Marine Energy Potential in New Zealand

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Renewable Energy in New Zealand

As a nation New Zealand has placed a high priority on producing as much energy through renewable sources as possible

In 2015, 80.8% of all electricity was from renewable sources

By 2025 the nation plans on having 90% or more of their electricity come from renewables

The majority of renewable energy in New Zealand is produced by hydroelectric dams, geothermal power stations, and wind turbines.

The government of New Zealand is actively pursuing new projects to increase their renewable energy resources

Marine Power Generation

Tidal Power- existing technology that uses the rising and falling of tides to turn turbines

Wave Power - existing technology that is used in areas with high average wave height

Ocean Current Power - Developing technology that uses strong ocean currents in the ocean to turn turbines

Tidal Power Generation

There are three main types of Tidal Barrage systems

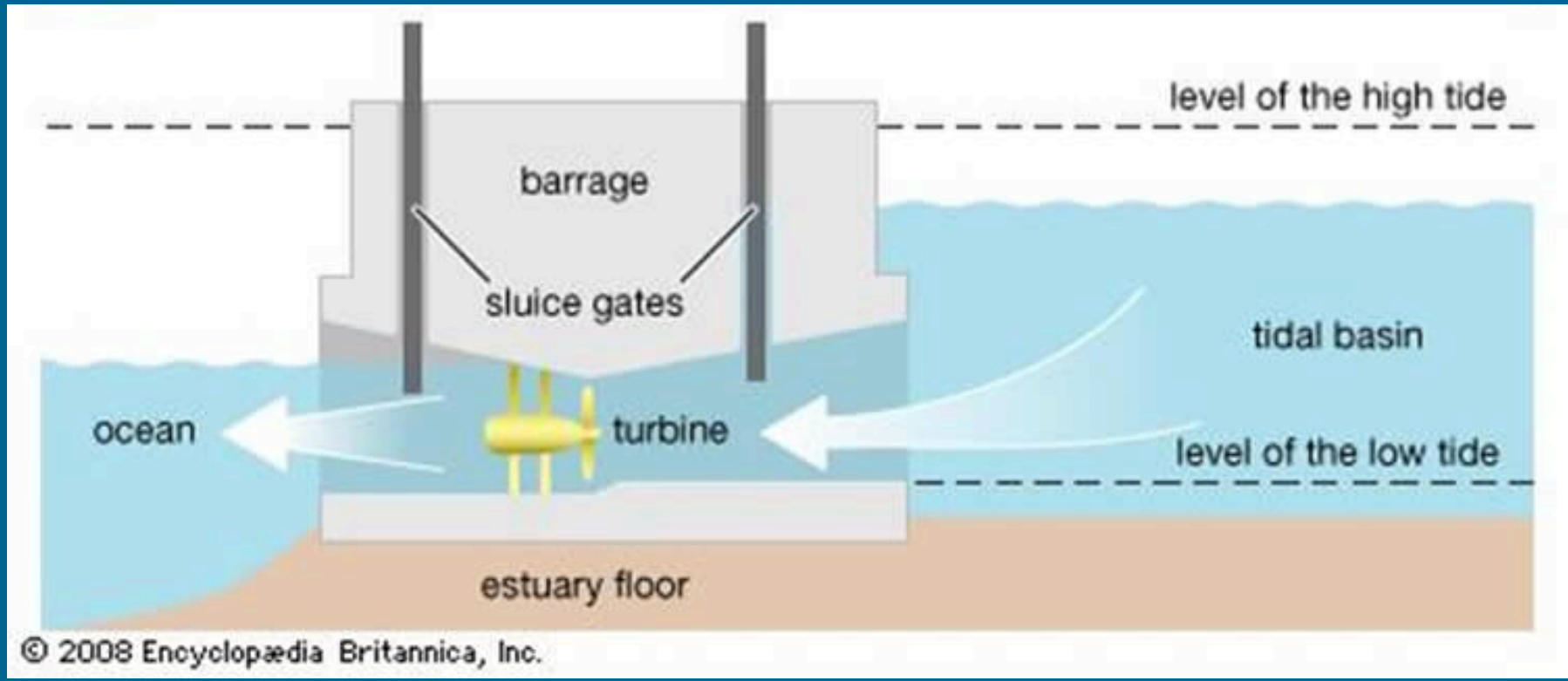
- Ebb, Flood, and Two-way Generation modes

