

Macro-Imagineering

Carpet Tidal Power-Plant Around the Peninsula Valdes in NE Chubut Province, Argentina

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Dedicated to a masterful “Vitruvian Man” [1], the late Prof. ROGER HENRI CHARLIER [2].

Received: _03/02/2020_ / Accepted: _04/25/2020_ / Published: _05/02/2020_.

Abstract: Tidal power is a renewable energy source that is environmentally friendly and has many advantages over traditional power supply that produces waste products. This macro-imageneering proposal is based on mesochronic tidal inequalities between *Golfo San José* and *Golfo Nuevo*, separated by the *Florentino Ameghino* Isthmus that connects the *Area Natural Protegida Península Valdés* with the mainland on the Argentine southeast coast in *Chubut* Province. Hypothetical construction of a canal or tunnel across the 6-8 km wide isthmus would allow a hydropower channeling turbine to take advantage of the M2 tidal amplitude differential between the two bays to produce electrical energy for the immediately adjacent region. Additional beneficitation of the site would accrue from eco-tourism associated with the commercial tidal-range electricity-generation macro-project that envisages terrestrial as well as submarine bio-site visitations by tourists. Properly conducted macro-imageneering projects such as this proposal offer multiple advantages to coastal sites such as this one near the famed *Península Valdés* in Argentina. During 2021, the United Nations is embarking on a Decade of the Ocean.

Key-words: Tidal energy, hydropower, renewable energy, tidal turbine, hydro-electricity supply, tidal barrage energy, eco-tourism, submarine sea tents, marine park.

Resumo: As marés são fontes de energia renovável que não agredem o meio ambiente e apresentam muitas vantagens sobre as fontes tradicionais que geram resíduos. Esta proposta de macroimagemaria é baseada nas desigualdades mesocrônicas das marés entre o Golfo *San José* e o Golfo *Nuevo*, separadas pelo Istmo *Florentino Ameghino* que liga a Área Natural Protegida *Península Valdés* ao continente na costa sudeste da Argentina, província de *Chubut*. A construção hipotética de um canal ou túnel através do istmo de 6 a 8 km de largura permitiria que uma turbina de canalização hidrelétrica aproveitasse o diferencial de amplitude de maré M2 entre os dois golfos no intuito de produzir energia elétrica para a região imediatamente adjacente. Benefícios adicionais para o local seriam advindos do ecoturismo associado ao macroprojeto comercial de geração de eletricidade por faixa de maré, o qual prevê visitas a *bio-sites* terrestres e submarinos. Projetos de macroimagemaria adequadamente conduzidos, como a presente proposta, oferecem múltiplas vantagens para locais costeiros. Durante 2021, as Nações Unidas estão embarcando em uma Década do Oceano.

Palavras-chave: Energia das marés, energia hidrelétrica, energia renovável, turbina de maré, fornecimento de hidroeleticidade, energia das barragens de marés, ecoturismo, tendas submarinas, parque marinho.

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1. Introduction

Within the early-21st Century Macro-Imagineering community, the word cliché usually describes a thing, event, or process that repeatedly appears in Oceanography's dominant macro-project propositional literature, causing a degree of weariness. Unfortunately, because renewable energy output schemes are extra-ordinarily predictive over extended timescales, conceptions of “tidal-power” may appear redundant but in fact their applications are greatly underestimated. Although many hundreds of tidal-power macro-project proposals have been elucidated and promoted by macro-imagineers worldwide, it is perhaps surprising that only about five tidal power installations have been constructed and operated since 1966 [3]!



Figure 1. Conceptualization of shoreline positions associated with a hypo-theoretical sea-level rise of 100 m. The dotted lines show the highly generalized relative positions of the present-day coastline and the solid line shows the hypothesized location of the shoreline for this improbably hyper-elevation of sea-level that would produce additional possibilities for macro-imagineering projects that could produce tidal power [8].

