

A multi-criteria evaluation of policy instruments for climate change mitigation in the power generation sector of Trinidad and Tobago

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ABSTRACT

Even as small island developing states (SIDS) like Trinidad and Tobago (T&T) increase industrialization and grapple with the challenges of increased pollution, few studies provide guidance to policy makers of such countries on appropriate policy measures and instruments that can be implemented to mitigate greenhouse gas emissions. Here we apply a multi-criteria evaluation methodology to ascertain preferences for policy measures and instruments in the power generation sector. Four broad policy measures and twelve policy instruments are assessed on criteria of environmental performance, feasibility of implementation and political acceptability. This method proves useful in T&T, since typical to many SIDS, the intensive data required by other policy assessment methods is unavailable. Results indicate little difference in preference among the four policy measures thereby indicating that a multi-pronged approach on several policy fronts is required. The most preferred policy instruments to operationalize measures included provision of subsidies for energy saving technologies, creating an industry wide carbon trading scheme and implementing a feed-in tariff to increase the use of renewable energy sources. This study therefore provides specific insights for policy makers in Trinidad and Tobago while also providing power generation sector specific guidance to other rapidly industrializing small island developing states.

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1. Introduction

It is now well understood, that anthropogenic GHG-emissions from the burning of fossil fuels are contributing to global warming and climate change (Doran and Zimmerman, 2009). Trinidad and Tobago (T&T), like many other geographically low lying island nations, is inadvertently threatened by the consequences of global warming including sea level rise and increased frequency of high impact climatic events such as hurricanes (IPCC, 2007). While T&T is only a very minor contributor to global GHG-emissions, the intensity of industrial activity in its small island geography makes it to one of the largest GHG-emitters per capita (UN MDGI, 2010; EIA, 2011a). Thus even in this developing country, policy makers are considering strategies for GHG-emission mitigation.

At present little guidance exists for T&T and other small island developing states (SIDS) on appropriate context specific policy instruments for GHG-emission mitigation. Policy measures and instruments applied in developed countries and large developing countries (e.g. India, China, Brazil) may not be appropriate for the economic and ecological sensitivities of SIDS (Shah and Rivera, 2007). Such vulnerabilities derive from, for example, SIDS limited size,

geographical location, high exposure of critical infrastructure and limited adaptive capacity. This study therefore provides some of the first guidance on policy measures and instrument selection to assist SIDS in making GHG and climate change related policy decisions.

This study focuses on T&T, a ratified signatory to the UNFCCC and the Kyoto Protocol. As a non-Annex-1 country, T&T has no GHG-emission reduction commitments within the frameworks of these international agreements. Notwithstanding this however, the government of T&T has recently embarked on two policy initiatives that will directly impact national GHG-emissions in the future. These are the National Draft Climate Change Policy (Ministry of Environment of Trinidad and Tobago, 2009) and the Framework for developing a National Renewable Energy Policy (Ministry of Energy and Energy Industries, 2011). Both draft policies allude to broad multi-sectoral principles and directions, which are intended to ultimately inform more defined implementation plans (see appendix for stated objectives of these draft policies). One common area of attention in both policies and indeed, an area of significant interest to other SIDS as well, is the power generation sector. Power generation is typically one of the more prominent contributors of GHG-emissions in SIDS. Given the rapid industrialization being realized in these countries, the potential GHG-emissions attendant to increased power generation capacity poses a major challenge.

We specifically focus on policy measure and instrument selection for GHG-emission reduction in the power generation sector of

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T&T. By implementing and presenting a multi-criteria policy assessment approach, we hope to provide specific guidance to the policy development efforts of T&T and a general model for holistic policy instrument selection that can be useful in other SIDS contexts. Since the method itself can overcome the challenges of lack of historical and technical data typical in many developing countries, it may be particularly useful.

Two main questions drive this study. First, what are the preferred *policy measures* for GHG-emission mitigation in Trinidad and Tobago? Second, what are the preferred *policy instruments* to make these policy measures operational? We provide an overview over the current situation of the power generation sector of T&T followed by descriptions of policy measures and policy instrument options available. Then the multi-criteria evaluation is described including the criteria for evaluating policy instruments. Next the results of the study are presented and analyzed. Finally, we provide some recommendations for moving forward based on our findings.

2. Background and context

Trinidad and Tobago is an oil and gas rich country in the Southern Caribbean. Despite its small size, it is a major international player in the energy sector, trading mainly with the US, Canada, UK, Brazil and Germany. Its gross domestic product (GDP) amounted to US\$ 23 billion in 2009 (International Monetary Fund, 2010) with nearly 50% of government revenue derived from the energy sector. Between 2003 and 2007 alone, U.S. investments in energy related projects were estimated at over 3 billion U.S. dollars (Lorde et al., 2009).