These systems work best in areas that have a high tidal range (5m +)

- Having a large tidal range allows for the systems to take advantage of the large hydraulic head

Expensive to install, but have a relatively low cost of operation

Pumped hydro storage is also used to increase the hydraulic head of the water stored in the tidal pools behind the system


level of the high tide
barrage
sluice gates
tidal basin
ocean
turbine
level of the low tide
estuary floor
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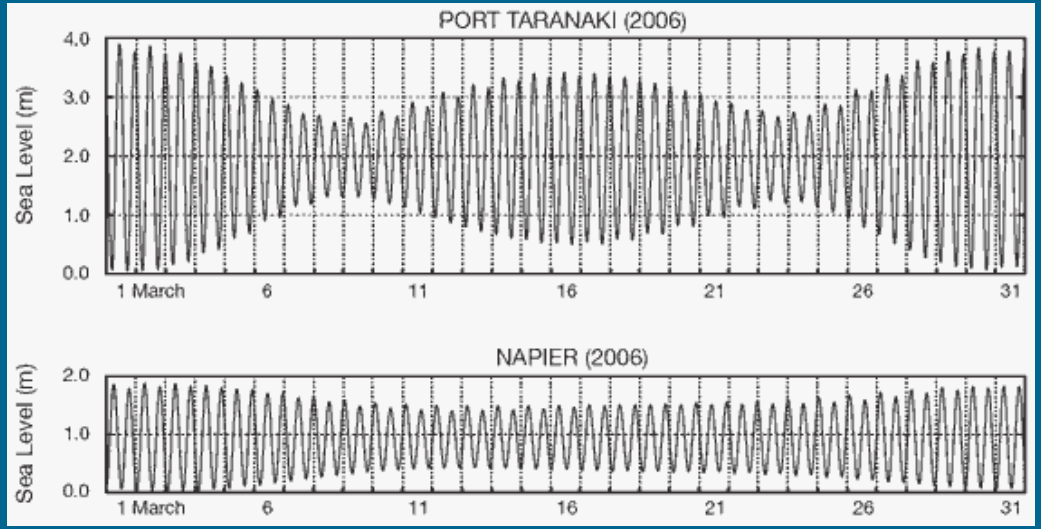
Application In New Zealand



The tidal range in New Zealand does not exceed 3.5m in most locations, making tidal barrage a poor choice for energy production, unless a pump is used to increas the hydraulic head.

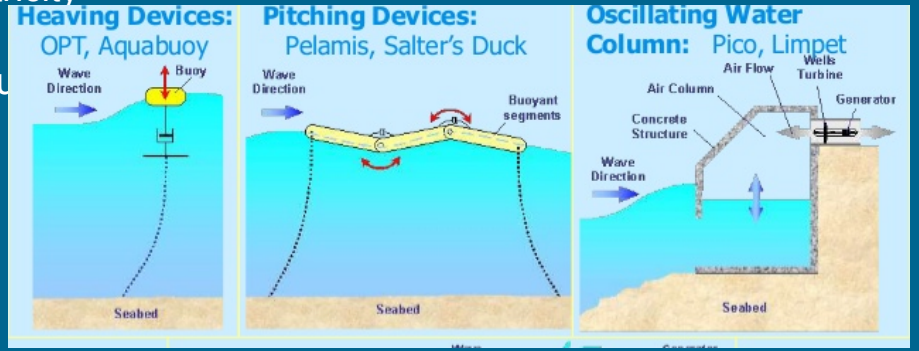
Wave Power Generation

There are three main types of wave power generating systems, but there are many different models for each type

Terminators - Devices that direct waves in a variety of ways in order to turn a turbine

