

文件編號：15-037

# 碳足跡產品類別規則 (CF-PCR)

## 液晶顯示器 Liquid Crystal Display (LCD)

第 2.0 版



行政院環境保護署核准日期：2015.11.24

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附錄 ENERGY STAR<sup>®</sup> Program Requirements Product Specification for Displays,  
Eligibility Criteria Final Draft Version 7.0, 2015.

## 一、一般資訊

本項文件係供使用於液晶顯示器的 PCR，產品適用範圍包括全球生產與製造之液晶顯示器，包含 LED 及 CCFL 背光源之液晶顯示器，可應用於電腦之液晶螢幕等(B2C 產品)，但不包含手機、筆電及整合式電腦螢幕之液晶顯示器模組(B2B 產品)；製造商產品分類號列(CCC Code)歸類條列如下：

- 8528.59.10.00.5 其他彩色非陰極射線管監視器
- 8528.51.00.00.5 專用或主要用於自動資料處理系統之其他監視器
- 8531.20.00.11-5 薄膜電晶體式液晶顯示之指示面板（指示器）
- 8531.20.00.19-7 其他液晶顯示之指示面板（指示器）
- 9013.80.30.21-9 薄膜電晶體式液晶顯示之顯示裝置
- 9013.80.30.29-1 其他液晶裝置

本項 PCR 之要求事項預期使用於依據「產品與服務碳足跡計算指引」標準來進行驗證之 CFP。本文件之有效期，自行政院環境保護署核准制訂後起算 3 年止。

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## **二、範疇**

### **2.1 產品系統邊界**

#### **2.1.1 產品組成**

液晶顯示器組成包括內容物/產品主體、配件、產品包裝等，如下所述。

1. 電源板(Power Board)
2. 訊號轉換板(Interface Board)
3. 轉換器(Inverters)
4. 液晶面板(LCD Panel)
5. 機殼(Housing)
6. 金屬件(Chassis)
7. 按鍵板(keypad)
8. 包裝材料(Packing Material)
9. 背光源模組
10. 其他組件(包括但不限於)：外接電源(適配器)、線材等
11. 其他輔助原料(包括但不限於)：清潔劑等

#### **2.1.2 產品機能與特性敘述**

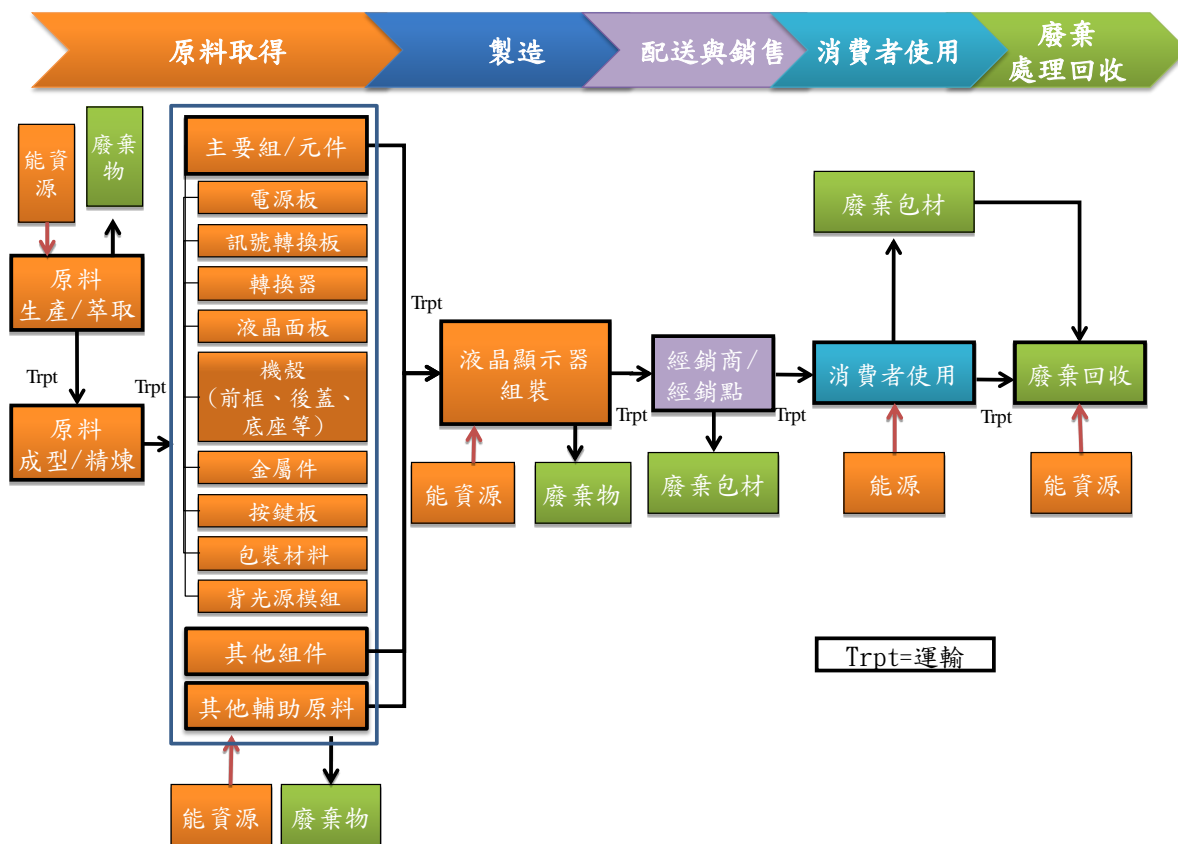
液晶顯示器主要功能為將接收的電子訊號轉換成為可視訊號。在液晶顯示器中可視訊號的形成，是由於外部電子訊號經顯示器內部控制電路的轉換後，在液晶面板上的呈現。

#### **2.1.3 產品功能單位或宣告單位**

本產品的功能單位定義為一台液晶顯示器(尺寸)，選此項功能單位係因產品出售時，係以一台為宣告單位。

## 2.2 生命週期範圍

本產品之生命週期流程如下圖 2.2-1 所示：



### 2.2.1 原料取得階段

原料取得階段包括下列過程：

1. 主要物料清單(BOM)與其他輔助原料製造等相關溫室氣體排放。
2. 各原料到製造工廠之運輸過程相關溫室氣體排放。

### 2.2.2 製造階段

製造階段包括下列過程：

1. 液晶顯示器組裝製程之能資源使用相關流程。
2. 液晶顯示器組裝製程廢棄處理相關流程。
3. 各元件/組件運送至組裝廠之運輸過程相關流程

### 2.2.3 配送銷售階段

配送銷售階段包括下列過程：

1. 運輸相關過程：從組裝工廠運送到銷售據點的過程。
2. 成品包材若為可回收製品，應依據實際回收情況進行考量(如：回收率)。
3. 上述過程中不列入評估之流程：
  - (1)銷售作業相關流程不列入評估。
  - (2)由銷售點到消費者中間各批發商或配送中心、倉儲及消費者往返銷售據點的相關運輸流程不列入評估。

#### **2.2.4 使用階段**

使用階段包括下列過程：

1. 使用階段依照使用情境及產品使用年限計算其能耗量，進而推估溫室氣體排放量。
2. 依最新版”Energy Star”監視器測試標準定義消費者使用情境下之功率。

#### **2.2.5 廢棄處理階段**

廢棄處理階段應依據實際情況進行考量(如：回收率)，本階段包括下列過程：

1. 使用液晶顯示器所產生廢棄物及回收資源，運送到清理地點之運輸相關溫室氣體排放量。
2. 使用液晶顯示器所產生廢棄物，在清理地點進行掩埋或焚化之相關溫室氣體排放量。

