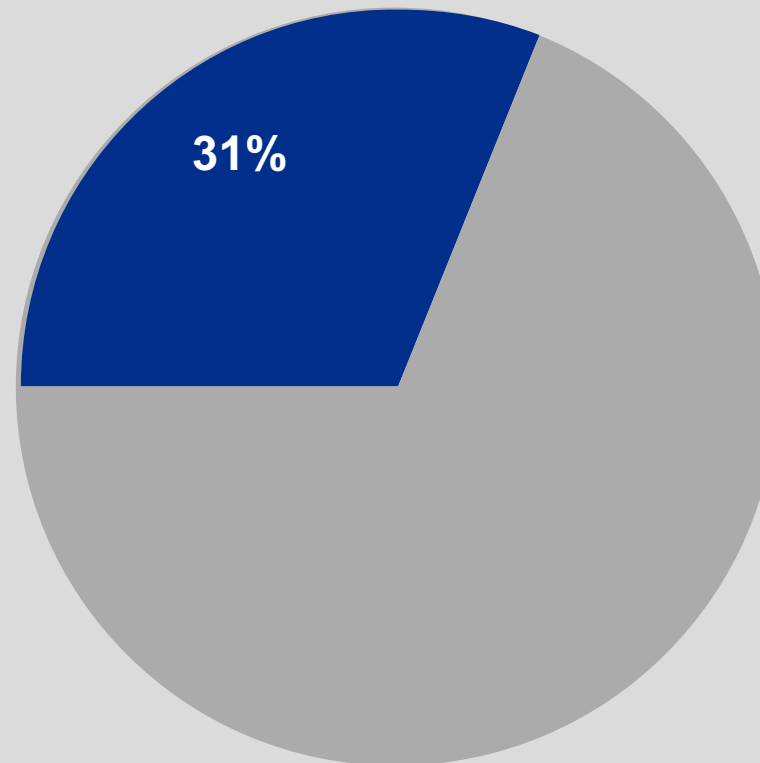


# Voith Hydro is the Hydro Power division of the Voith Group

Organi- sation	Voith AG			
	Voith Paper Voith Fabrics	Voith Turbo	Voith Hydro	Voith Industrial Services
<b>Sales 07/08</b>	EUR 1984 mio	EUR 1161 mio	EUR 800 mio	EUR 983 mio
<b>Markets served</b>	Paper			Paper
		Energy	Energy	Energy
		Transportation		Transportation
		Processing industry		Processing industry
	Technical services	Technical services	Technical services	Technical services

## Worldwide installed hydro capacity

■ Voith Hydro  
■ Others



With more than 40,000 turbines and generators supplied, Voith Hydro is the leading manufacturer of the world.



