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The Application of TIMES Model in Assessing the Decline in Taiwan's Energy Intensity

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Presented by
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IEA-ETSAP workshop, Paris, France, June 17, 2013

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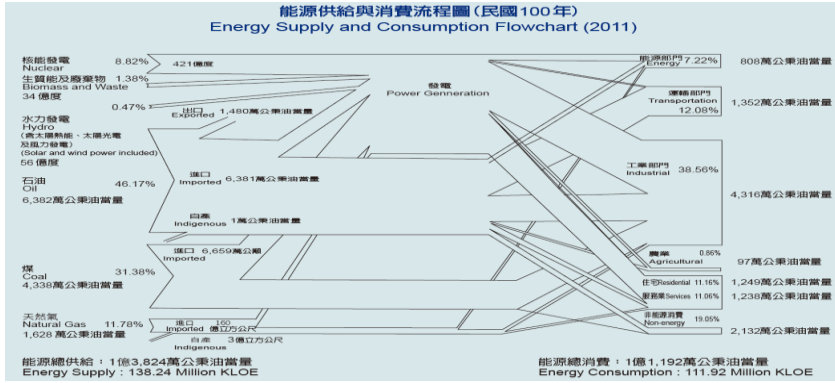
Outline

Introduction

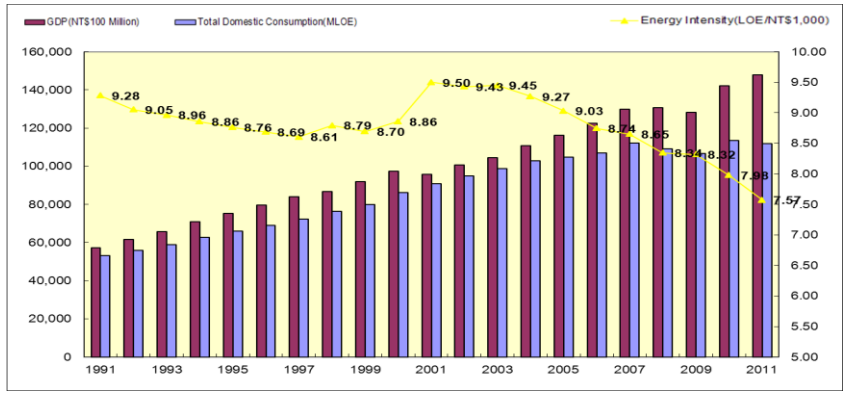
- Taiwan has very limited domestic energy resources and relies on imports for 98% of its total energy supply. Classified by energy form, fossil fuels contributed 89.3% in 2011, nuclear power provided 8.8%, and renewable provided 1.8%.
- Energy consumption of Taiwan is growing 3.8% each year over the past two decades. Share of electricity increase gradually, while that of oil decreases.



Source: Energy Statistics Handbook 2011, Bureau of Energy, MOEA.

Energy Intensity

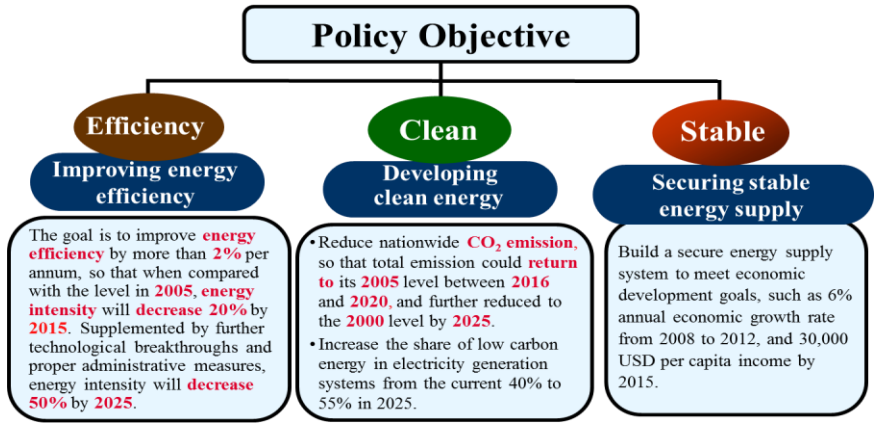
- In the past 20 years, energy consumption of Taiwan has grown annually at an average rate of 2.1% while GDP grew annually at 4.4%.
- Energy intensity is decreasing annually by 2.2%, showing that Taiwan's GDP and energy consumption are gradually decoupling.



Source: Energy Statistics Handbook 2011, Bureau of Energy, MOEA.

Sustainable Energy Policy

- Taiwan's sustainable energy policy is a triple win solution for Energy, Environment and Economy.
- The objectives of our energy policy are to improve energy efficiency, to develop clean energy and to secure stable energy supply.