### 三、名詞定義

與本產品相關之主要名詞定義如下所述。

1. 電源板(Power Board)：焊接及黏著相關電子零件之載體，例如：電阻、電極、電晶體、連接器、積體電路等。
2. 訊號轉換板(Interface Board)：適用於需要快速、而且穩定傳輸資料的高階應用環境使用，然後將這些裝置輸出的影像擷取下來。
3. 轉換器(Inverters)：用來點亮LED背光模組，以提供顯示器所需之亮度。
4. 液晶面板(LCD Panel)：含薄膜電晶體、彩色濾光片、偏光膜、液晶等之模組。
5. 機殼：包含前框、後蓋、底座等。
6. 金屬件(Chassis)：控制系統設備，採用非整體性屏蔽體之金屬網作為屏蔽。
7. 按鍵板(keypad)：按鍵。
8. 包裝材料(Packing Material)：指成品内外包裝物料、標籤、防偽標誌和說明書等。
9. 背光源模組：由於液晶本身不會發光，必須在液晶顯示面板後方加上背光源，光線穿透玻璃基板、液晶、彩色濾光片、偏光板等相關材料，進入人的眼睛形成影像。
10. 外接電源(適配器)：提供兩種不同接頭之轉換介面。
11. 線材：訊號線(Signal cable)：提供顯示訊號之配線，例如：HDMI, AV, D-sub等訊號。電源線(Power cable)：提供機器運作所需電力之配線。變壓器(Transformer)：提供交流與直流或不同電壓之轉換功能的元件。
12. 其他輔助原料：如清潔劑等。



## 四、生命週期各階段之數據蒐集

產品數據蒐集期間係以一年為基準。若計算時非使用一年或以下數據，須詳述其原因，並確認其代表性；相關數據進行分配時可依質量、進料量、重量、工時等物理性質作為分配基礎，若引用其他參數得說明採用之依據。對於不具實質性貢獻排放源之加總，不得超過產品預期生命週期內溫室氣體總排放量 5%。液晶顯示器碳足跡在生命週期階段之數據蒐集項目與規則如下所述。

### 4.1 原料取得階段

#### 4.1.1 數據蒐集項目

原料取得階段，需蒐集的項目包括：

1. 與生產各原料及原料成型精煉相關的生命週期溫室氣體排放量。
2. 與生產主要組件/元件、其他組件、其他輔助原料相關的生命週期溫室氣體排放量。
3. 其他與生產原料相關的生命週期溫室氣體排放量。
4. 上述原料到工廠製造之運輸過程相關的生命週期溫室氣體排放量。

#### 4.1.2 一級活動數據蒐集項目

1. 與生產各原料及原料成型精煉相關的生命週期溫室氣體排放量。
2. 與生產主要元件/組件相關的生命週期溫室氣體排放量。
3. 其他原料於本階段不強制要求蒐集一級活動數據，但應優先採用一級活動數據。
4. 實施本項產品類別規則的組織本身，若對產品溫室氣體排放量未達到以下情境，則原料取得階段必須納入一級活動數據蒐集要求：「若組織(製造階段)所擁有、營運或控制之製程的溫室氣體排放量未達上游原料階段至製造階段之溫室氣體總排放量10%或10%以上的貢獻率，則原料取得階段就必須納入一級活動數據蒐集，直到組織(製造階段)及上游供應商蒐集的溫室氣體排放量大於或等於原料取得階段溫室氣體總排放量之貢獻率10%以上。」

#### 4.1.3 一級活動數據蒐集方法與要求

一級活動數據可以由下列三種方法取得：

1. 依據各流程所需設備或設施所投入之能源。  
(例如：設備設施作業時間 x 電力消耗 = 電力投入量)
2. 將各供應商在特定時間中之資源消耗分配到各產品。  
(例如：年度燃料投入總量分配到製造的標的產品上)
3. 其他相關溫室氣體盤查(ISO 14064-1)常見數據蒐集方法。  
(例如：質量平衡法)

以上三種數據蒐集方法在產品類別規則之原料取得階段中均可接受。若採用方法 1，則在同一地點生產但非本產品類別規則目標之產品，亦應採用相同分配原則，如此所有產品測量結果總值不致與整個地點所產生的數值差距過大。若採用測量方法 2，則分配方法應優先採用物理關係。

若辦公室中央空調與照明之間接燃料與電力消耗無法排除在測量以外時得包含於

測量範圍內。

#### **4.1.4 二級數據內容與來源**

原料取得階段之二級數據，可由生命週期評估軟體資料庫或具有公信力文獻中取得；內容包括：

1. 燃料提供與電力使用相關的生命週期溫室氣體排放量。
2. 包裝原料的製造及運輸相關的生命週期溫室氣體排放量。
3. 廢棄物處理相關的生命週期溫室氣體排放量。
4. 運輸貨物消耗燃料的生命週期溫室氣體排放量。

#### **4.1.5 情境內容**

原料運輸階段供應商出貨之運輸，得考量有關運輸距離、運輸方式、裝載率及載重噸公里、運費、平均耗油量/油價(費)等方式來訂定運輸情境。

#### **4.1.6 回收材料與再利用產品之評估**

1. 若取得原料為資源回收或再利用原料，則與其製造及運輸相關的溫室氣體排放量須包含資源回收(回收、前處理、再處理等)或再利用過程(回收、洗淨等)。
2. 如主管機關已公布相關流程之溫室氣體排放係數或計算原則時，則依規定計算及評估。

### **4.2 製造階段**

#### **4.2.1 數據蒐集項目**

製造階段，需蒐集的項目包括：

1. 投入量或輸入量
  - (1)各元件/組件投入量
  - (2)使用自來水投入
  - (3)電力投入量
  - (4)燃料投入量
  - (5)其他輔助原料
2. 產出量或輸出量
  - (1)液晶顯示器產出量
  - (2)廢棄物產出量
3. 與液晶顯示器組裝製程相關的溫室氣體排放量。
4. 與供應用水相關的溫室氣體排放量。
5. 與電力消耗相關的溫室氣體排放量。
6. 與燃料使用相關的溫室氣體排放量。
7. 與廢棄物相關的溫室氣體排放量。

#### **4.2.2 一級活動數據蒐集項目**

1. 投入量或輸入量
  - (1)各元件/組件投入量
  - (2)使用自來水投入

- (3)電力投入量
- (4)燃料投入量
- 2. 產出量或輸出量
  - (1)液晶顯示器產出量
  - (2)廢棄物產出量
- 3. 與液晶顯示器組裝製程相關的溫室氣體排放量。
- 4. 與供應用水相關的溫室氣體排放量。
- 5. 與電力消耗相關的溫室氣體排放量。
- 6. 與燃料使用相關的溫室氣體排放量。
- 7. 與廢棄物相關的溫室氣體排放量。

#### 4.2.3 一級活動數據蒐集方法與要求

- 1. 一級活動數據蒐集方法與4.1.3相同；另有關製造工廠間之運輸、中間運輸或廢棄物運輸，其運輸距離、運輸方法，以及運輸裝載率須為一級活動數據。
- 2. 關於成品組成部分，應蒐集生產設備運作資料，包括各單元生產量、投入原料、能資源耗用(水電，瓦斯等)、水的種類與量，以及廢棄物的種類、數量與處理方法，到成品工廠的運送過程之一級資料。
- 3. 關於成品生產與包裝，應蒐集生產設備的運作資料，包括完成品生產量、投入組件、原料，成品捆包材，能資源耗用(水電，瓦斯等)，水的種類與量，以及廢棄物的種類、數量與處理方法。
- 4. 蒐集直接部門的資料，掌握過程中必需的機器、設備(商品的生產線，建築物內的照明、空調等)在運轉單位(單位運轉時間、一批等)內的輸入出項目的投入量或排出量，以計算之。
- 5. 若生產地點不只一處，則應蒐集所有地點之一級活動數據。若生產地點數量龐大，則重要生產地點之一級活動數據之平均值，可作為所有其他地點之二級數據，但前提是重要生產地點之生產總量超過總生產量的60%以上。

#### 4.2.4 二級數據內容與來源

製造階段之二級數據，可由生命週期評估軟體資料庫或具有公信文獻中取得；資料庫中沒有的數據得由相關且具有公信文獻取得。內容包括：

- 1. 供應用水生命週期溫室氣體排放係數。
- 2. 燃料耗用與供應相關之生命週期溫室氣體排放係數。
- 3. 電力耗用與供應相關之生命週期溫室氣體排放係數。
- 4. 廢棄物處理生命週期溫室氣體排放係數(廢棄物處理若為回收，則不納入計算)。