The dynamic world-ocean covers about 72% of the Earth's surface with a volume of about 813,485 km³ and yet continental shelves have been subaerially exposed by lowered sea levels during much of Geologic Time [4-5]. Certainly, the Earth's under-seawater landscape does provide a rich source of data about the archaeology of past

human settlement and long-term changes in climate regimes and sea-levels. Some geographers speculate that the theoretical maximum fluctuating local relief along continental margins was on the order of ~100 m, although there are other estimates that show fluctuations ranging up to 200 m. Figure 1 shows that about 17% of South America's coastal belts could theoretically become inundated, that is with a marginal seascape [6], due to an hyper-hypothetical 100-m rise in sea level [7]. This magnitude of sea-level rise would drastically change shoreline positions and flood Amazonia, but at the same time produce new possibilities for macro-imagineering of tidal power plants [8].

Tidal power (electricity generation) devices effectively utilize tidal differentials by impounding seawater within a basin that is naturally occurring or artificially excavated or blockaded, prior to release through turbines which turn generators during ebb and/or flood tidal cycles. Because rhythmic tidal cycles respond to lunar stresses induced by interpositions of the Earth-Moon system, macro-imagineers envision ocean tides as massive moving liquid "plateaus" containing significant potential energy. Whether sea-level rises or falls during the 21st Century, regional tidal regimes will be altered everywhere within Earth's bioshell [9-10]. These potential changes in sea-level are minuscule compared to hyper-theoretical possibilities envisaged by macro-imagineers who look at the big picture over long-time scales.

2. Southern Argentina's potential tidal-power generation using two barely separated gulfs

Interpretation of archaeological data obtained from today's continental shelves has become increasingly useful in organizing assumptions about the "Aquaterra" past sea-level still-stands [11]. From these studies it is presumed that pre-literate humans moved landward and seaward with coastline changes that occurred in response to deglaciation, interstadial phases, and short duration Ice Ages. In accordance with Dr. Jerome Dobson's "Aquaterra" concept [8], much of human history is posited to have been intricately entangled with fluctuating coastal margins because of relative changes in global and regional sea-levels!

Drs. Roger Henri Charlier and Charles William Finkl, in *Ocean Energy: Tide and Tidal Power* (2009), at Section 6.3, pages 123-124 of their book's Chapter Six, offers readers a concise but nevertheless complete description of the multiple tidal-power opportunities afforded by the proposed variably-configured "San Jose Tidal Power Plant", an electricity-generation macro-project scheme to be situated both north, in the 17,000-km² San Matias Gulf (the deepest sea-bed basin known to exist on Argentina's continental shelf) and south, in the 2,500-km² Nuevo Gulf. This proposed macro-imagineering project is located on the Florentino Ameghino Isthmus that connects the Peninsula Valdes Natural Protected Area [12] because it could harness the large amplitude M2 tidal-wave which presents a phase shift of six hours on either side of the peninsula (Figure 2). Since 1923, in some mega-project configurations, namely the "San Jose Tidal Power Plant" concept, these two marine gulfs were to be connected by a 6-8 km-long canal dug across the narrow 35 km-long isthmus, a geologically complex gravely spit or tombolo that is part of the Peninsula Valdes linking, via unpaved National Highway #2, with the mainland; other

configurations involved the difficulty and costly emplacement of a control dam north of the isthmus to separate the Golfo San Jose from the Golfo San Matias [13] (Figure 3).

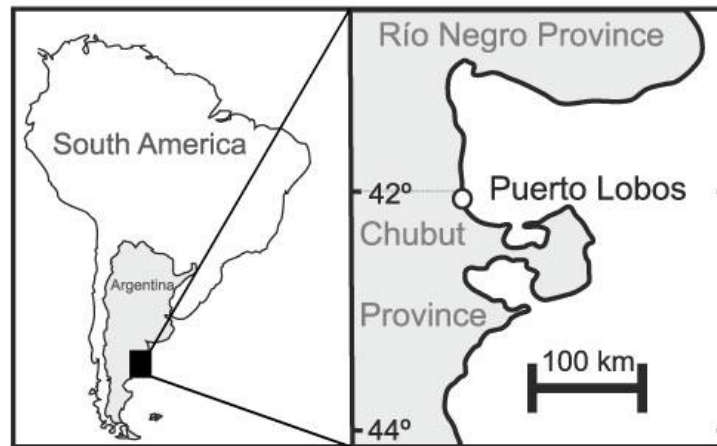


Figure 2. Satellite imagery illustrating the general geographical placement in South American and Argentina of this paper's subject.