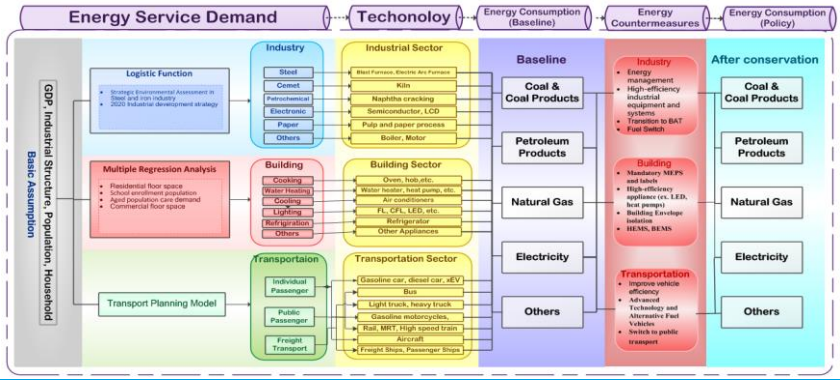
Source: Bureau of Energy, MOEA.

Objective & Scenario Definition

- Objective
  - Assess the effect of increasing technological efficiency towards the decrease of final energy consumption and energy intensity.
  - Explore the energy saving potential in the industry, buildings, and transportation.
- Technology development scenarios
  - Technological stagnation development (TSD)
  - Technological normal development (TND)
  - Technological aggressive development (TAD)

Taiwan TIMES Model

- The Industrial Technology Research Institute (ITRI) established the Taiwan MARKAL model since 1993 with funding support by BOE.
- In order to enhance analysis capabilities, TIMES model was introduced by ITRI in 2007 and in 2010, the Taiwan TIMES model localized database was completed.
- Currently the Taiwan TIMES model database is categorized by 3 major technologies: conversion technology (63 items), processing technology (75 items), and demand



Scenario Assumptions

■ Basic Assumptions

Driver	Assumption
GDP	GDP: average annual growth of 3.65% (2010-2030)
Industrial Structure	Share of primary sector of GDP is about 1.4%, secondary decreases little and tertiary sector increases to a share of 72.2% in 2030
Population	Annual growth rate is 0.09%
Household	Mean size of household decreases; annual growth rate of household is 1.31% from 2010 to 2030
Energy Carrier Prices	Based on Word Energy Outlook 2012 (IEA) and American Energy Outlook 2012 (EIA)

Source：TaiSEND (2012), Council for Economic Planning and Development (2012), IEA(2012), WEO(2012)

Scenario Description

■ Technology development scenarios

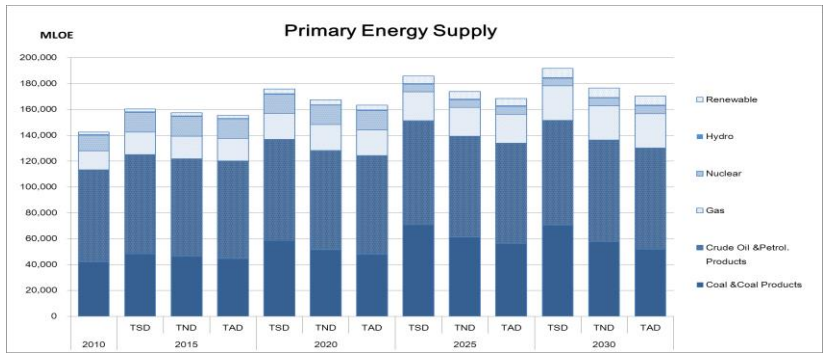
Scenarios	TECH Stagnation (TSD)	TECH Normal (TND)	TECH Aggressive (TAD)
Industrial Sector	■ Technology maintained at level of the year 2010	■ Change manufacturing process, introduce highly efficient technology ■ Utilizing best performing technology (BPT) ■ Introduce high efficiency motors and boilers.	■ Based TND scenarios, improving technical efficiency and promotion rates ■ Partially utilizing best available technology (BAT)
Residential and Services Sectors	■ Technology maintained at level of the year 2010	■ Based current policy of energy efficiency management in Taiwan ■ Heat pump water heating will increase to 25% in 2030 ■ LED lighting is 20% in residential and 40% in service sector by 2030	■ Enhanced the energy efficiency standards ■ LED lighting is 30% in residential and 60% in service sector by 2030
Transportation Sector	■ Technology maintained at level of the year 2010	■ Increase fuel efficiency of passenger vehicles – Stage 1 (2011-2015) improvement by 10% – Stage 2 (2016-2030) improvement by 30% ■ Promote bio-fuels – B2 policy in 2011, raise to B5 in 2016, B10 in 2025. ■ Promote clean cars, including HEV, PHEV, BEV and FCEV. About 45% sales in 2030, BEV reaches 4.5% ■ 2.5% of private passenger kilometer will shift to mass transit in 2030	■ Based TND scenarios ■ Promote clean cars, about 60% sales in 2030, BEV reaches 10% ■ 5% of private passenger kilometer will shift to mass transit in 2030