#### 4.2.5 情境內容

有關製造工廠間之運輸、中間運輸，以及廢棄物運輸所產生之溫室氣體排放量，得考量有關運輸距離、運輸方式、裝載率及載重噸公里、運費、平均耗油量/油價(費)等方式來訂定運輸情境。

### **4.3 配送銷售階段**

#### **4.3.1 數據蒐集項目**

配送銷售階段，需蒐集的項目包括：

1. 產品運輸數量。
2. 運送距離。
3. 交通工具相關資料。
4. 可回收成品包材之回收情形。
5. 裝載率與空車率。

#### **4.3.2 一級活動數據蒐集項目**

本階段僅計算組裝廠至銷售據點之相關溫室氣體排放量。涉及情境假設及數據蒐集較為複雜，因此無一級活動數據要求項目。但若有需要蒐集一級活動數據時，則須遵循4.3.3節之規定。若情況許可，一級活動數據的蒐集須包含以下項目：

1. 產品運輸數量。
2. 運送距離。
3. 交通工具相關資料。
4. 可回收成品包材之回收情形。
5. 裝載率與空車率。

#### **4.3.3 一級活動數據蒐集方法與要求**

1. 燃料使用應以合理之「燃料法」或「燃料費用法」檢討；運輸距離得實際測量或以電子地圖、導航軟體記錄之。
2. 若產品運輸路線不只一條時，得蒐集所有路線之一級活動數據，並依照運輸量做加權平均；若運輸路線數量龐大，則一級活動數據得使用銷售量占總銷售量50%以上之主要銷售地點之運輸路線來做加權平均，且自路線所蒐集之數據加權值，作為無法取得數據路線的二級數據。
3. 若無法取得運輸路線之一級活動數據時，得考量返程空車率、採用地圖測量每趟運輸距離、每件產品運送重量(含外包裝重量)，以及生命週期評估軟體資料庫運輸排放係數之乘積方式處理。

#### **4.3.4 二級數據內容與來源**

配送銷售階段之二級數據，可由生命週期評估軟體資料庫或具有公信文獻中取得；資料庫中沒有的數據得由相關且具有公信文獻取得。內容包括：

1. 運送距離。
2. 交通工具噸數。
3. 產品運輸之單位重量里程溫室氣體排放係數。

#### **4.3.5 情境內容**

有關產品之銷售，得考量有關運輸距離、運輸方式、裝載率及載重噸公里、運費、平均耗油量/油價(費)等方式來訂定運輸情境。

#### 4.4 使用階段

##### 4.4.1 數據蒐集項目

使用階段，需蒐集的項目包括：

1. 電力使用量。
2. 液晶顯示器於開機、睡眠及關機之使用情境假設。
3. 產品使用年限。

##### 4.4.2 一級活動數據蒐集項目

本產品不需蒐集一級活動數據蒐集項目。

##### 4.4.3 一級活動數據蒐集方法與要求

本產品無一級活動數據蒐集方法與要求。

##### 4.4.4 二級數據內容與來源

使用階段之二級數據，可由生命週期評估軟體資料庫或具有公信力文獻中取得；內容包括：

1. 電力使用之溫室氣體排放係數。
2. 液晶顯示器於開機、睡眠及關機之使用情境假設。
3. 產品使用年限。

##### 4.4.5 情境內容

液晶顯示器產品於一般情況下，本 PCR 建議之使用情境如下，若宣告之產品有特殊情境，應予以說明。

###### (1) 開啟模式/有效功率

開啟模式/有效功率係依據ENERGY STAR® Program Requirements Product Specification for Displays, Eligibility Criteria Final Draft Version 7.0, 2015。此狀態時產品與外界電源相連接，且有產生影像。

- 開啟模式/有效功率的使用時間：每天6小時
- 每年之使用天數: 240 天

$$5\text{作業天/星期} \times 4\text{星期/月} \times 12\text{月/年} = 240\text{作業天/年}$$

- 每年電力消耗(kwh)=開啟模式有效功率(w)×每天開啟模式的使用時間×每年之使用天數=開啟模式有效功率(w)×6×240÷1000...(1)

###### (2) 睡眠模式/低功率

依據ENERGY STAR® Program Requirements Product Specification for Displays, Eligibility Criteria Final Draft Version 7.0, 2015，此狀態是指監視器在接受來自電腦或其他功能傳達之指示後所進入的低耗能狀態。監視器在進入此狀態後，螢幕出現無內容，電力使用量會降低。

- 睡眠模式/低功率狀態使用時間：每天2小時

- 每年之使用天數: 240 天

$$5\text{作業天/星期} \times 4\text{星期/月} \times 12\text{月/年} = 240\text{作業天/年}$$

- 每年電力消耗(kwh)=睡眠模式有效功率(w)×每天睡眠模式的使用時間×每年之使用天數=睡眠模式有效功率(w)×2×240÷1000...(2)

### (3) 關閉模式/待機功率

依據ENERGY STAR® Program Requirements Product Specification for Displays, Eligibility Criteria Final Draft Version 7.0, 2015, 此狀態是指在有正常的外部電源的連接上, 依據監視器之指示方式讓監視器進入使用電力最少的一種用電狀態。

關閉時間支計算應依據每年使用天數(240天)乘以未使用之時數(每天16小時), 加上未使用之天數(125天)乘以這些天未使用之時數(每天24小時)。

- 每年電力消耗(kwh)=關閉模式有效功率(w)×每天關閉模式的使用時間×每年之使用天數 =關閉模式有效功率(w)×〔(16×240)+(24×125)〕÷1000...(3)

(4) 液晶顯示器使用年限: 依EuP Lot3中關於LCD年限的調查及說明, 考量20%的LCD會被回收再使用3年, 所以平均使用年限合理假設為6.6年。

(5) 使用階段總消耗電力之碳足跡=〔(1)+(2)+(3)〕×6.6×當地電力排放係數

## 4.5 廢棄處理階段

### 4.5.1 數據蒐集項目

廢棄處理階段, 需蒐集的項目包括(但不限於):

1. 產品廢棄後至處理商或回收商之運輸。
2. 應納入回收資訊, 如回收率、回收通路資訊, 並依所宣告之回收率計算環境衝擊。

### 4.5.2 一級活動數據蒐集項目

本產品在廢棄處理階段資料蒐集困難, 目前無一級活動數據之要求。

### 4.5.3 一級活動數據蒐集方法與要求

本產品無一級活動數據蒐集方法與要求。

### 4.5.4 二級數據內容與來源

廢棄處理階段之二級數據, 可由生命週期評估軟體資料庫或具有公信力文獻中取得, 但應針對實際情況進行考量(如: 回收率)。內容包括:

1. 廢棄物處置時生命週期相關溫室氣體排放量。
2. 計算運輸時燃料消耗的溫室氣體排放量。
3. 焚化廢棄包裝材之溫室氣體排放量。

### 4.5.5 情境內容

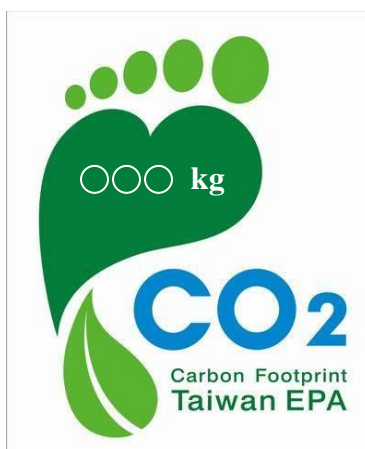
本產品於廢棄處理階段之情境假設, 應符合下列要求或考量:

1. 將廢棄物運送至處理地點之距離，係考量現有資源回收處理體系。
2. 計算使用液晶顯示器之包裝材廢棄物運送至處置地點溫室氣體排放量時，建議蒐集二級數據，如各區運輸加權平均距離、重量...等。
3. 廢棄物處理建議依實際情況取得二級數據。

