A new indicator for carbon-neutral consumption - An enhancement to CFP with cost for emission compensation by renewable energy technologies

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Introduction

Carbon footprint (CFP) label
- Knowledge of environmental impact
- CO₂ emission reduction in purchasing
- 18.6% of population notice and 56.1% of them are guided by the information [Thesis, NCU, 2011]

Renewable energy technologies
- Goals in 2025 of:
  1. Photovoltaic(PV): 1000MW
  2. Wind power(WP): 3000MW
- Capacity in 2011 [BOE, 2012]
  1. PV: 74MW
  2. WP: 523MW
- Installation capacity of PV: 1kW

Objective

To construct a new indicator for:
1. Enhancing awareness of CFP to change purchase behavior
2. Leading company to produce longer lifetime products
3. Guiding customers to choose lower CFP, longer lifetime products

Methodology

1. Estimation of CC media (CCM):
   - CCM: Generation of electricity required by CCTs for compensating CE
     \[ CCM = \frac{CFP\times EP}{EF} \]
     - \( i\): PV/ WP
     - \( EP\): CO₂ emission of current power generation
     - \( CE\): CO₂ emission of PV / WP

2. Estimation of installation number (Nᵢ):
   - \( Nᵢ\): Number of CCTs installation for realizing electricity needed for compensating CO₂ emission
     \[ Nᵢ = \frac{CCMPF_i}{CCMPF} \]
     - \( CCMPF_i\): Potential of electricity generation of each PV module / WP turbine during \( LT_{EP} \)
     - \( CCMPF\): Comprehensive indicator

3. Estimation of CC with CCTs implement (CCᵢ):
   - \( CCᵢ\): Cost of installation (\( Ce\), Equip) and land occupation (\( C_i\), Land) with CCTs implemented
     \[ CCᵢ = C_{i Equip} + C_i \]

   1) Guide customers toward lower CFP
   a. \( LT_{EP}\) is not a main concern. EX: Stationary, tableware.
   b. Guide customers toward longer \( LT_{EP}\)
   \( LT_{EP}\) affects the purchase behavior. EX: Car, bag
   c. Act as a comprehensive indicator

   Environmental impact (CFP), durability (\( LT_{EP}\))

Result and discussion

Condition
- Installation capacity of PV: 1kW
- Operation period (Depending on lifetime of evaluated product, \( LT_{EP}\)): 1000hr
- Cost for PV: 15,000NTD/kW

Result
CC table (i=PV, NTD)
- \( LT(y)\)
  - \( CFP\) (kgCO₂-e)
    - \( LT_{EP}\) (year)
    - \( LT\) (year)
    - \( LT_{EP}\) (year)
    - \( LT\) (year)
  - \( CCMPF\) (kW)
    - \( LT_{EP}\) (year)
    - \( LT\) (year)

Product selection
- Cost estimation of purchase and environmental protection

Findings
- Main factors of purchasing: Quality and Price.
- High level of understanding to CFP (54.3%) has significant difference (p=0.038<0.05) compared to CC (54.2%).
- High level of information referring to CFP (28.9%) has significant difference (p=0.000<0.05) compared to CC (73.7%).
- Behavior influence to CC (85.7%) has significant difference compared to CFP (71.4%) while these two information exist separately.

Conclusion
1. CC acting as a comprehensive indicator
   - Guide customers to choose lower CFP and longer \( LT_{EP}\) products.
   - Provide a tool to compare those three things in same unit.
2. CC cannot increase the understanding compared to CFP.