## Vier nichtthermische Meeresenergieformen

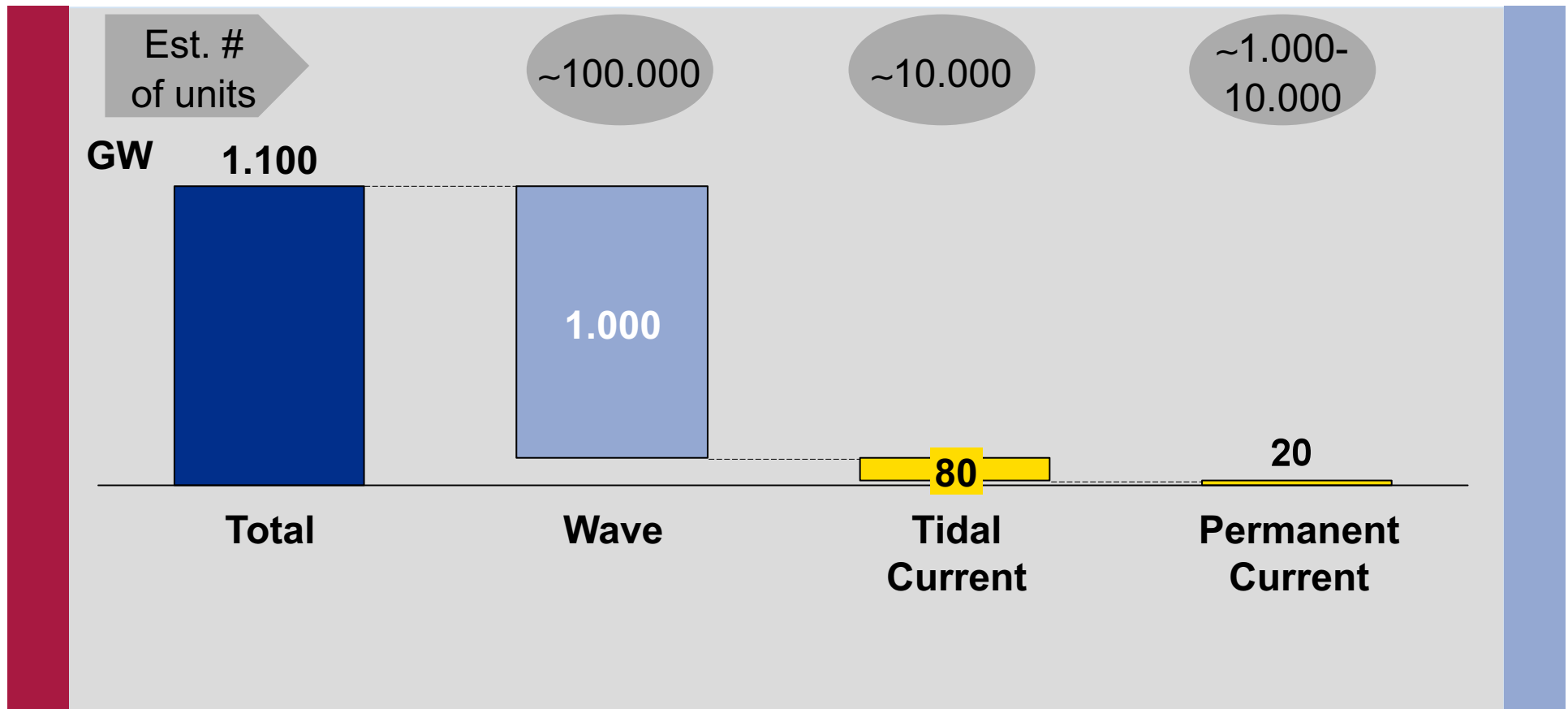
Meeresenergieformen						
	Welle	Gezeitenströmung	Permanentströmung	Osmosekraft	Ozeanische Geothermie	Maritime Biomasse
Fit zu Wasserkraft				/ <sup>(1)</sup>		
Technologische Reife						
Time to market Jahren	1-3	1-3	5-10	10	10-20	5-10
<b>Hohe Relevanz</b>						

○ Sehr gering      ● Sehr hoch

(1) Membrane kein und Turbine hoher Fit zur Wasserkraft

Quellen: UN Atlas of the Oceans; Projekt Team

# Global theoretical wave and current power potential totals 1.1 TW



## Our two step market entry and development strategy

Entry into Tidal Current Power through  
in-house development

Market entry through acquisition of Wavegen

## Two options to harvest tidal power

### Tidal current



- Kinetic energy of the periodically returning tides is harvested
- Tidal current plant is a dam-free “underwater wind mill”