## 五、資訊揭露方式

### 5.1 標籤形式、位置與大小

1. 產品碳足跡標籤之使用應符合「推動產品碳足跡標示作業要點」。
2. 碳標籤圖示，除心型內應依實標示產品碳足跡數據及計量單位外，不得變形或加註字樣，但得依等比例放大或縮小，且其寬度不得小於1.0 cm、高度不得小於1.2 cm。
3. 碳標籤應標示在產品主體或包裝上。
4. 產品碳足跡標籤下方加註相關資訊，標示碳標字第○○○○號及功能單位等字樣，如下圖範例所示。



碳標字第○○○○號  
1台(尺寸)

### 5.2 額外資訊內容

額外資訊說明應符合「推動產品碳足跡標示作業要點」並經由PCR委員會認可之內容作為額外資訊(例如在標示減量時可標示減量前之溫室氣體排放及減量承諾等)。此外，請先行評估未來在原料與製造階段之減量目標，並於申請產品碳足跡標籤時載明於申請書中。



## 六、參考文獻

1. 行政院環境保護署，推動產品碳足跡標示作業要點，2014年公告。
2. 行政院環境保護署，碳足跡產品類別規則訂定、引用及修訂指引，2014年公告。
3. 行政院環境保護署，產品與服務碳足跡計算指引，2010年公告。
4. PCR Library, TFT-LCD Monitors, Korea, 2002
5. PCR Library, TFT-LCD Display, Taiwan, 2008
6. ENERGY STAR<sup>®</sup> Program Requirements Product Specification for Displays, Eligibility Criteria Final Draft Version 7.0, 2015。
7. Lot 3 Personal Computers (desktops and laptops) and Computer Monitors Final Report.

## 七、磋商意見及回應

單 位	磋 商 意 見	答 覆 情 形
明基	液晶顯示器 PCR 是否應拆成兩份，Displays 及 TV，因液晶顯示器排碳量約 50%，在使用階段，兩者使用情境不同，若只寫一份 PCR 涵蓋資訊類 Displays、家用電視、看板三種類別，Displays 的排碳量會被高估。	經利害相關者討論後決議將本份 PCR 範疇界定在資訊類產品：液晶顯示器(TFT-LCD Display)，並移除 -8528.72.00.00-0 彩色電視機，增加 8528.59.10.00.5 其他彩色非陰極射線管監視器及 8528.51.00.00.5 專用或主要用於自動資料處理系統之其他監視器。
電電公會	本份 PCR 一般資訊部份，內容提到三種類別的產品，包括：看板類、家用電視類以及資訊產品類：螢幕。三種類別的使用情境假設不相同，應不適用單一份 PCR 即涵蓋三種類別的產品。	
三洋	Displays 及 TV 的使用情境不同，安規定義也不同，貨物稅也不同，兩者應區分為資訊類產品(Display)及家電產品(TV)。	
環發會	將此份 PCR 的名稱 TFT-LCD Displays 的題目定義更精確及使用情境分為兩種表示。	
台灣松下、友達光電、環管協會	Display 應該是指資訊類產品，此份 PCR 若納入範圍較多，省去其他的前置作業時間，應較注重後面數據的蒐集情形，若納入一份計算困難應當分開表示。	
明基電通	建議製造商品分類號列(CCC Code)歸類去除-8528.72.00.00-0 彩色電視機。	
全體與會者	有關產品組成部分，是否應增加外接電源、背光源模組，以及 Inverters 應翻譯為我國用語。	已將 Inverters 翻譯為轉換器，並增加背光源模組及其他(包括但不限於)：外接電源(適配器)、線材等。
友達、環管協會	應在 2.1.3 節說明功能單位。	遵照辦理，已於 2.1.3 節說明功能單位為 1 台液晶顯示器(尺寸)。
奇美電子	2.1.1 節產品組成應與第 3 章名詞定義相對應。	已依建議事項修正。
環管協會、電電公會	2.2 生命週期範圍流程圖 (1)修改原料取得範圍主要組件組成	依建議事項修正第 2.2 節生命週期流程圖。

單 位	磋 商 意 見	答 覆 情 形
	<p>(2)配送銷售階段方框修正為「經銷商/銷售點」</p> <p>(3)銷售至使用者階段的運輸採用虛線箭頭表示志願性盤查不列入評估</p>	
環管協會	生命週期各階段是否為強制性納入，例如：估量很小及難以計算的再予以排除，此部分較 EPD-PCR 寬鬆。	
明基、環發會	2.2.4 使用階段討論：建議納入所參考之監視器 Energy Star 版本以及詳細名稱使閱讀者能清楚了解參考文件出處。	待與內部專家審查會議確認 Energy Star 之參考文獻寫法。
友達光電	四、生命週期各階段之數據蒐集討論 針對生命週期較短以及季節性產品可能無法取得一整年的盤查數據，建議可加入具代表性期間或特定期間的平均數值。	已依意見將其敘述修正為「若計算時非使用一年或以下數據，須詳述其原因，加入具代表性期間或特定期間的平均數值。」
明基電通	4.3.4 第 3 點應修正敘述為「...單位重量里程...」。	已依意見修正。
全體與會者	4.4.5 情境內容應參照其他液晶顯示器產品類別規則之制定文件。	有關使用階段假設情境已參照今年度(2012)兩岸合作制訂之 TFT-LED 顯示器 EPD-PCR。
明基電通	5.1 第 3 點建議加入可標示在包裝上之敘述。	遵照意見修正敘述為「碳標籤應標示在產品主體或外包裝」。
奇美電子	五、資訊揭露方式討論：此份 PCR 為何會出現環保署碳標籤？	此份產品類別規則係為後續申請環保署碳標籤所使用，而資訊揭露將以碳標籤所呈現，故在該文件會提供碳標籤圖示範例供業者參考。
環管協會	產品碳標籤之圖示下方應納入功能單位。	遵照辦理，已依意見修正。

## 八、審查意見及回應

單 位	審 查 意 見	答 覆 情 形
財團法人工業技術研究院綠能與環境研究所黃英傑經理	中文為「液晶顯示器」，英文為「TFT-LCD Displays」，兩者並不相同。	已參酌委員意見，將PCR英文名稱修改為 Liquid Crystal Display (LCD)。
財團法人工業技術研究院綠能與環境研究所黃文輝經理	封面名稱「液晶顯示器」之英文建議將 TFT-LCD Displays 修正為 Liquid Crystal Displays (LCD)。	
台灣區電機電子工業同業公會徐興副秘書長	TFT LCD Displays建議只用LCD Displays即可。	
財團法人環境與發展基金會丁執宇經理	中英文名稱之對應，英文應該刪除TFT字眼。	
財團法人工業技術研究院綠能與環境研究所黃文輝經理	P.3本文件係由友達光電擬定，以友達於本產業之角色及相關關係企業，足以擬訂B2C之PCR。	謝謝委員指教。
台灣區電機電子工業同業公會徐興副秘書長	P.3可應用於電腦即可，不必列出筆電及桌上型電腦，且不概括TFT LCD電視有其原因。	已依委員意見修改敘述為“產品適用範圍包括全球生產與製造之液晶顯示器，包含LED及CCFL背光源之液晶顯示器，可應用於電腦之液晶螢幕等”。
台灣區電機電子工業同業公會徐興副秘書長	P.4產品包裝建議刪除“包裝”；運輸包裝刪除“包裝”二字。	已依委員意見修改，詳見
財團法人環境與發展基金會丁執宇經理	P.4產品組成 應將運輸包裝刪除	

單 位	審 查 意 見	答 覆 情 形
台灣區電機電子工業同業公會徐興副秘書長	2.1.2節TFT-LCD改為液晶面板。	已遵照修正。
財團法人環境與發展基金會丁執宇經理	2.1.2產品機能與特性敘述...在“TFT-LCD”等改以“液晶”中文字句描述。	
台灣區電機電子工業同業公會徐興副秘書長	P.5流程圖加其他輔助原料。	已依委員意見修改，詳見圖2.2-1。
財團法人環境與發展基金會丁執宇經理	2.2 LCA Scope增加之“其他輔助原料”，並加入名詞定義。原料取得分為三大項次層次(主要組件/元件、其他組件、其他輔助原料)，架構應更清楚。背光源模組應為“主要組件/元件”之層次。	
財團法人工業技術研究院綠能與環境研究所黃文輝經理	圖2.2-1原料取得階段中加入「其他輔助原料」。	
財團法人環境與發展基金會丁執宇經理	...“其他小型零件”改為與圖對應之“其他組件”。	
台灣區電機電子工業同業公會徐興副秘書長	2.2.1.1改正“其他小型零件”文字為主要元件(主要物料清單BOM)及其他輔助原料，另刪除“開採與製造”。 2.2.2.1刪除“用水”、“與電力”等字	已將此段2.2.1節第1點敘述修改“為主要物料清單(BOM)與其他輔助原料製造等相關溫室氣體排放。”，並於產品組成納入其他輔助原料。
財團法人工業技術研究院綠能與環境研究所黃英傑經理	2.2&2.2.1宜將製造過程所使用之輔助原物料，例如清潔劑等納入。	
財團法人工業技術研究院綠能與環境研究所黃英傑經理	2.2.1原料取得階段第1點修正為主要物料清單(BOM)與其他輔助原料製造等...	