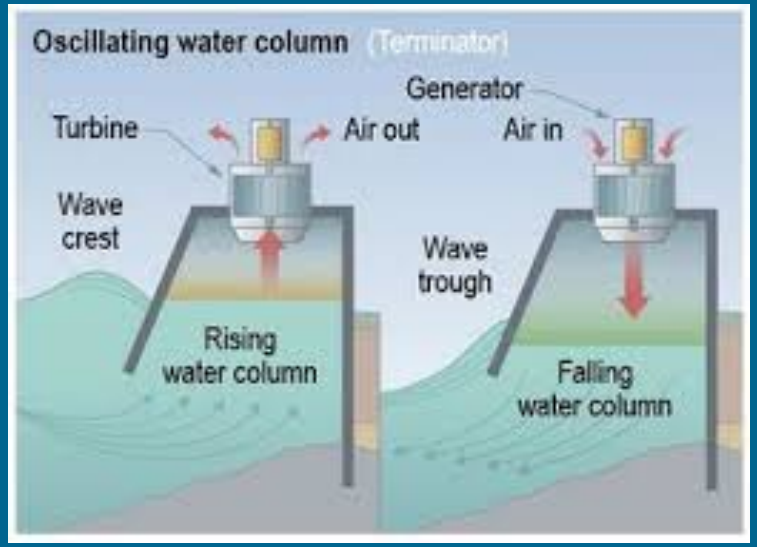
Attenuators - Offshore devices that flex with the motions of the waves and uses that motion to move hydraulic pumps creating electricity

Point Absorbers - Offshore devices (bu
hydraulic energy converters



Terminators

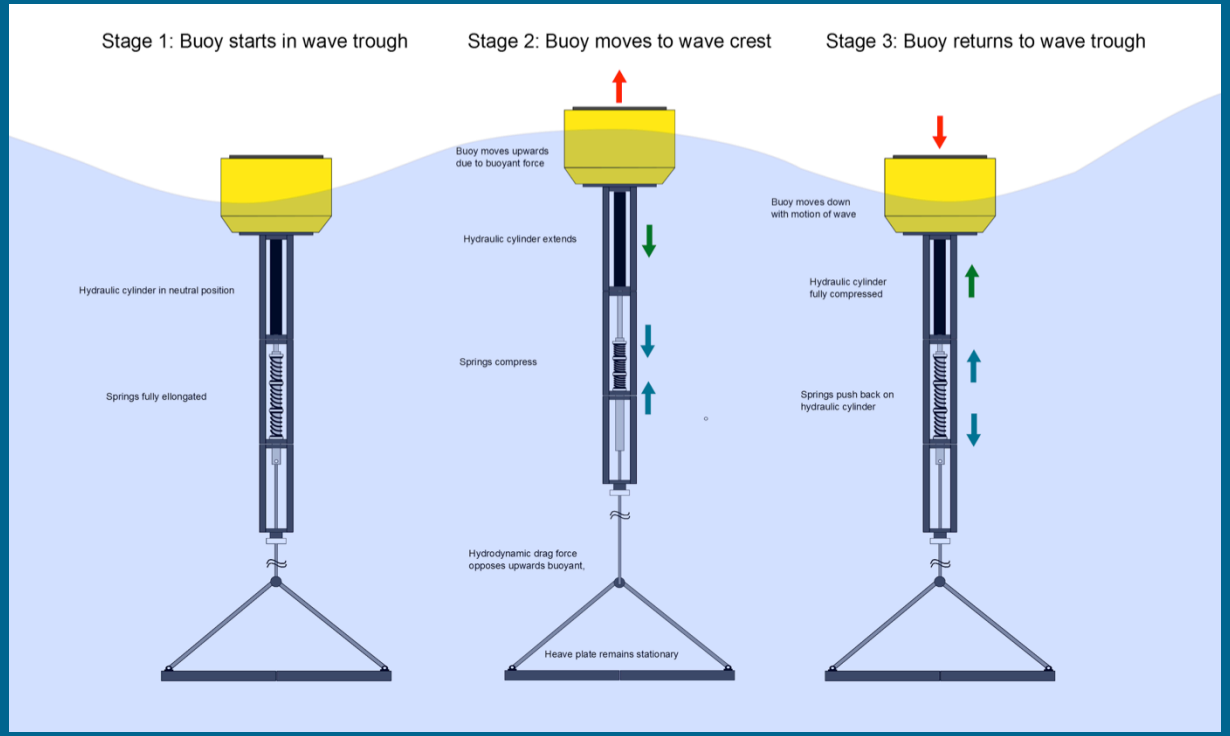
These devices include, spillover devices, Wave Dragons, cavity resonators and oscillating water columns