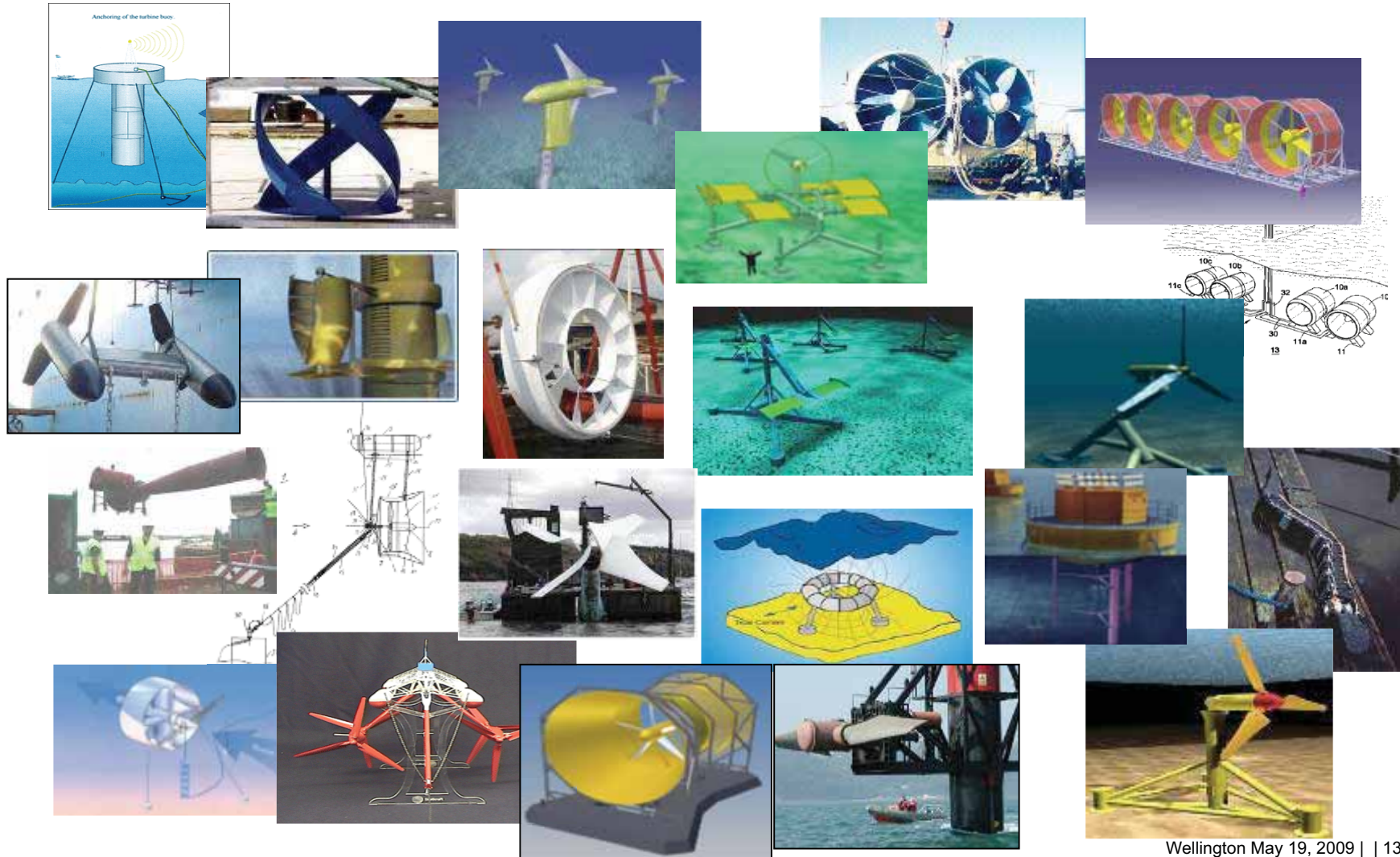
Development focus

### Tidal dam



- Sea water flows into (and out of) a natural basin
- Dam creates head
- Classical hydro technology