單 位	審 查 意 見	答 覆 情 形
所黃文輝經理		
財團法人環境與發展基金會 丁執宇經理	2.2.4使用階段之“Energy Star”監視器測試標準定義之明確規範，請友達提供，若“Energy Star”有最新規定，應依其最新版本內容。	已依委員意見修改，詳見2.2.4節，另友達公司提供之能源之星計畫要求事項顯示器產品規格標準符合資格準則(第6.0版)草案第二版將作為本PCR之附件。
財團法人工業技術研究院綠能與環境研究所黃文輝經理	2.2.4使用階段第1、2點互換，原第1點修改，使目的為「測出功率」能顯現出來。	已依委員意見修改，詳見2.2.4節。
台灣區電機電子工業同業公會徐興副秘書長	2.2.4第1、2點對調且其第2點文字修正。	
台灣區電機電子工業同業公會徐興副秘書長	P.7 (1)取消TFT LCD Panel (2)背光源模組刪除“(大部分螢光燈管)”加“其他輔助原料”。 (3)前框、後蓋、底座皆不定義	已依委員意見修改，詳見第三章名詞定義。
財團法人環境與發展基金會 丁執宇經理	名詞定義： (1)第11點刪除“(大部分螢光燈管)” (2)前框、後蓋、底座應不用特別定義 (3)按鍵板(keypad) (4)第14點增加“其他輔助原料”	
台灣區電機電子工業同業公會徐興副秘書長	P.8使用一年以下數據，須詳述其原因，並確認其代表性	已依委員意見將其敘述修改。
財團法人工業	4.1.2之4「...排放量未達上游原料階段之溫	已依委員意見修正。

單 位	審 查 意 見	答 覆 情 形
技術研究院綠能與環境研究所黃英傑經理	室...」請修正為「...未達上游原料階段至製造階段之溫室...」	
財團法人環境與發展基金會丁執宇經理	4.2.1節增加(5)其他輔助原料	已依委員意見增加其他輔助原料。
財團法人工業技術研究院綠能與環境研究所黃英傑經理	4.2.3之5「95%」是否過於嚴格？宜視業界普遍狀況再行考量。	經審查委員們及友達公司討論，將4.2.3節第5點...重要生產地點之生產總量超過總生產量的95%以上之數值改為60%以上。
財團法人環境與發展基金會丁執宇經理	4.2.3一級活動數據方法與要求，將95%改為60%。	
財團法人工業技術研究院綠能與環境研究所黃英傑經理	4.4.5之(4)使用年限為7.2年，依據為何？宜說明之。	謝謝委員指教，本PCR依據行政院公佈之固定資產耐用年數表，液晶顯示器耐用年限為3年，故4.4.5節之使用年限修改為3年。
台灣區電機電子工業同業公會徐興副秘書長	P.13使用年限改3年	
財團法人環境與發展基金會丁執宇經理	4.4.5使用情境  (1)建議於本段落之初增加一段文字“液晶顯示器產品於一般情況下，本PCR建議之使用情境如下，若宣告之產品有特殊情境，應予以說明”。  (2)確認各種模式之定義  (3)使用年限改三年	已依委員意見修改，詳見4.4.5節。
台灣區電機電子工業同業公會徐興副秘書長	P.13  (2)睡眠模式及(3)關閉模式之內容應加以對應修正  (5)“使用”公式中7.2修改為3；刪除“之碳足跡	使用階段之情境內容已依委員意見修改，詳見4.4.5節。

單 位	審 查 意 見	答 覆 情 形
	(二氧化碳當量)”	
財團法人工業技術研究院綠能與環境研究所黃英傑經理	4.4.5之(2)&(3)中英文配對部分，請再確認，如：關閉模式/待機功率(off mode/standby power)是否一致？	因考量本PCR為後續申請我國環保署碳標籤所使用，故將其英文對照刪除。
財團法人工業技術研究院綠能與環境研究所黃英傑經理	4.5.1節指的應是”產品”使用後之廢棄處理階段，但現行文字中看不出是”產品”的廢棄處理。	已依委員意見修改4.5.1節。
工業技術研究院綠能與環境研究所黃文輝經理	4.5.1修改如下： 1.產品廢棄後至處理商或回收商之運輸 2.應納入回收資訊，如回收率、回收通路資訊，並依所宣告之回收率計算環境衝擊。	





## ENERGY STAR® Program Requirements Product Specification for Displays

### Eligibility Criteria Final Draft Version 7.0

1 Following is the ENERGY STAR product specification ("specification") for Displays. A product shall meet  
2 all of the identified criteria if it is to earn the ENERGY STAR.

## 3 1 DEFINITIONS

### 4 A) Product Types:

- 5 1) Electronic Display (Display): A product with a display screen and associated electronics,  
6 often encased in a single housing, that as its primary function produces visual information  
7 from (1) a computer, workstation, or server via one or more inputs (e.g., VGA, DVI, HDMI,  
8 DisplayPort, IEEE 1394, USB), (2) external storage (e.g., USB flash drive, memory card), or  
9 (3) a network connection.
  - 10 a) Monitor: An electronic display intended for one person to view in a desk based  
11 environment.
  - 12 b) Signage Display: An electronic display intended for multiple people to view in non-  
13 desk based environments, such as retail or department stores, restaurants,  
14 museums, hotels, outdoor venues, airports, conference rooms or classrooms. For the  
15 purposes of this specification, a display shall be classified as a signage display if it  
16 meets two or more criteria listed below:
    - 17 (1) Diagonal screen size is greater than 30 inches;
    - 18 (2) Maximum Reported Luminance is greater than 400 candelas per square meter;
    - 19 (3) Pixel density is less than or equal to 5,000 pixels per square inch; or
    - 20 (4) Ships without a mounting stand.

21 **Note:** In Draft 2, EPA proposed distinguishing a signage display using three criteria: screen size,  
22 Maximum Reported Luminance, and pixel density. Given a stakeholder comment that there still may be  
23 overlap among two or more of these criteria, EPA is proposing a fourth criterion based on the physical  
24 configuration of a product to reflect the typical use cases for signage displays. Most signage displays are  
25 wall-mounted as opposed to stand-mounted like computer monitors. Therefore, EPA has added the  
26 additional criterion "ships without a mounting stand" to further delineate the product types. As such, EPA  
27 now proposes a set of four criteria, where a display would have to meet at least two to be classified as a  
28 signage display.

### 29 B) Operational Modes:

- 30 1) On Mode: The mode in which the display has been activated, and is providing the primary  
31 function.

