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# Key factors around ocean-based power in the Caribbean region, via Trinidad and Tobago

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ABSTRACT

Caribbean residents outside of Trinidad and Tobago primarily utilize hydrocarbons for electricity, earning them the highest energy bills in the world. Apart from global climate change concerns, these high energy prices make it clear that alternative energy must be sourced for the Caribbean region. With Trinidad and Tobago's large offshore hydrocarbon reserves, Trinidad and Tobago has bolstered its economy and its expertise in offshore engineering and technology in the past five decades. Caribbean regional efforts to find ocean-based renewable energy resources can largely exploit the aforementioned advantages and opportunities in Trinidad and Tobago. The present work involves a collaboration between a team of engineers to collect and analyze oceanic data in Trinidad and Tobago, and a team of sustainability scholars to survey the maritime context of Trinidad and Tobago via the lens of sustainable development. This is done to appropriately contextualize Trinidad and Tobago, which is the territory via which Caribbean regional ocean-based power exploration is recommended.



**Contents**



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## 1. Introduction

To date, hydrocarbons dominate the Caribbean energy market [1–5], and very little has been published concerning the use of the abundant Caribbean Sea as a major energy source in the Caribbean region. Much of the published literature on ocean-based sources of renewable energy originate outside of the Caribbean, in regions such as the US, Asia, and Europe (see Fig. 1).

Despite their abundant access to sun, wind and the ocean throughout the year, Caribbean residents, primarily utilizing imported hydrocarbons, pay the highest energy bills in the world (see Fig. 5). Within the region, the exception, Trinidad and Tobago, has bolstered its oil-based economy and its expertise in offshore engineering and technology in the past five decades [6–8]. Because of the high price of hydrocarbons, and the long-term environmental effects of hydrocarbons, alternative energy must be found for the Caribbean region. The data collection and other groundwork needed to start exploring the Caribbean's ocean-based energy resources can largely exploit the aforementioned resources and opportunities in oil-rich Trinidad and Tobago. Towards this, the present work is a collaborative, multi-disciplinary analysis of the potential for exploring ocean-based alternative energy sources in the Caribbean Sea. This work comprises of two components: (1) data collection from the physical oceanic environment in Trinidad and Tobago, as well as (2) a contextual examination of ocean-based enterprizes in Trinidad and Tobago.

The physical investigation involves engineers and technicians deploying an upward-facing Acoustic Doppler Current Profile meter to measure ocean waves in Las Cuevas Bay, Trinidad and Tobago (see Fig. 2). Physically, a consistently gentle ocean surface is observed at Las Cuevas Bay in 7 h of high-frequency data, showing wave heights up to 1.8 m. This, in the Caribbean socio-economic context, has implications on the type of ocean-based energy resources that can be generated at Las Cuevas Bay and other comparable oceanic locations throughout the Caribbean region.

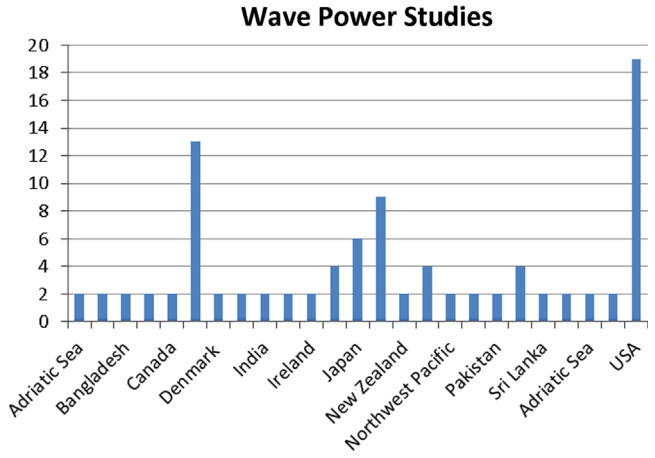


**Fig. 1.** Location-specific break-down of a survey of 387 papers sourced on a Google Scholar search using search term "wave power potential". For each paper found, the associated location (if any) was tabulated. There is nothing in this survey written about the wave power potential of the Caribbean.

The contextual examination of the Caribbean region towards oceanic energy sources consists of a series of local field trips and interviews, coupled with a literature review.

### 1.1. Trinidad and Tobago

Trinidad and Tobago is an archipelagic republic in the southern Caribbean, consisting of 33 islands in total. As shown in the data in Fig. 3, Trinidad and Tobago is the number one offshore supplier of Liquified Natural Gas imports to the United States [9], and is thereupon economically strong. Much of Trinidad and Tobago's oil and gas reserves are offshore. As a by-product of this, Trinidad and Tobago is consequently inundated with the newest offshore exploration devices and technologies. Research vessels, Teledyne ADCP's, Nortek AWAC's and other useful wave measurement devices are on the ground and available for use. Offshore divers and technicians who can design surveys, and deploy and retrieve instruments are readily available. Underwater umbilical cables are already widely implemented, primarily to take electric power from Trinidad or Tobago to the nation's smaller islands.

### 1.2. Why help the Caribbean?

The majority of Caribbean nations outside of Trinidad and Tobago are less economically strong, as illustrated in Fig. 4. Worse, their residents pay the highest electricity bills in the world [2–5] (see Fig. 5). The way forward for many of these nations is to move away from oil and gas-powered electricity and to move towards alternative energy in their local resources, such as the ocean.

### 1.3. Why ocean-based energy?

We consider the importance of the ocean in solving this Caribbean economic problem, because all Caribbean territories consist several (up to 1000) times more oceanic territory than dry land (see Fig. 6). Looking at these countries in a global context (as shown in Fig. 6), ocean-based resources are comparably plentiful for the Caribbean region [11].

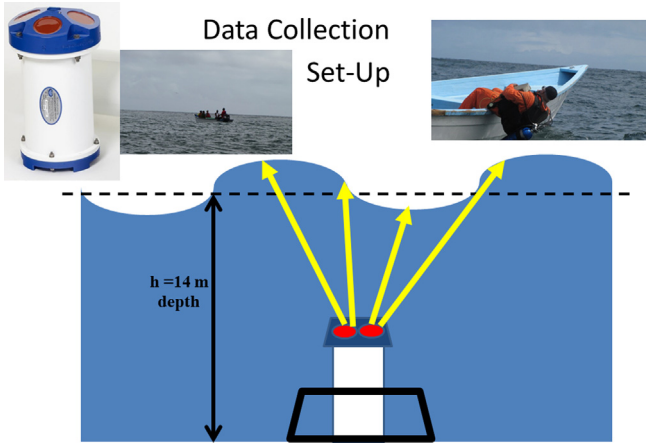


**Fig. 2.** Data is collected using a Teledyne ADCP secured to the ocean floor under 14 m ocean depth.