# The tidal technology patchwork

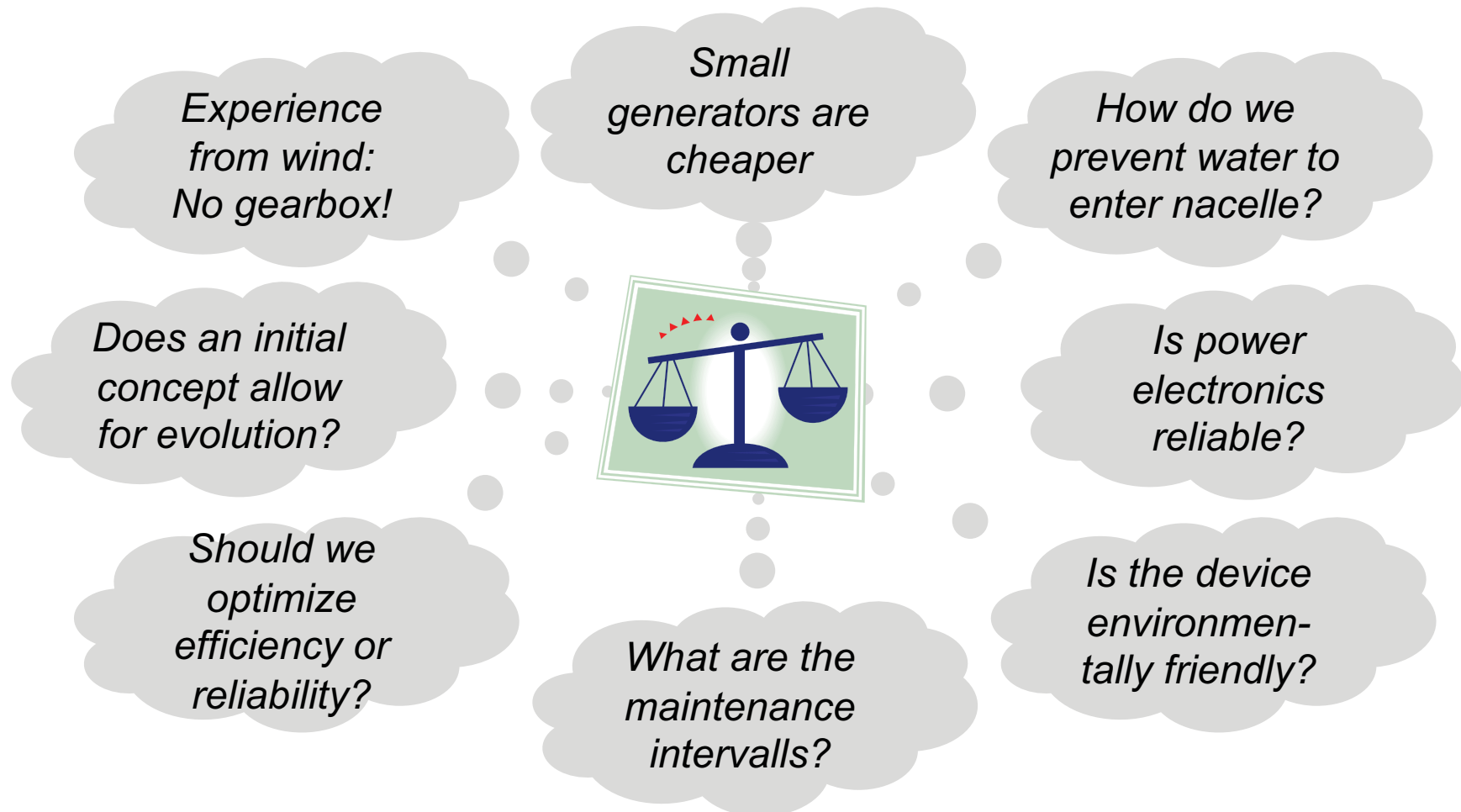


## The tidal current resource represents a challenging environment

1. Flow direction changes every six hours by (almost) 180 degrees
2. Machine has to be installed in an environment at strong tidal currents (8-10 knots are possible) – only approximately 1 hour per cycle of almost standing water
3. Machine has to be operated safely under (salt-) water and should ideally never fail – in case of failure it has to be recovered safely at minimum costs