- 32 2) Sleep Mode: A low-power mode in which the display provides one or more non-primary protective  
33 functions or continuous functions.
- 34 Note: Sleep Mode may serve the following functions: facilitate the activation of On Mode via  
35 remote switch, internal sensor, or timer; provide information or status displays including clocks;  
36 support sensor-based functions; or maintain a network presence.
- 37 3) Off Mode: The mode where the display is connected to a power source, produces no visual  
38 information, and cannot be switched into any other mode with the remote control unit, an internal  
39 signal, or an external signal.
- 40 Note: The display may only exit this mode by direct user actuation of an integrated power switch  
41 or control. Some products may not have an Off Mode.
- 42 C) Visual Characteristics:
- 43 1) Ambient Light Conditions: The combination of light illuminances in the environment  
44 surrounding a display, such as a living room or an office.
- 45 2) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness  
46 of a Display as a function of Ambient Light Conditions.
- 47 Note: ABC functionality must be enabled to control the brightness of a Display.
- 48 3) Color Gamut: Color gamut area shall be reported as a percentage of the CIE LUV 1976  $u' v'$   
49 color space and calculated per Section 5.18 Gamut Area of the Information Display  
50 Measurements Standard Version 1.03.
- 51 Note: Any gamut support in non-visible/invisible color areas is not to be counted. The  
52 gamut's size must be expressed as a percentage of area of the visible CIE LUV color space  
53 only.
- 54 4) Luminance: The photometric measure of the luminous intensity per unit area of light  
55 travelling in a given direction, expressed in candelas per square meter ( $\text{cd/m}^2$ ).
- 56 a) Maximum Reported Luminance: The maximum luminance the display may attain at  
57 an On Mode preset setting, and as specified by the manufacturer, for example, in the  
58 user manual.
- 59 b) Maximum Measured Luminance: The maximum measured luminance the display  
60 may attain by manually configuring its controls, such as brightness and contrast.
- 61 c) As-shipped Luminance: The luminance of the display at the factory default preset  
62 setting the manufacturer selects for normal home or applicable market use.
- 63 5) Native Vertical Resolution: The number of physical lines along the vertical axis of the  
64 Display within the visible area of the Display.
- 65 Note: A display with a screen resolution of 1920 x 1080 (horizontal x vertical) would have a  
66 Native Vertical Resolution of 1080).
- 67 6) Screen Area: The visible area of the display that produces images.
- 68 Note: Screen Area is calculated by multiplying the viewable image width by the viewable  
69 image height. For curved screens, measure the width and height along the arc of the  
70 display.
- 71 D) Additional Functions and Features:
- 72 1) Bridge Connection: A physical connection between two hub controllers (i.e., USB, FireWire).
- 73 Note: Bridge Connections allow for expansion of ports typically for the purpose of relocating  
74 the ports to a more convenient location or increasing the number of available ports.

- 75 2) Full Network Connectivity: The ability of the display to maintain network presence while in  
 76 Sleep Mode. Presence of the display, its network services, and its applications, is  
 77 maintained even if some components of the display are powered down. The display can  
 78 elect to change power states based on receipt of network data from remote network devices,  
 79 but should otherwise stay in Sleep Mode absent a demand for services from a remote  
 80 network device.
- 81 Note: Full Network Connectivity is not limited to a specific set of protocols. Also referred to  
 82 as "network proxy" functionality and described in the Ecma-393 standard.
- 83 3) Occupancy Sensor: A device used to detect human presence in front of or in the area  
 84 surrounding a display.
- 85 Note: An Occupancy Sensor is typically used to switch a Display between On Mode and  
 86 Sleep Mode.
- 87 4) Touch Technology: Enables the user to interact with a product by touching areas on the  
 88 Display screen.
- 89 5) Plug-in Module: A modular plugin device that provides one or more of the following functions  
 90 without the explicit purpose of providing general computing function:
- 91 a) Display images, mirror remote content streamed to it, or otherwise render content on  
 92 the screen from local or remote sources; or
- 93 b) Process touch signals.
- 94 Note: Modules providing additional input options are not considered Plug-in Modules for the  
 95 purposes of this specification.
- 96 E) Product Family: A group of product models that (1) are made by the same manufacturer, (2)  
 97 share the same Screen Area, Resolution, and Maximum Reported Luminance, and (3) are of a  
 98 common basic screen design. Models within a Product Family may differ from each other  
 99 according to one or more characteristics or features. For displays, acceptable variations within a  
 100 Product Family include:
- 101 1) External housing;
- 102 2) Number and types of interfaces;
- 103 3) Number and types of data, network, or peripheral ports; and
- 104 4) Processing and memory capability.
- 105 F) Representative Model: The product configuration that is tested for ENERGY STAR certification  
 106 and is intended to be marketed and labeled as ENERGY STAR.
- 107 G) Power Source
- 108 1) External Power Supply (EPS): An external power supply circuit that is used to convert  
 109 household electric current into dc current or lower-voltage ac current to operate a consumer  
 110 product.
- 111 2) Standard dc: A method for transmitting dc power defined by a well-known technology  
 112 standard, enabling plug-and-play interoperability.
- 113 Note: Common examples are USB and Power-over-Ethernet. Usually Standard dc includes  
 114 both power and communications over the same cable, but as with the 380 V dc standard,  
 115 that is not required.

## 116 2 SCOPE

### 117 2.1 Included Products

118 2.1.1 Products that meet the definition of a display as specified herein and are powered directly from ac  
119 mains, an External Power Supply, or Standard dc are eligible for ENERGY STAR certification,  
120 with the exception of products listed in Section 2.2. Typical products that would be eligible for  
121 certification under this specification include:

- 122 i. Monitors;
- 123 ii. Monitors with keyboard, video, and mouse (KVM) switch functionality;
- 124 iii. Signage Displays; and
- 125 iv. Signage Displays and Monitors with Plug-in Modules.

### 126 2.2 Excluded Products

127 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for  
128 certification under this specification including Televisions and Computers (Thin Clients,  
129 Slates/Tablets, Portable All-in-one Computers). The list of specifications currently in effect can be  
130 found at [www.energystar.gov/products](http://www.energystar.gov/products).

131 2.2.2 The following products are not eligible for certification under this specification:

- 132 i. Products with an integrated television tuner;
- 133 ii. Displays with integrated or replaceable batteries designed to support primary operation  
134 without ac mains or external dc power, or device mobility (e.g., electronic readers, battery-  
135 powered digital picture frames); and
- 136 iii. Products that must meet Food and Drug Administration specifications for medical devices  
137 that prohibit power management capabilities and/or do not have a power state meeting the  
138 definition of Sleep Mode.

## 139 3 CERTIFICATION CRITERIA

### 140 3.1 Significant Digits and Rounding

141 3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

142 3.1.2 Unless otherwise specified, compliance with specification requirements shall be evaluated using  
143 directly measured or calculated values without any benefit from rounding.

144 3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR  
145 website shall be rounded to the nearest significant digit as expressed in the corresponding  
146 specification requirements.

147 **3.2 General Requirements for Monitors and Signage Displays**

148 3.2.1 External Power Supplies (EPSs): Single- and Multiple-voltage EPSs shall meet the Level VI or  
149 higher performance requirements under the International Efficiency Marking Protocol when tested  
150 according to the Uniform Test Method for Measuring the Energy Consumption of External Power  
151 Supplies, Appendix Z to 10 CFR Part 430.

152 i. Single- and Multiple-voltage EPSs shall include the Level VI or higher marking.

153 ii. Additional information on the Marking Protocol is available  
154 at <http://www.regulations.gov/#/documentDetail;D=EERE-2008-BT-STD-0005-0218>.

155 **3.2.2 Power Management:**

156 i. Products shall offer at least one power management feature that is enabled by default, and  
157 that can be used to automatically transition from On Mode to Sleep Mode either by a  
158 connected host device or internally (e.g., support for VESA Display Power Management  
159 Signaling (DPMS), enabled by default).

160 ii. Products that generate content for display from one or more internal sources shall have a  
161 sensor or timer enabled by default to automatically engage Sleep or Off Mode.

162 iii. For products that have an internal default delay time after which the product transitions  
163 from On Mode to Sleep Mode or Off Mode, the delay time shall be reported.

164 iv. Monitors shall automatically enter Sleep Mode or Off Mode within 5 minutes of being  
165 disconnected from a host computer.

166 3.2.3 Signage Displays shall have a true power factor in On Mode of 0.7 or greater per Part G of  
167 Section 5.2 in the ENERGY STAR Test Method.