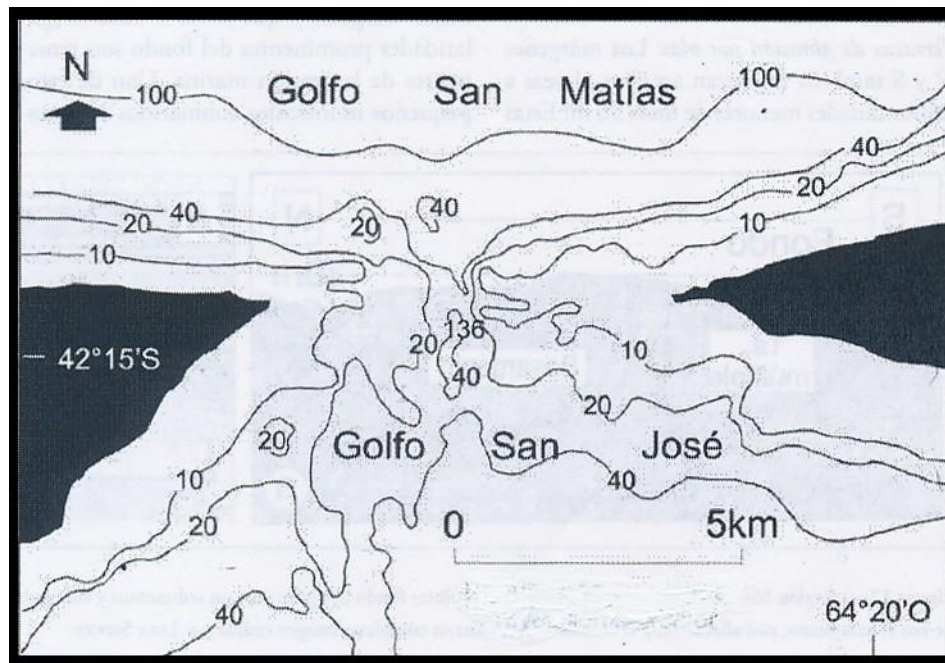


Figure 3. A not easily overcome by macro-engineering bathymetry typifies the gap between the gulfs, highlighting the preferability of the macro-imagineering concept proposed by this article. Depths are in meters below sea-level. (Image provided by JMH.)

3. Macro-Imagineering coastal NE Chubut Province, Argentina: a mimic littoral region?

Employment of “mimic” phraseology is intended to inform readers of a 21st Century national impetus in Argentina to minimally alter the present-day littoral zones of the two gulfs situated on each side of the narrow Peninsula Valdes. Such efforts mean to literally deconstruct, by applied macro-engineering techniques, the existing seascapes and landscapes that are normally geomorphologically modified by maximum flood- and ebb-tidal flows near their respective navigational entrances where there are ~2 m/s semidiurnal tidal currents. As a result, a thalassographic vision is invoked that optimistically surpasses the several potential tidal-range electricity-generation developmental scenarios already elucidated in **Section 2**, above. Nearby subaerial (dryland) land surface depressions are tectonic relatives to the strand-erosion sediment trap depressions on the Argentine continental shelf at the gulfs of San Matías and Nuevo [14]. The main effects of regional and global climate change on coastal regions are alterations in the hydrodynamics of sea-level rise or fall, change in seasonal impacting wave-heights, diminished or enhanced coastal erosion, and damage to coastal infrastructure. Great oceanic storms can cause ship groundings that desecrate the seascape by sunk wreckage. Sometimes, urban-sprawl becomes (as at Guanabara Bay at Rio de Janeiro, Brasil) submarine-sprawl [15]! Also, not to be overlooked are uncontrolled marine biotic invasions. In other words, the essential environmental baseline for any proposed tidal-range harnessing macro-project near or about the Peninsula Valdes is constantly transforming and transitioning due to natural and anthropogenic processes.