***Simplicity is key!***

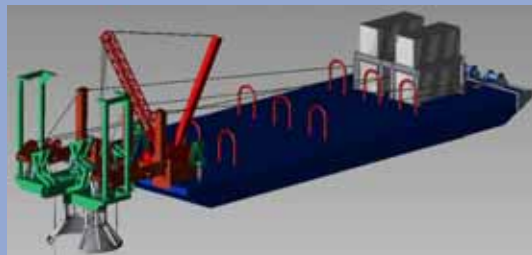
# Turbine technology has to optimize life cycle cost of energy production



# Three major components of a tidal power plant need to be developed

Responsibility:

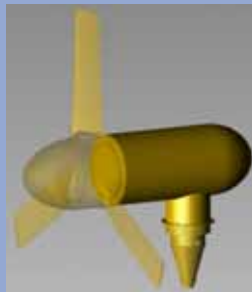
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**Installation and maintenance concept**  
 Significant cost driver

Tidal technology developer

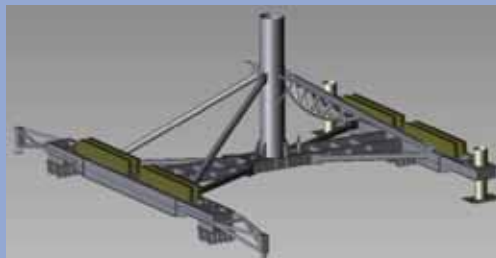
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**Turbine concept**  
 Core element of power plant technology

Tidal technology developer

1



**Support structure**  
 Dependent on seabed different solution are possible

Offshore specialists



## Built-in simplicity as guiding design principle for our tidal technology



No failure-prone technologies under water

- No gearbox ⇒ direct drive
- No static excitation ⇒ permanent excitation
- No blade pitch ⇒ variable speed
- No adjustment to flow direction ⇒ symmetric blades
- No dynamic seals ⇒ water passes through generator “water” gap
- No greasing of bearings ⇒ sea water lubricated bearings
- Initially: Power electronics located on land