168 **3.3 Energy Requirements for Computer Monitors**

169 3.3.1 The Total Energy Consumption (TEC) in kWh shall be calculated per Equation 1 based on  
170 measured values.

171 **Equation 1: Total Energy Consumption Calculation**

172 
$$E_{TEC} = 8.76 \times (0.35 \times P_{ON} + 0.65 \times P_{SLEEP})$$

173 Where:

- 174  $E_{TEC}$  is the Total Energy Consumption calculation in kWh;
- 175  $P_{ON}$  is Measured On Mode Power in watts
- 176  $P_{SLEEP}$  is Measured Sleep Mode Power in watts; and
- 177 The result shall be rounded to the nearest tenth of a kWh for reporting.

178 3.3.2 The Maximum TEC ( $E_{TEC\_MAX}$ ) in kWh for Monitors shall be calculated per Equation 2.

180 **Equation 2: Calculation of Monitor Maximum TEC ( $E_{TEC\_MAX}$ ) in kWh**

181 
$$E_{TEC\_MAX} = 6.13 \times r + 89 \times \tanh(0.0016 \times [A - 59] + 0.085) + 9$$

182 Where:

- 183  $E_{TEC\_MAX}$  is the Maximum TEC requirement in kWh;
  - 184  $r$  is the screen resolution in megapixels;
  - 185  $A$  is the Screen Area in  $\text{in}^2$ ; and
  - 186  $\tanh$  is the hyperbolic tangent function.
- 187



188 **Note:** In this Final Draft, EPA has retained a Total Energy Consumption approach that recognizes the  
 189 current top performing 20 percent (241 out of 1179 models) of products in the market. EPA seeks to  
 190 ensure that ENERGY STAR remains a market differentiator for efficiency in monitors when the  
 191 specification takes effect in 2016.

192 3.3.3 For all Monitors, Calculated TEC ( $E_{TEC}$ ) in kWh shall be less than or equal the calculation of  
 193 Maximum TEC ( $E_{TEC\_MAX}$ ) with the applicable allowances and adjustments (applied at most once)  
 194 per Equation 3.

195 **Equation 3: Total Energy Consumption Requirement for Monitors**

$$E_{TEC} \leq (E_{TEC\_MAX} + E_{EP} + E_{ABC} + E_N + E_{OS}) \times eff_{AC\_DC}$$

196 |  
 197 Where:

- 198 ▪  $E_{TEC}$  is TEC in kWh calculated per Equation 1;
- 199 ▪  $E_{TEC\_MAX}$  is the Maximum TEC requirement in kWh calculated per Equation 2;
- 200 ▪  $E_{EP}$  is the enhanced performance display allowance in kWh per Section 3.3.4;
- 201 ▪  $E_{ABC}$  is the Automatic Brightness Control allowance in kWh per Equation 5;
- 202 ▪  $E_N$  is the Full Network Connectivity allowance in kWh per Table 2;
- 203 ▪  $E_{OS}$  is the Occupancy Sensor allowance in kWh per Table 3; and
- 204 ▪  $eff_{AC\_DC}$  is the standard adjustment for ac-dc power conversion losses that occur at the device  
 205 powering the Display, and is 1.0 for Ac-powered Displays and 0.85 for displays with Standard dc.

206 3.3.4 For Monitors meeting the enhanced performance display (EPD) requirements below, only one of  
 207 the following Table 1 allowances shall be used in Equation 3:

- 208 i. Contrast ratio of at least 60:1 measured at a horizontal viewing angle of at least 85° from  
 209 the perpendicular on a flat screen and at least 83° from the perpendicular on a curved  
 210 screen, with or without a screen cover glass;
- 211 ii. A native resolution greater than or equal to 2.3 megapixels (MP); and
- 212 iii. Color Gamut greater than or equal to 32.9% of CIE LUV.

213 **Note:** Since the Draft 2, EPA received new feedback on the difficulty of achieving the contrast ratio of at  
 214 least 60:1 at a measurement of 85° on a curved screen. Based on the information, EPA proposes curved  
 215 computer monitor screens have a contrast ratio of at least 60:1 measured at a horizontal viewing angle of  
 216 at least at 83° to be eligible for the allowances outlined in Table 1 below.

217 **Table 1: Calculation of Energy Allowance for Enhanced Performance Displays**

Color Gamut Criteria	$E_{EP}$ (kWh)
	Where: ▪ $E_{TEC\_MAX}$ is the Maximum TEC requirement in kWh; and ▪ $r$ is screen resolution in megapixels
Color Gamut support is 32.9% of CIE LUV or greater.	$0.15 \times (E_{TEC\_MAX} - 6.13 \times r)$
Color Gamut support is 38.4% of CIE LUV or greater.	$0.65 \times (E_{TEC\_MAX} - 6.13 \times r)$

218 |  
 219 Note: A model supporting greater than 99% of the sRGB color space translates to 32.9% of CIE LUV  
 220 and a model supporting greater than 99% of Adobe RGB translates to 38.4% of CIE LUV.

221 **Note:** In Draft 2, EPA classified EPD models based on color gamut performance using the Version 6.0  
 222 dataset. Since data were submitted using varying standards (NTSC, sRGB, Adobe RGB), EPA  
 223 normalized the data to make it comparable by converting the percentage of the color space of each  
 224 standard into percentage of the color space of the CIE standard. In this Final Draft, as reflected in the  
 225 definition of color gamut, EPA maintains that manufacturers report their color gamut in terms of CIE LUV  
 226 to allow for information to be standardized across models.

227 In further reviewing color gamut data, EPA found that nearly half of all monitors in the dataset cover the  
 228 sRGB color gamut, indicating that this level of performance, as an isolated feature, is no longer limited to  
 229 a small subset of premium models. Holding resolution and area constant, the data indicate that increased  
 230 color gamut performance typically requires more power. Models supporting 32.9% of CIE LUV (99% or  
 231 more of defined sRGB colors) indicate a need for additional power over models with a smaller color  
 232 space. Models covering at least 38.4% of CIE LUV (99% of Adobe RGB)—an even higher coverage—  
 233 appear to require more power still.

234 EPA continues to propose a tiered allowance for EPDs based on color gamut, as proposed in Draft 2.  
 235 After reviewing the most recent data, EPA has made a modest adjustment to the allowance for models  
 236 meeting EPD criteria such that they are eligible for one of the following two allowances based on their  
 237 color gamut:

238 **1) A 15% allowance for models meeting proposed EPD criteria with color gamut support greater**  
 239 **than 32.9% of CIE LUV (aka, 99% of sRGB).** In the Final Draft dataset, EPA identified nearly 40 models  
 240 not categorized as Enhanced Performance Displays under the Version 6.0 specification that appear to  
 241 meet the Final Draft color gamut criterion and also likely the contrast ratio criterion. By including these  
 242 models, EPA expanded the set of models considered to be EPD to 76 which may include relatively more  
 243 efficient models that did not necessarily need the EPD allowance under Version 6.0. With this set of  
 244 models, EPA found that a 15% allowance for models with color gamut support greater than 32.9% of CIE  
 245 LUV recognized a similar percentage of passing models the Draft 2 allowance of 25% applied to a  
 246 relatively less efficient set of models. After substantial review of products in the marketplace, including  
 247 those not qualified to the ENERGY STAR, EPA considers that its EPD dataset is reflective of the majority  
 248 of the EPD market.

249 Or

250 **2) A 65% allowance for models meeting the current EPD criteria with color gamut support greater**  
 251 **than 38.4% of CIE LUV (aka, 99% of sRGB and at least 99% Adobe RGB).** In Draft 2, EPA proposed a  
 252 65% allowance for models supporting a color gamut of at least 96% Adobe RGB. Upon final review of its  
 253 dataset, EPA noted that nearly all of the models that support 96% or greater of Adobe RGB in fact  
 254 support 99% or greater of Adobe RGB. EPA has therefore revised the CIE LUV criterion to be equivalent  
 255 to 99% or greater of Adobe RGB.