4. The Polemic of Seascape Ecological Art

From 1894 until 1907, William Dean Howells (1837-1920) penned three novels encompassing the futurity of Komatsu Sakyo's later science-fiction [16], in which he imagined the utopic ecosystem-nation of *Altruria*, which occupied a whole Southern Hemisphere continent, but not necessarily Australia or South America. As Howells tells his tale, a large sea-strait had been 'artfully' excavated through a peninsula that had blocked a warm-seawater oceanic current from closely skirting his fabled continent's southeastern coastline. Successful completion of the massive earth-moving mega-project resulted in "...the climate of Italy" for happy *Altrurians* instead of its former harshly unpleasant, almost Siberia-like, climatic conditions [17]. Ecological Art is characterized by its absolute geographical location, sometimes intentional ephemerality, as well as its participatory and pedagogical deliberateness. Of course, wind and precipitation can modify the shapes of such fanciful artworks set in, on or beneath landscapes whilst Art placed (mostly) on the seascape is inevitably transformed by maritime climatic conditions and biota. More or less imitating the *negative art* produced by Michael Heizer [18]. Before 2017, Norway planned to finance *The Memory Wound*, an artwork designed by Swedish artist Jonas Dahlberg to commemorate the 22 July 2011 deaths of 77 persons at the hands of terrorist Anders Breivik during his lone-gunman attack on the Utoya Island-situated Workers' Youth League summer-camp. Dahlberg's unique memorial proposal was for a clean-cut, vertical slit, made at sea-level and below, through Norway's rocky Sorbraten Peninsula (Figure 4), below.



Figure 4. An artistic conception of what the proposed Dahlberg memorial would possibly look like from a sea-level view. Note the clean face of the surficial and submarine trench cut through the Sorbraten Peninsula showing its relative size compared to humans and an observation platform that is cut out of solid rock.

Due to professional training and mutual cultural tastes, it is not possible to recommend fieldwork investigations in Argentina that would permit a similar Macro-Imagineering travesty by splitting the picturesque parkland Peninsula Valdes, to materialize the technically outdated 7,000 MW "San Jose Tidal Power Plant" mega-project scheme! Appreciating the tourist attraction it might become, like the French 240 MW La Rance Tidal Power

Plant completed in 1966, such a project could endanger many creatures such as right whales, seals, various sea-bird flocks, dusky dolphins and sealions that already attract Argentine vacationers and Nature-adoring foreign tourists! It thus seems far wiser to retain the region's present-day elemental composure rather than brutally eradicate it from the Earth's bioshell, perhaps substituting instead a blobby unnatural sculpture in the energized vacuity of outer-space called *Ocean* [19], perhaps to be seen only telescopically! In most circumstances Jonas Dahlberg's artwork is labeled "Land Art"; however, a better and significantly more comprehensive term is available in "Earthworks" which logically might someday even be extended to artistic "Marsworks". "Earthworks" has the advantage of encompassing terrestrial and seabed terrains. Some preservationists might delight in the artwork *Ocean* as a vivid visual reminder to the planet's far-future minded-creatures that Earth's first land, the supposed super-continent "Kenorland", emerged ~2.4 billion years ago [20] and the world-ocean will probably be reduced in total volume in the far-future. So, it appears that Earth's ocean is not sempiternal, of never-ending duration as a superficial liquid planetary geophysical presence. Eventually, it will surround a future super-continent [21] and then, ultimately, entirely disappear whenever the Sun enters its Red Giant phase of thermonuclear decline. Hence, it behooves observers to now cherish its beauty and useful presence, as our admired colleague Roger Henri Charlier did.