Scenario Results (1/7)

■ Primary Energy Supply

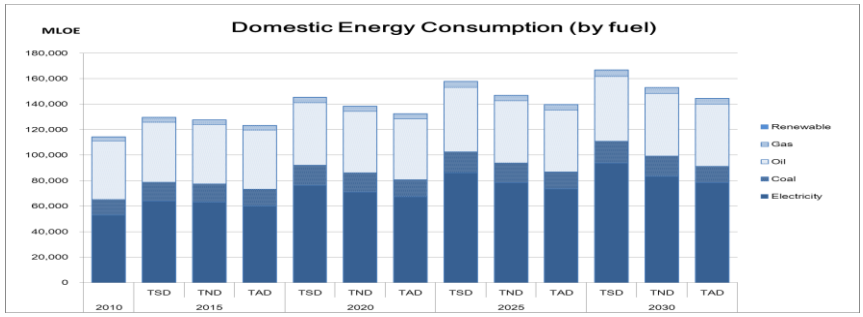
– The total energy supply in 2030 is growth 35% in TSD scenario. In another scenarios of technology development (TND and TAD), the energy supply in 2030 will be less 8.0% and 11.1% relative to TSD scenario.

– Of this, coal is the main energy source decreased, representing 85% of total reduction.



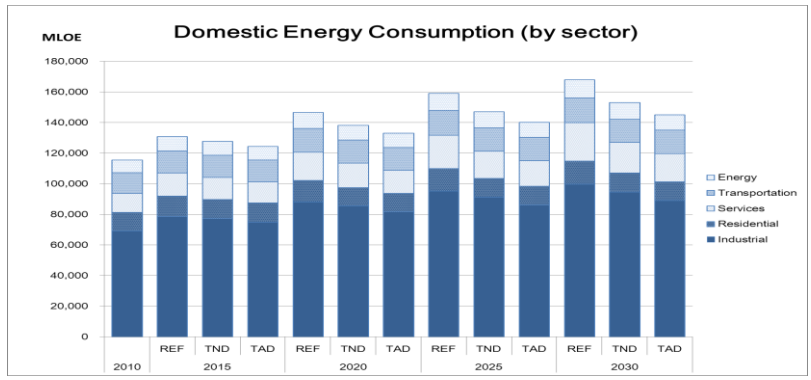
Scenario Results (2/7)

- Total Domestic Energy Consumption
  - Energy consumption continues to rise in the future，in the scenario of technology stagnant, the annual growth rate between 2010 and 2030 is 2.2%.
  - In the scenario of technology development, future energy consumption in TND and TAD scenario will reduce by 8.9% and 13.5% respectively in 2030 (compared to TSD), with electric power as the main source of energy reduction at 70-80% and followed by petroleum products at 10-13%.



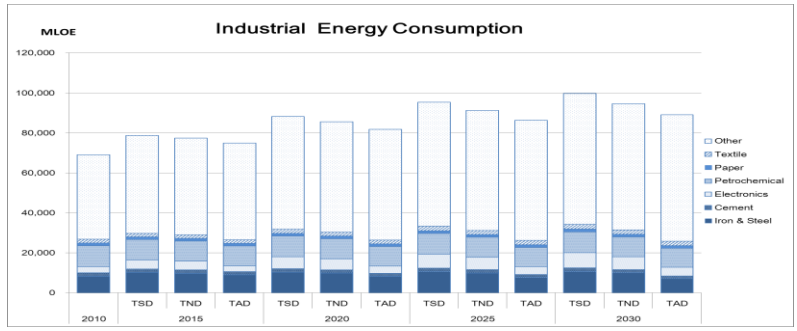
Scenario Results (3/7)

- Sector Energy Consumption
  - Energy saving capabilities of the industrial, residential and services sectors are most significant.
  - Under TND and TAD scenario each saves energy by 34-47% and 42-53% respectively, while the transportation department's energy saving is at 4-6%.



