

***MEDIUM-TERM FORECASTS OF  
ENERGY USAGE: AN APPLICATION  
OF THE MMRF-GREEN TOPS-DOWN  
MODEL***

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1

***Overview of Project***

- MMRF-Green model used to produce medium-term forecasts for greenhouse gas emissions and energy usage for Australian regions
- Variables forecasted include
  - ◆ production by industry
  - ◆ emissions by major source
    - ◆ stationary energy sector, transport, non-combustion sources
  - ◆ energy usage by major source
- Forecast period, 1999 to 2020

2

## ***What is MMRF-Green?***

- Dynamic Applied Regional General Equilibrium Model of Australia
- Complete *bottoms-up* model of the Australian economy
  - ◆ covers the six states and two territories
  - ◆ recognising over 50 industries and their products in each region
  - ◆ models each region as an economy in its own right
    - ◆ region-specific prices
    - ◆ region-specific consumers
    - ◆ region-specific industries, etc.

3

## ***What is MMRF-Green?***

- *Equilibrium* means that:
  - ◆ households are utility maximisers and industries are cost minimisers
  - ◆ prices equal costs
  - ◆ demand equals supply for commodities and services, but not necessarily labour and capital
- Features detailed emissions and energy accounting:
  - ◆ emissions from combustion and non-combustion sources
  - ◆ energy from all primary and secondary fuels

4

## ***What is MMRF-Green?***

- Emissions and energy usage driven by core economic variables:
  - ◆ volumes of fuels used by industry in each region (combustion emissions and energy usage)
  - ◆ output by industry (non combustion emissions)
  - ◆ residential usage of fuels (residential emissions and energy usage)

5

## ***What is MMRF-Green?***

- Extensive scope for inter-fuel substitution
  - ◆ in electricity generation adopts the technology bundle approach used by ABARE
  - ◆ price-responsive substitution allowed for energy-intensive commodities used by industries
  - ◆ household usage of petroleum complementary to usage of vehicle services
  - ◆ exogenously imposed changes in technologies

6

## ***Why Forecast?***

- Forecasts required for *planning*:
  - ◆ Greenhouse gas targetting
    - ◆ Kyoto protocol
  - ◆ Gauging Australia's future energy requirements
  - ◆ Planning development of public infrastructures
  - ◆ For businesses planning and resourcing large energy projects
  - ◆ Environmental planning requires long lead times

7

## ***Methodology***

- Large amount of information imposed
  - ◆ macro forecasts
  - ◆ assumptions for changes in industry technologies and household tastes
  - ◆ forecasts for the quantities of exports
  - ◆ assumptions for changes in industry technologies
    - ◆ efficiencies of energy usage
    - ◆ trends towards and away from certain fuels
    - ◆ renewables

8

## ***Methodology***

- Changes in policies exogenously imposed
  - ◆ Energy market reforms
  - ◆ Renewable energy targets
  - ◆ Energy efficiency requirements
  - ◆ Opening up of national electricity and gas market
- Large energy projects
  - ◆ electricity
  - ◆ oil, gas and coal
- Model traces out implications for structural variables, emissions and energy.

9

## ***Assumptions - Macro variables***

- Subdued business cycle through the decade to 2020
  - ◆ GDP growth average 3.0 per cent, c.f. 3.5 per cent between 1995 and 2000
- Unemployment reduced to around 5 per cent by 2010
- Real private consumption grows at same rate as real GDP
- Real investment growth higher than real GDP growth
- Exports and imports increase as a share of GDP
  - ◆ growth rates of almost 6 per cent

10

## ***Assumptions - Technology and Tastes***

- Tastes
  - ◆ favouring fruit, vegetables, dairy, cars and communications
  - ◆ against tobacco and petrol
- Intermediate input using technological change
  - ◆ favouring chemicals (including plastics), equipment (especially electronic), financial and property services, communications
  - ◆ against trade services and freight
- Primary factor saving technological change
  - ◆ moderate savings for agriculture, mining and food manufacturing
  - ◆ rapid improvements in utilities

11

## ***Assumptions - Structure of Exports***

- Poor export prospects:
  - ◆ Oil and gas
- Good export prospects
  - ◆ Most industrial commodities, including
    - ◆ Textiles, clothing and leather products
    - ◆ Petroleum products and other chemicals
    - ◆ Metal products
- Middle export prospects
  - ◆ Most agricultural commodities

12

## ***Assumptions - Energy Policies***

- Effects of Energy Market Reform (EMF)
  - ◆ 0.5 per cent per year improvement in factor productivity of generators
- Mandatory renewable energy target (MRET)
  - ◆ renewable electricity increases from 62 pj to 84 pj by 2010
- Generator efficiency standards
  - ◆ fuel efficiency of generators improves to reduce emissions by around 5 Mt in 2010
- Greenhouse Gas Abatement Programs (GGAP)
  - ◆ fuel efficiency of other emitters improves in line with proscribed schedule
- QLD government initiatives
  - ◆ promotes gas at the expense of coal for electricity in QLD

13

## ***Baseline Forecasts for Industry Output***

- Five fastest growing industries in our forecast
  - 1 Communication services
  - 2 Financial and business services
  - 3 Air transport
  - 4 Other manufacturing
  - 5 Other metal products
- Five slowest growing industries in our forecast
  - 1 Crude oil
  - 2 Oil-fired electricity
  - 3 Water transport freight services
  - 4 Building materials
  - 5 Electricity from renewable sources

14

## ***Baseline Forecasts for Greenhouse Emissions***

- Total emissions growth, 1.7 per cent per annum
  - ◆ 1.3 percentage points less than real GDP growth
  - ◆ fastest growing source is waste dumps
  - ◆ fastest growing area is the forestry sink (LUCF)
  - ◆ slowest growing is electricity emissions
    - ◆ emissions from the energy sector projected to grow by 1.4 per cent per year
- Growth in emissions from electricity slow
  - ◆ increased share of gas at the expense of coal
  - ◆ growth in fuel efficiency at 0.7 per cent per annum
  - ◆ all policies except for EMR reduce emissions

15

## ***Conclusions: Strengths***

- Very detailed
  - ◆ For Australia, forecasts are produced for up to 56 industries in each state, for emissions from all fuels and users plus emissions from non-combustion sources
- Flexible
  - ◆ Able to take on board a wide range of forecasts from specialist forecasting groups
- Consistent
  - ◆ Economy-wide framework where everything has to add up

16



## ***Tops-down and Bottoms-up***

- **Tops-down**
  - ◆ Detailed account of forces external to the energy sector
    - ◆ wages, required returns to capital
    - ◆ industrial, residential and government demands
    - ◆ foreign conditions
- **Bottoms-up**
  - ◆ Detailed account of forces internal to the energy sector
    - ◆ engineering specifics of individual plants
- **Integration for policy analysis and forecasting?**

17