**And this is how the turbine is maintained...**



## **The first project will start next year in Korea – together with our Joint Venture Partner RENETEC**



### **Location**

Jeollolam-do, Korea

### **Technology**

Tidal Current power plant

### **Envisaged project size**

Several 100MW in units of 1MW

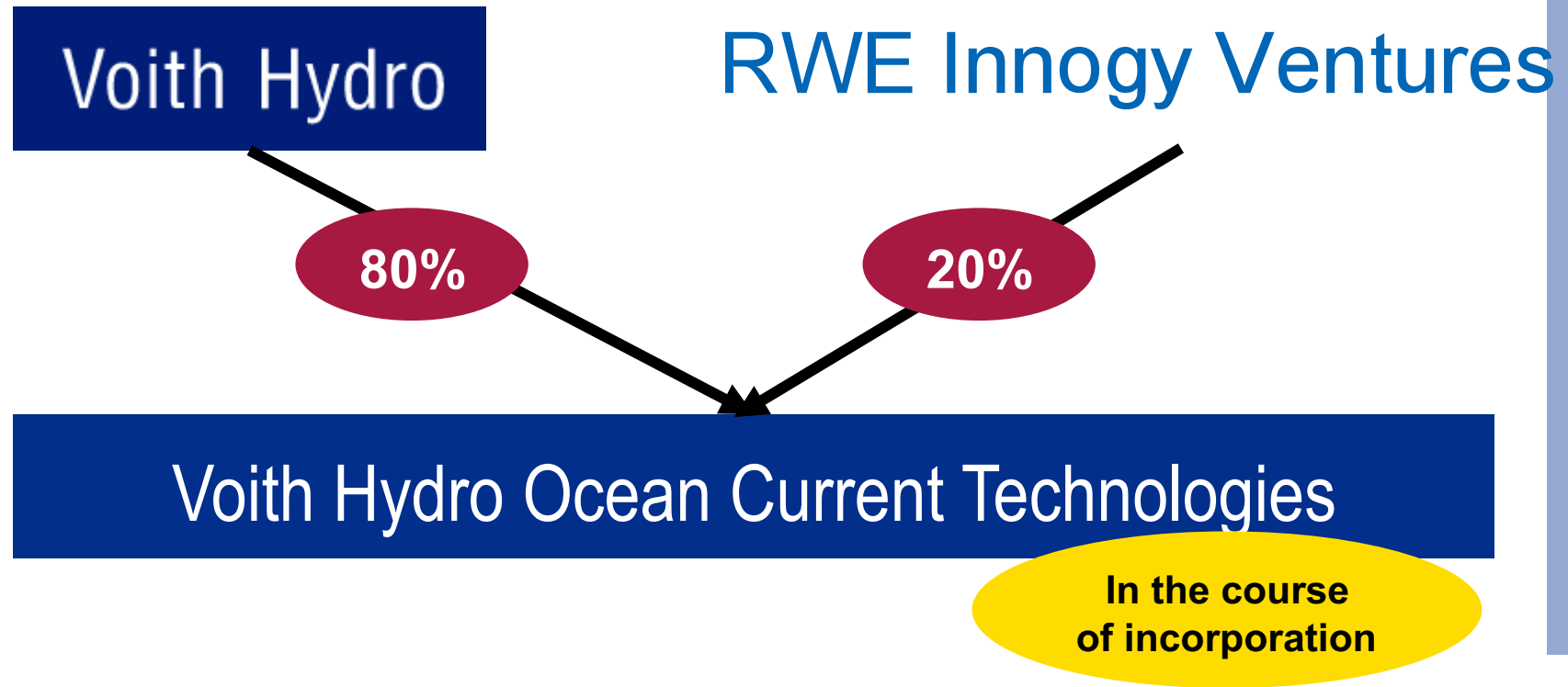
### **Planned installation of first 110kW unit**

Winter 2009/10

**But it is no longer CAD pictures and movies only ...**



# That brought a strong partner on board: Our Joint Venture with RWE Innogy Ventures



## Some words on costs of energy production...

*“... xy’s stated aim of producing electricity at a commercial price of 5.0p/kWh is realistically achievable...”*

*Webpage of tidal developer A*

*“... we believe our device will generate electricity costing 8-9p/kWh for initial farms, falling to 5-6p/kWh when the technology is sufficiently well established ...”*

*Webpage of tidal developer B*

***Unfortunately: Proximity to realisation destroys all dreams!***

## Some facts on tidal current power

Wind has installed more than 120GW worldwide – due to site restrictions current power will never reach that

Water depth limits the rotor diameter (rated power) of tidal plants

Due to high thrust loads, support structures have to be more robust

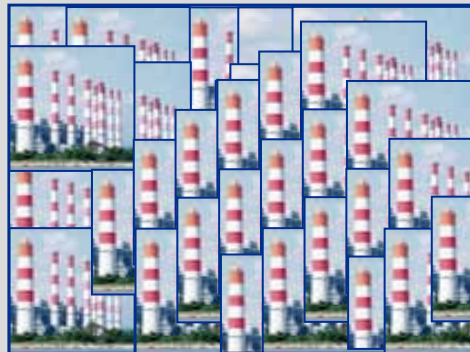
Tidal machines need to be placed sub-sea which implies higher maintenance costs

Good news: The energy density of strong tidal currents is 5 to 10 times higher compared to wind power

***Tidal current power may eventually reach the cost level of off-shore wind – costs will be similar to those of wave power***



## Can we afford to disregard Wave and Tidal energy – event though they might be expensive as of today?



Every 5.2 days a coal fired plant with low efficiency technology goes on-line in China



Indian car maker Tata to launch their peoples' car *Tata Nano* at a price starting from USD 2,500

***No, we can't!***





**VOITH**  
*Engineered reliability.*