4. Mimicking Nature's seafloor for eco-friendly tidal-range electricity production

South America's seacoast contains many coastal marine locations that are well suited to the installation requirements of commercial tidal-range electricity-generation macro-projects [22]. Macro-imagineers have elucidated many different mechanical devices that contain electricity-generating turbines [23-24]. The professional terminology of Earth-ocean focused macro-imagineers is such that it attracts the lexicon of Mathematics, Physics and is, under normal circumstances, revealed through essays and mappings. Understanding these proposals is a "must happen event-process" or the entire effort to illuminate progressive Earthly oceanographic mega-project possibilities will be for naught, undeniable failures. Thus, here the authors try to impart sufficient basic information to entice persons attached to the region discussed, Argentines in northeastern Chubut Province, whilst at the same time giving *CALIBRE* readers exciting verbal content that will stimulate their own future strivings to acquire usefully accurate knowledge. For example, a new tourist attraction might be a variable depth, down to 150 m water depth, anchored field of spherical bubble-shaped 360° view live-feed television cameras that allow tourists to observe sea creatures that won't be disturbed by the presence of operational bubble "telescopes"! Super-computer algorithmic methods have been developed that permit color-correction of underwater images and other techniques ensure moderation of real-time image distortion caused by seawater's density and light-refraction effect (Figure 5).



Figure 5. Photographic conceptualization of submarine live-feed television cameras that could provide views and real-time views of ambient marine life in the project area.

Another tourism amplifier might be the installation of several Sea Tents, of the type designed by William D. Boyce, II, who was awarded US Patent 4,047,390 for same on 13 September 1977. His apparatus allows the isolation of parts of the seafloor via a funnel-shaped plastic material curtain that protects SCUBA divers from turbulent currents and aggressive sea-creatures by allowing aqualung-equipped tourists to view wrecks and marine seascapes.

The oceanic region surrounding the Peninsula Valdes is generally well-mapped and fairly up-to-date because nautical charts are used for surface and submarine navigation. However, new data must be acquired to produce an updated seascape map of the two hyper-tidal gulfs derived from multibeam sonar bathymetry and imagery that visually classify the floors of both gulfs in terms of morphology, texture and biotic zones. As automation advances, exploration and assessment of the seafloor by un-crewed submarine and aerial drone vehicles will intensify. Unquestionably, the manipulation of “Big Data” and Artificial Intelligence will also afford 21st Century macro-project researchers with investigative tools that enlarge the mapped thalassographic scale whilst affording fine-resolution charts! The “Neo-Aquaterra” of our common future Earth-bioshell’s ocean, whatever its shape, will become fully knowable by the world-public!

Apparently, future physical integration of South America’s eco-friendly electricity generation and transmission systems is an impending real-world possibility [25]. Additionally, and perhaps more importantly, a single intertidal global electrical system of the global bioshell will be achieved sometime during the 21st Century. For instance, see US. Patent Application 2004/0199478 A1 issued on 7 October 2004 to Hiroshi Arita and his sixteen associates in Japan for “Energy and Power Interchange system and its Method”. The region centered on rural “Cabo San Jose” will be reviewed finally during the 2018-2020 LafargeHolcim Awards Research in Practice Grant

“TERRITORIAL FIGURE IN ARGENTINA: Evolutionary process of infrastructures in new territories: The Patagonia Case” the goal of which is to (1) “Develop a territorial strategy of tidal energy in the Argentinian coast, (2) Localize opportunity areas, (3) “Identify links between possible tidal projects along the coast,” and (4) “Study the economical, energetical and social benefits of tidal projects in cities, provinces and nation”. Dr. Nilo Serpa and Cathcart [26] peripherally pointed out the serious commercial issue that has to be addressed also by these researchers: how and where to timely use the intermittent electric-power generated by tidal-range mega-projects. The maximum ebb and flow of South Atlantic Ocean tides, once thought to be utterly predictable, are actually quite variable over long periods of Geologic Time. For example, tides have changed markedly over thousands of years, and may change again in the near-term future at North America’s famous Bay of Fundy. That bay’s tidal-range, which is one of the most extreme in the world, perhaps 5,000 years ago may not have been hardly remarkable [27]! As pointed out previously, tides in the gulfs on the north and south sides of Peninsula Valdes will likely be lower than currently and will consequently necessitate some major mathematical and physics recalculation accommodations. In socio-ecological terms, the region may become more attractive to migrants, meaning an increase in human population from <1,000 full-time residents to some more numerous censused populace.