The oil and gas industry is comprised of upstream oil and gas production and exploration and downstream processing and manufacturing along with chemical production by firms dependent on large inputs of cheap energy from oil and gas feedstock.

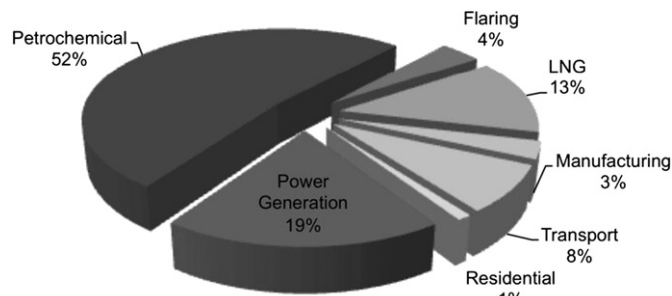


Fig. 1. Share of GHG-emissions in Trinidad and Tobago in 2009.

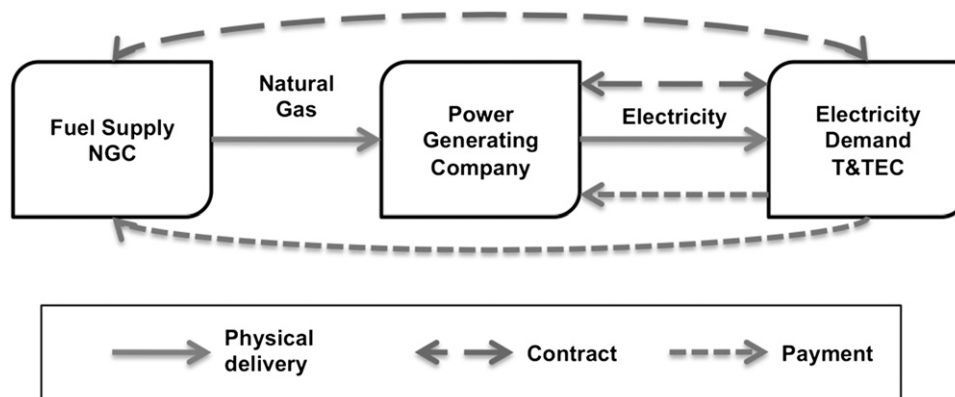


Fig. 2. Market structure of the power generation sector.

The petrochemical sector is also highly productive and the country is a top global producer of ammonia and methanol. Abundant natural gas feedstock has also made T&T a lucrative exporter of basic chemicals, fertilizers and liquefied natural gas. For example, in 2010 the U.S. imported 431,010 million cubic feet of natural gas in the form of liquefied natural gas, with some 44% of this coming from Trinidad and Tobago (EIA, 2011b). Unfortunately, as can be expected from this level of industrial activity, Trinidad and Tobago is also the fifth largest carbon dioxide emitter per capita in the world (United Nations, 2007). In 2009 the GHG-emissions of T&T have been 23.4 million metric tons, which leads to 18 t_{GHG-emissions}/capita (Al-Taweel and Boodlal, 2010).

2.1. The power generation sector

The power generation sector, with almost only natural gas power plants, is responsible for 19% of the GHG-emissions as shown in Fig. 1 (Al-Taweel and Boodlal, 2010). The installed capacity of the power generation sector is 1700 MW and almost 100% natural gas fired. In 2008, 7500 GWh were sold by T&TEC, which leads to 5800 kWh/capita (T&TEC, 2009). Some 80% of the power plants have efficiency less than 30% and only one includes the combined-cycle plant (CCP) technology (T&TEC, 2009). Given that the efficiency of a new CCP is from 45% to 55%, there is tremendous potential of improvement (Strauss, 2006). It is the intention of the government to install a combined cycle at every new power plant (Ministry of Finance, Republic of Trinidad and Tobago, 2010).

Fig. 2 illustrates the market structure of the T&T power generation sector. Only one state company, the Natural Gas Company (NGC), delivers the natural gas for the power plants. A sole provider—the T&T Electricity Commission (T&TEC), delivers the electricity to the customers, while other private companies generate all the power sold to T&TEC. The market structure and the stakeholders of the power generation sector of T&T are also highlighted in Fig. 3.

A breakdown of electricity demand by sector (2008) reveals that heavy industry accounts for the greatest demand (38%) followed by residential (28%) and light industry (23%). Total demand is forecasted to exceed 2500 MW by 2020 (T&TEC, 2010).

2.2. Energy supply and security

While T&T is fully self-sufficient in terms of fueling its power generation needs, some threats to future capacity exist. One threat is in the predicted decline of reserves in the medium term. In 2007, the Ryder Scott report assessed the gas reserves of T&T and concluded that some 12 years of known reserves were left.

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