Attenuators

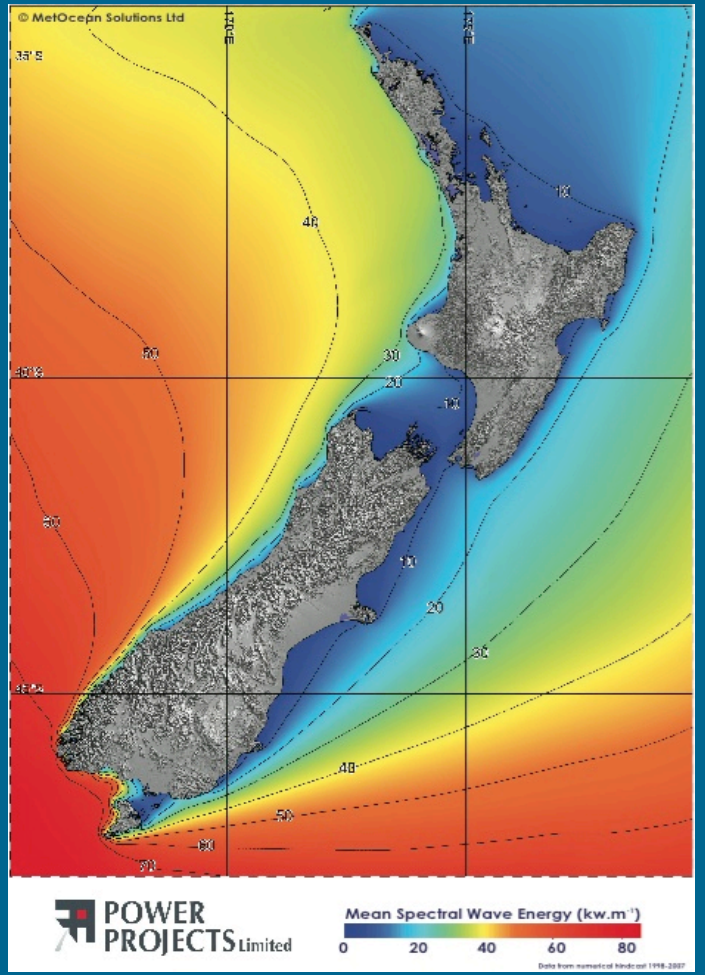
Wave attenuators bend are long floating devices that bend at the joints as the waves pass perpendicular to the attenuator and use hydraulic drivers to produce electricity.

Point Absorbers (Buoys)



Wave Energy In New Zealand

There is a lot of potential for wave power generation in New Zealand, especially on the south island where the waves deliver over 60 Kw/m of coastline. However the existing technology can be expensive compared to existing renewables, but the price eis expected to go down with new developments. A company in Australia makes OWC’s that can produce 500-3,000 KW per units, so they do produce a considerable amount of energy.



Current Turbines (In Developement)

- Using strong ocean currents to produce electricity is a relatively new development.
  - There are no commercial installations yet, only prototype facilities
- The majority of prototype currents turbines essentially work like wind turbines.
  - A large, bladed turbine is placed in the middle of the current and spins as the current flows past.

Kaipara Harbour (Cancelled Project)

In 2011 a New zealand company, Crest Energy, planned to install a 200 MW tidal current generation plant in the opening of Kaipara Harbour, just north of Aukland. However uncertainty, and a lack of necessity caused them to forgo this project. In generally government funding for marine projects has been pulled due to the lack of need for the electricity.

