# *THE IMPACT OF CLIMATE CHANGE ON RESIDENTIAL ENERGY DEMAND: A CASE STUDY OF AUSTRALIA*[1]

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## Overview

Regional energy consumption patterns vary substantially and differ from one country to the other [1]. The differences are mainly due to factors such as socioeconomic and climatic conditions which exhibit seasonal patterns [2-3]. On socioeconomic factors, studies have documented the influence of household income, energy price and population growth on energy demand in the residential sector [4-5]The literature has also shown that past climatic conditions had an impact on residential consumption behaviour and future climate projections show increasing energy demand during the summer, but decreasing demand during winter months [6-7]. The residential sector accounts for 15% of the global energy use and rising population indicates that this share of energy demand in the residential sector will likely increase in the future [8]. Energy consumption in residential buildings contribute to a major share of global environmental concerns [9]. The major consumptions in buildings have been attributed to the increase in cooling and heating demand in most regions of the world with share varying between 18% and 73% [10]. In Australia, the residential sector accounts for about 11% to the total end-use energy demand in which 40% is used for space conditioning alone [11]. Australia's population growth has increased about 1.4% from 2014 – 2015, but regional population growth vary with the state of Victoria growing at 1.7%, New South Wales 1.4%, Western Australia 1.3% and Queensland 1.3% among others [12]. Regional population growth differences can insert pressures on utility companies to expand power generation, transmission, and distribution capacities [13]. More compounding is the issue of climate change and seasonal variations which can cause peaking of energy demand in a particular region [14-15]. Therefore, understanding the influence of climatic factors on energy demand and how the seasonal variations will affect energy planning is necessary for Australia. The main aim of this study is to analyse the impact of climate change and socioeconomic variables on residential energy demand in in two Australian States: New South Wales and Queensland. The rest of this paper is organised as follows: Section 2 describes the methodological approach applied in this study. The results and discussion are presented in Section 3 which includes the diagnostic and stability test, and the climate change projections. While Section 5 is the concluding part of the study.

## Methods

The methodological approach used to examine the impact of climate change on residential energy demand began with the retrieval of relevant state-level datasets such as energy data which were transformed into per capita energy consumption; socioeconomic data which includes expenditures, income, population and energy price index; weather dataset retrieved were max and minimum temperature data converted into CDD and HDD. The unit root test was then carried out to ascertain the stationarity of the datasets and the results showed that the datasets include variables integrated in both I(0) and I(1). The Autoregressive distributed lag (ARDL) model was used to estimate the short- and long-run relationship between the variables. The datasets were split into the four seasons which are summer, autumn, winter and spring seasons. This was followed by a diagnostic and stability test for the split sample ARDL model. In the second stage, future temperature datasets were generated from global climate models (GCM) under the four Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathways. The future temperatures were converted to CDD and HDD for four time periods which are the 2030s, 2050s, 2070s and 2090s. The monthly percentage change in CDD and HDD were used to project the future energy demand.

[1] This conference paper is part of an on-going study investigating the impact of climate change on residential energy demand in seven Australian States.

## Results

The results of the ARDL model indicates that the short and long run sensitivity of residents in the seven states in Australia were not uniformed. During the summer months on the short run, a one unit increase in CDD lead to a change in residential per capita energy demand by 0.14% in NSW and 0.41% in QLD. On the socioeconomic parameters, welfare losses represented as expenditures were positive on the short and long run with increasing elasticities across the seasons in the states of NSW and QLD, indicating higher welfare losses due to seasonal differences. The disposable income parameters show that resident of NSW treat energy as an inferior good in most part of the year, but QLD resident treat energy as a normal good. Price elasticity were observed to decrease on the long run as compared to their respective short run estimates across the states. The results of the projections show a uniform decline in HDD across the periods in all the states within Australia except NT. This will increase per capita energy demand during summer period in NSWand QLD.

## Conclusions

Planning for the future increase in energy demand is a major concern for policymakers and utility companies. This increase as shown in this study depends on climatic factor such as temperatures changes as well as socioeconomic factors such as population growth, price and disposable income. Generally, welfare losses due to seasonal expenditures are expected to be higher on the longer term as temperature increases across the states in Australia. Further, seasonal variability may cause an increase in underutilized installed capacity required to meet cooling requirement during the summer seasons. Therefore, adaptive measures such as peak saving needs to be implemented, especially for air condition use during the peak periods during the summer, while energy commodities can be traded with other states during peak demand.

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