Dredge spoils and fill mounds dumped on the seafloor can be configured to alter the flow patterns and adjacent ecosystems. Indeed, Tatsuo Suzuki of the Hazama Corporation has already designed a “Super-Ridge” to be deployed over the deep seabed offshore Japan to create a nutrient-rich upwelling to form the substantial basis of a high-seas commercial aquaculture business. In the case of Hazama Corporation’s block-mound, it was to be composed of cement-stabilized coal-ash derived from an extant, coast-sited electricity-generation facility in Japan. Interestingly, the Canadian Earthworks artist Betty Beaumont offers an existing example with her similar, but smaller, monumental mound, her *Ocean Landmark* (1980) [28]. This barely sketched macro-project for electricity production from the two gulfs bracketing the Peninsula Valdes is founded, basically, on the concept of a power-producing seabed “carpet” pioneered by Mohammad-Reza Alam [29]. Dr. Alam’s synthetic seafloor “carpet”, useful only in water depths of 20 m to the surf-zone, mimics the sea-wave damping effect of muddy seafloor sediments yet can be used to extract kinetic energy from incoming ocean waves passing above it. It might be most effective if deployed along coastlines with cliffs and other rocky shorelines of Golfo Nuevo and Golfo San Matias which currently have a maximum 5 m tidal-range potential. Dr. Alam’s device is always completely underwater and hence imposes minimal danger to over-passing boats and mobile sea-life. Further, such an installation will likely not have any visible impact on the appearance of the natural strand.

Finally, it is suggested, that Argentinian regional planning authorities consider a new architecture for their Control Center needed to oversee such an interesting facility: possibly an official building resembling China’s *Chapel of Sound*, constructed by 2020 of massive concrete mixed with locally-supplied crushed stone to resemble a rugged country-rock outcrop, in a depopulating rural region north of Beijing near restored remnants of the Great Wall of China. With the semi-outdoor amphitheater, outdoor stage and viewing balconies is a ~790 m² concert-hall.

Visitors may hear and see Nature's wonders from the viewing platforms and somewhat idealistically (Figure 6), it is macro-imagined that audiences might listen to renditions of appropriate music in the concert-hall. Tunes such as "Higher Ground" (Red Hot Chili Peppers), "Radioactive" (Imagine Dragons), "Rock the Casbah" (The Clash), "Rock with You" (Michael Jackson) and "Under Pressure" (Queen and David Bowie)! But, maybe not, even though the magnificent sounds of "Golden Years" (M-Phazes, Ruel) might be appealing.



Figure 6. As the natural and gardened growth of the vegetation takes hold of the landscape, the *Chapel of Sound* in China will, more and more, come to blend with its surroundings. A similar building would fit pleasantly into the landscape of Argentina's Valdes Peninsula.

5. Conclusions

The scientific question is: What distinctive added value does our macro-imagineering approach hold? Local and global anthropogenic agency compels an urgent change of human behaviors that is only possible if each Argentinian understands the world-ocean's vital role in supporting human civilization. All macro-projects are complicated to undertake and to complete [30]. However, educational-recreational facilities built on the Vales Peninsula which are focused on both Golfo San Matias and Golfo Nuevo, along with the intermediary bay Golfo San Jose, could accomplish that task without too-great expenditure of public funds. A tidal power mega-project of the kind we have proposed here can support the goal of increased coastal conservation.

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