

# 再生性能源與總體經濟效率之提升

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## 摘 要

本論文以資料包絡法分析再生性能源對四十五個經濟體在 2001 年到 2002 年技術效率的影響。在我們的 DEA 模型中，三項投入變數為勞動、資本存量及能源，實值 GDP 是唯一的產出變數。研究結果顯示，增加再生性能源的使用可以提高一個經濟體的技術效率。另一方面，增加傳統能源的投入卻會降低技術效率。OECD 和非 OECD 經濟體相較，OECD 經濟體之技術效率較高。在全體再生性能源之中，OECD 經濟體使用之地熱、太陽能、潮汐及風力能源比例較非 OECD 經濟體高。然而非 OECD 經濟體所使用之再生性能源在總體能源供給的比例較高。如果固定傳統能源投入總量，我們可以藉著將傳統能源替代為再生性能源以提高技術效率。然而，若要進一步再提高技術效率，我們可以減少傳統能源及再生性能源的投入。文中傳統能源及再生性能源的節能目標係由 DEA 分析而來，我們計算經過總量調整後的再生性能源佔總能源投入的比率，發現並未比調整前高，由此可見，只要傳

統能源及再生性能源的投入都能減少，未來各國並不需要強制設定再生性能源佔總能源的比例。只要兩種能源的投入都能減少，技術效率即能大幅提升。

為了證實增加再生性能源的使用確實能提高 GDP，我們必須測試再生性能源的使用是否能提高資本形成及貿易淨出口。我們以路徑分析證實再生性能源的使用確實能提高資本形成。然而，再生性能源的增加和能源的進口卻成正向關係。並且再生性能源對貿易淨出口沒有顯著的影響。這些結果顯示再生性能源並沒有進口替代的效果且無法影響貿易淨出口。總而言之，我們證實再生性能源的使用確實能以提高資本形成的方式增加 GDP，但是無法以提高貿易淨出口的方式增加 GDP。

關鍵詞：資料包絡分析、技術效率、再生性能源。





for each economy are not greater than before adjustments. That means that if we could reduce both traditional energy input and renewable energy input, there is no need to set up national target of renewable energy ratio. The reduction of traditional energy input and renewable energy input could lead to great improvement in technical efficiency.

To sum up, to confirm the relationship between the increase of renewables and the increase of GDP, we need to test whether renewables could increase capital formation or trade balance. We show that capital formation is positively influenced by renewables by path analysis. However, the relationship between renewables and energy imports is significantly positive. Further more, renewables do not have significant impact on trade balance. The results show that renewables do not have import substitution effect and could not influence trade balance. Thus, we confirm the positive relationship between renewable energy and GDP through the path of increasing capital formation but not the path of increasing trade balance.

Keywords: Data Envelopment Analysis; Technical Efficiency; Renewable Energy

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最後期許自己及所有的家人和朋友，一起減少二氧化碳排氣量，愛惜使用地球資源，大家一起來面對及解決全球暖化問題！

# 目 錄

中文提要	i
英文提要	iii
誌謝	v
目錄	vi
List of Tables	vii
List of Figures	ix
List of Abbreviations	x
一、 Introduction	1
1.1 Background of the Research: A Brief Review on Renewable Energy Issues	1
1.2 Data and Descriptive Statistics of Renewable Energy	4
二、 Macroeconomic Technical Efficiency	7
2.1 Measuring Macroeconomic Technical Efficiency by DEA	7
2.2 Second Stage Statistical Analysis	10
三、 ANOVA Analysis	21
3.1 Comparing OECD and non-OECD economies by Profile Analysis	21
四、 Estimating Target Energy Input	27
4.1 Slack and Radial Adjustments of Traditional and Renewable Energy Input	27
4.2 Measuring energy input targets by DEA	31
五、 The Macro-economic theory of the impact of Renewable Energy on GDP	44
六、 The Path Analysis of the impacts of Renewable Energy on GDP	46
七、 Concluding Remarks and Policy Implications	62
Bibliography	68

## List of Tables

Table 1.	Correlation matrix for inputs and the output (2001-2002)	6
Table 2.	2001-2002 TE and PFEE scores for forty-five economies	9
Table 3.	Regression results of all forty-five economies in 2001-2002	12
Table 4.	Results of Model 2 when omitting the variable of share of GSTW fuels in renewable energy in 2001-2002	14
Table 5.	2001-2002 TE scores for twenty-six OECD economies	16
Table 6.	Regression results for twenty-six OECD economies in 2001-2002	18
Table 7.	TE scores for nineteen non-OECD economies in 2001-2002	19
Table 8.	Regression results for nineteen non-OECD economies in 2001-2002	20
Table 9.	Mean difference tests of OECD and non-OECD economies in the year 2001	23
Table 10.	Mean difference tests of OECD and non-OECD economies in the year 2002	24
Table 11.	Average values of the 13 indicators for OECD economies and non-OECD economies in 2001-2002	25
Table 12.	Correlation matrix for inputs and the output (2001-2003)	31
Table 13.	2001-2003 technical efficiency scores for forty-two economies	33
Table 14.	2001-2003 technical efficiency scores for OECD economies	35
Table 15.	Total adjustments amount of traditional energy for OECD economies	36
Table 16.	Total adjustments amount of renewable energy for OECD economies	37
Table 17.	2001-2003 technical efficiency scores for non-OECD economies	38
Table 18.	Total adjustments amount of traditional energy for non-OECD economies	39
Table 19.	Total adjustments amount of renewable energy for non-OECD economies	40

Table 20.	Renewable energy ratio for OECD economies	41
Table 21.	Renewable energy ratio for non-OECD economies	42
Table 22.	Summary of descriptive statistics for SEM model	51
Table 23.	Estimated path coefficients for the initial SEM model	53
Table 24.	Rank order of the 10 largest normalized residuals for the initial SEM model	54
Table 25.	Estimated path coefficients for revised SEM model 1	55
Table 26.	Estimated path coefficients for revised SEM model 2	57
Table 27.	Estimated path coefficients for final SEM model	58
Table 28.	Goodness of fit indices for various models	59
Table 29.	R- square for each endogenous variable in final SEM model	60
Table 30.	Rank Order of the 10 largest normalized residuals in final SEM model	61





## List of Figures

Figure 1. Fuel shares in world electricity production in 2003	5
Figure 2. World sectoral consumption of renewable energy in 2003	5
Figure 3. Conceptual framework of GDP constitution	46
Figure 4. Conceptual framework of the influences of renewables on GDP	47
Figure 5. The initial SEM model	50
Figure 6. Revised SEM model 1	54
Figure 7. Revised SEM model 2	56
Figure 8. Final SEM model	58



## List of Abbreviations

$K_t$ : the capital stock in the current year

$K_{t-1}$ : the capital stock in the previous year

$\delta$ : depreciation rate

$I_t$ : capital formation in the current year

GSTW: geothermal, solar, tide and wind

GDP: gross domestic products

GNP: gross national products

$C$ : final household consumption expenditure

$G$ : general government final consumption expenditure

$X$ : export

$M$ : import

$W$ : wage

$r$ : rent

$i$ : interest

$\pi$ : revenue

SEM: structural equation modeling

$CF$ : capital formation

$TB$ : trade balance

$EI$ : energy imports

$RN$ : renewables

$Y$ : income

$AE$ : aggregate demands