Cook Strait

Certain Areas in the Cook Strait have ocean currents, generated by unique tidal patterns, that can range from 3-4 m/s. These currents provide an ideal location for current turbines, as they are close to shore which helps in the transmission of power.

Depending on what type of turbine used, the plan outlined by the Electricity Commission Energy Efficiency and Conservation Authority of New Zealand could produce up to 590 Gwh/per year from the Cook Strait alone

Cook Strait- Potential Generation

Location	Water Depth	Unit Power	Array Capacity	Annual Mean Yield	Annual Production
Figures 5.8 & 5.9	m	kW/unit	50 x 300 kW	MW/year	GWh/year
CS1	42	48.8	15.0	2.32	20.3
CS2	50	93.4	15.0	4.44	38.9
CS3	69	49.6	15.0	2.36	20.6
CS4	31	107.2	15.0	5.09	44.6
CS5	86	33.0	15.0	1.57	13.7
FX1	31	8.5	15.0	0.40	3.5

Table 5.6: Proposed 50 x 300 kW Seaflow Tidal Current Arrays

Cook Strait- Potential Generation

Location	Water Depth	Unit Power	Array Capacity	Annual Mean Yield	Annual Production
Figures 5.8 & 5.9	m	kW/unit	50 x 1.2 MW	MW/year	GWh/year
CS1	42	210.0	60.0	9.98	87.4
CS2	50	400.0	60.0	19.00	166.4
CS3	69	211.0	60.0	10.02	87.6
CS4	31	458.6	60.0	21.78	190.8
CS5	86	143.0	60.0	6.79	59.5
FX1	31	38.8	60.0	1.84	16.1

Table 5.7: Proposed 50 x 1.2 MW SeaGen Tidal Current Arrays

Wave Power - Project Potentials

Location	Unit Power	Array Capacity	Annual Mean Yield	Capacity Factor	Annual Array Production
	kW/unit	50 x 1,500 kW	MW/year	%	GWh/year
Port Waikato	1,236	75.0	58.7	78	514.3
Taranaki	1,275	75.0	60.6	81	530.5
Gisborne	815	75.0	38.7	52	339.1
Wairarapa	999	75.0	47.4	63	415.7
Westport	1,316	75.0	62.5	83	547.6
Southland	1,354	75.0	64.3	86	563.4

Table 5.3: Annual Production from a 50 x 1,500 kW Pelamis Array

Wave Power - Project Potentials

Location	Unit Power	Array Capacity	Annual Mean Yield	Capacity Factor	Annual Array Production
	kW/unit	50 x 750 kW	MW/year	%	MWh/year
Port Waikato	551	37.5	26.2	70	229.3
Taranaki	572	37.5	27.2	72	238.0
Gisborne	371	37.5	17.6	47	154.4
Wairarapa	441	37.5	21.0	56	183.5
Westport	592	37.5	28.1	75	246.3
Southland	643	37.5	30.5	81	267.6

Table 5.4: Annual Production from a 50 x 750 kW SPA Array

Wave Power - Project Potentials

Location	Unit Power	Array Capacity	Annual Mean Yield	Capacity Factor	Annual Production
	kW/unit	50 x 750 kW	MW/year	%	GWh/year
Port Waikato	129	37.5	6.1	16	53.7
Taranaki	149	37.5	7.1	19	62.0
Gisborne	88	37.5	4.2	11	36.6
Wairarapa	109	37.5	5.2	14	45.4
Westport	158	37.5	7.5	20	65.7
Southland	228	37.5	10.8	29	94.9

Table 5.2: Annual Production from a 50 x Pelamis P750 Array

Conlcusion

New Zealand has a large potential for marine based energy production, but at this time the demand for enbergy is not high enough to offset the cost of reasearch and installation of the facilities. In the future it may become nesecary, but at this time there is no cheap way to pursue marine based production.

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