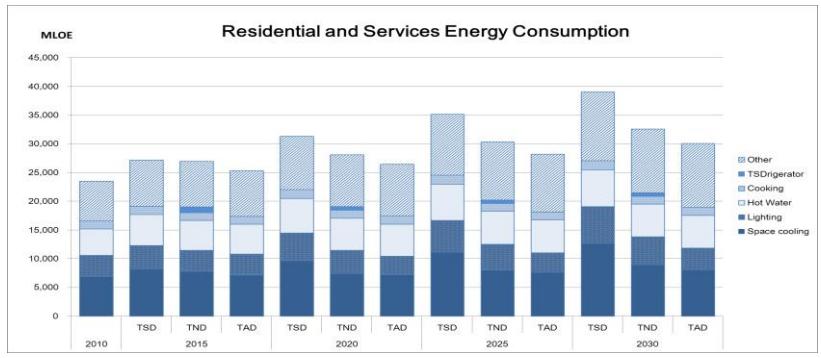
Scenario Results (4/7)

- Industrial Energy Consumption
  - The average annual growth rate of industrial sector energy consumption in 2030 will be from 1.9% in the TSD scenario, decrease to TND and TAD scenario respectively 1.6% and 1.3%..
  - Of this, the most significant energy saving contributions are shown in the electronics industry and others (including common devices).



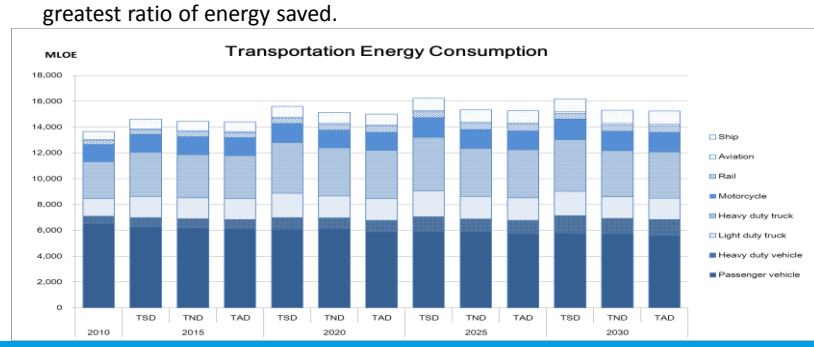
Scenario Results (5/7)

- Residential and Services Energy Consumption
  - The energy consumption in 2030 of TND and TAD scenario decrease 18.9% and 23.7% respectively relative to TSD scenario.
  - Of this, the most energy conservation potential is space cooling (energy-saving contribution to 48%), followed by lighting which contributes to 21-28% of energy saved.



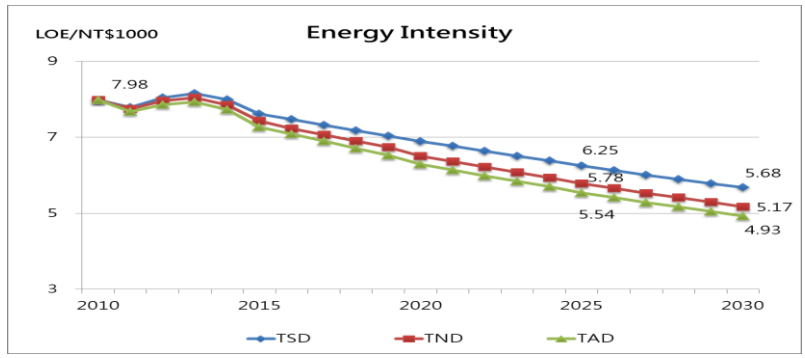
Scenario Results (6/7)

- Transportation Energy Consumption
  - Under the trend of high oil price in the future, demand for passenger vehicles expected negative growth; therefore, the average annual growth of energy consumption in the transport sector is 0.8% from 2010 to 2030 (TSD scenario).
  - The average annual growth rate of energy consumption under TND and TAD scenarios decreases to 0.6% and 0.5% respectively.
  - Among the types of transportation equipment, trucks and vehicles show the greatest ratio of energy saved.



Scenario Results (7/7)

- Energy Intensity
  - In TSD scenario, energy intensity will decrease to 6.25LOE/NT$1000 with an average annual decrease of 1.6% over the period of 2010 to 2025.
  - In the scenario of technological development, as highly efficient technologies are gradually available in the market, the energy intensity show an average annual decrease of 2.1% and 2.4%.



Conclusions

1. In the scenarios of technological development (TND & TAD), government's target of reducing energy intensity by 2% annually can be achieved.
2. However, if a goal of 50% decrease in energy intensity will be reached by 2025 compared to 2005, much aggressive measures such as higher efficiency of new technologies and market penetration approaches as well as relevant incentives must be taken into the context of government's energy policy.
3. This research is just based on the assumptions of optimizing industrial structure and implementation of energy-saving measures, its effectiveness in the future still have lots uncertainties lay ahead.
4. To achieve policy objectives, more in-depth analysis regarding the possibility of actual implementation on technology development and the effects of financial mechanism (ex. energy tax) on energy intensity should be taken into account in the scopes of further research .

Thank you for your attention !

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