256 With a 15% allowance for EPDs with at least 32.9% of CIE LUV, 33% of models identified as meeting the  
 257 EPD criteria qualify, whereas none of the higher color-gamut models do. With the addition of a 65%  
 258 allowance for models with at least 38.4% of CIE LUV (99% or greater Adobe RGB), 4 out of 16 models, or  
 259 25% in the  $\geq 38.4\%$  CIE LUV category, meet the proposed criteria.

260 Finally, EPA removed the additional  $E_{TEC\_MAX}$  resolution allowance of  $6.13 \times r$  from the EPD allowance  
 261 because including it resulted in a multiplier effect on the resolution allowance, such that Ultra HD (UHD)  
 262 EPD models would qualify at much higher rates than non-UHD EPD models. Removing this portion of the  
 263 EPD allowance will ensure that the resolution allowance is applied only once against the On Mode power  
 264 requirements.

265 **3.3.5** For monitors with Automatic Brightness Control (ABC) enabled by default, an energy allowance  
 266 ( $E_{ABC}$ ), as calculated per Equation 5, shall be added to  $E_{TEC\_MAX}$  in Equation 3, if the On Mode  
 267 power reduction ( $R_{ABC}$ ), as calculated per Equation 4, is greater than or equal to 20%.

268

**Equation 4: Calculation of On Mode Reduction with ABC Enabled by Default**

$$R_{ABC} = 100\% \times \left( \frac{P_{300} - P_{12}}{P_{300}} \right)$$

269

270

271

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275

Where:

- $R_{ABC}$  is the On Mode percent power reduction due to ABC;
- $P_{300}$  is the On Mode power in watts, as measured at an ambient light level of 300 lux in Section 6.4 of the Test Method; and
- $P_{12}$  is the On Mode power in watts, as measured at an ambient light level of 12 lux in Section 6.4 of the Test Method.

276

**Equation 5: Monitors ABC Energy Allowance ( $E_{ABC}$ ) for Monitors**

$$E_{ABC} = 0.05 \times E_{TEC\_MAX}$$

277

278

279

280

Where:

- $E_{ABC}$  is the energy allowance for Automatic Brightness Control in kWh; and
- $E_{TEC\_MAX}$  is the Maximum TEC in kWh, per Equation 2.

281

282

- 3.3.6 Products with Full Network Connectivity confirmed in Section 6.7 of the ENERGY STAR Test Method shall apply the allowance specified in Table 2.

283

**Table 2: Full Network Connectivity Energy Allowance ( $E_N$ ) for Monitors**

$E_N$ (kWh)
2.9

284

285

- 3.3.7 Products tested with an Occupancy Sensor active shall apply the allowance specified in Table 3.

286

**Table 3: Additional Functions Energy Allowance ( $E_{OS}$ ) for Monitors**

287

Type	Allowance (kWh)
Occupancy Sensor $E_{OS}$	1.7

288

**3.4 On Mode Requirements for Signage Displays**

289

- 3.4.1 The Maximum On Mode Power ( $P_{ON\_MAX}$ ) in watts shall be calculated per Equation 6.

290

**Equation 6: Calculation of Maximum On Mode Power ( $P_{ON\_MAX}$ ) in Watts for Signage Displays**

$$P_{ON\_MAX} = (4.0 \times 10^{-5} \times \ell \times A) + 119 \times \tanh(0.0008 \times (A - 200.0) + 0.11) + 6$$

291

292

293

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Where:

- $P_{ON\_MAX}$  is the Maximum on Mode Power, in watts;
- $A$  is the Screen Area in square inches;
- $\ell$  is the Maximum Measured Luminance of the display in candelas per square meter, as measured in Section 6.2 of the test method;
- $\tanh$  is the hyperbolic tangent function; and
- The result shall be rounded to the nearest tenth of a watt for reporting.



299 **Note:** Since the release of Draft 2, EPA identified very bright ( $2,500 \text{ cd/m}^2$ ) signage displays in the  
 300 smaller signage sizes (under 50 inches) that operate very efficiently. Therefore, in the Final Draft, EPA  
 301 has adjusted the luminance allowance from  $7.5 \times 10^{-5}$  to  $4.0 \times 10^{-5}$  to allocate a greater proportion of  
 302 power to area in Equation 6. Despite, the shift in the weight of the allowances, this Final Draft Maximum  
 303 On Mode Power for Signage Displays continues to capture approximately 25 percent of signage products  
 304 in EPA's dataset. Measured On Mode Power ( $P_{ON}$ ) in watts shall be less than or equal to the calculation  
 305 of Maximum On Mode Power ( $P_{ON\_MAX}$ ) with the applicable allowances and adjustments per Equation 7.

306 EPA also received feedback that very large models (>70 inches) intended for indoor operation were  
 307 challenged to meet the proposed Draft 2 signage display criteria compared to their smaller counterparts  
 308 (40–70 inches). EPA developed its proposal based on trends in efficiency seen in large TVs over the past  
 309 three years. According to stakeholder feedback in Draft 2, signage displays intended for indoor use are  
 310 manufactured to be very similar to TVs. As such, EPA estimates that efficiency trends should easily  
 311 translate to signage displays. However, EPA will watch the energy use of displays larger than 70 inches  
 312 that are intended for indoor use and is able to amend this specification in the future, if warranted. The  
 313 Agency encourages manufacturers with an interest in very large models to share performance data with  
 314 EPA to inform this ongoing analysis.

#### 315 Equation 7: On Mode Power Requirement for Signage Displays

$$P_{ON} \leq P_{ON\_MAX} + P_{ABC}$$

316  
 317 Where:  
 318 •  $P_{ON}$  is On Mode Power in watts, as measured in Section 6.3 or 6.4 of the Test Method;  
 319 •  $P_{ON\_MAX}$  is the Maximum On Mode Power in watts, per Equation 7; and  
 320 •  $P_{ABC}$  is the On Mode power allowance for ABC in watts, per Equation 8.

321 3.4.2 For Signage Displays with ABC enabled by default, a power allowance ( $P_{ABC}$ ), as calculated per  
 322 Equation 8, shall be added to  $P_{ON\_MAX}$ , as calculated per Equation 7, if the On Mode power  
 323 reduction ( $R_{ABC}$ ), as calculated per Equation 4, is greater than or equal to 20 percent.

#### 324 Equation 8: Calculation of On Mode Power Allowance for Signage Displays with ABC Enabled by 325 Default

$$P_{ABC} = 0.05 \times P_{ON\_MAX}$$

326  
 327 Where:  
 328 •  $P_{ABC}$  is the Measured On Mode Power allowance for ABC in watts; and  
 329 •  $P_{ON\_MAX}$  is the Maximum On Mode Power requirement in watts.

### 330 3.5 Sleep Mode Requirements for Signage Displays

331 3.5.1 Measured Sleep Mode Power ( $P_{SLEEP}$ ) in watts shall be less than or equal the sum of the  
 332 Maximum Sleep Mode Power Requirement ( $P_{SLEEP\_MAX}$ ) and any allowances (applied at most once)  
 333 per Equation 9.

#### 334 Equation 9: Sleep Mode Power Requirement for Signage Displays

$$P_{SLEEP} \leq P_{SLEEP\_MAX} + P_N + P_{OS} + P_T$$

335  
 336 Where:  
 337 •  $P_{SLEEP}$  is Measured Sleep Mode Power in watts;  
 338 •  $P_{SLEEP\_MAX}$  is the Maximum Sleep Mode Power requirement in watts per Table 4;  
 339 •  $P_N$  is the Full Network Connectivity allowance in watts per Table 5;  
 340 •  $P_{OS}$  is the Occupancy Sensor allowance in watts per Table 6; and  
 341 •  $P_T$  is the Touch allowance in watts per Table 6.  
 342

343 **Table 4: Maximum Sleep Mode Power Requirement ( $P_{\text{SLEEP\_MAX}}$ ) for Signage Displays**

$P_{\text{SLEEP\_MAX}}$ (watts)
0.5

344

345 3.5.2 Products with Full Network Connectivity confirmed in Section 6.7 of the ENERGY STAR Test  
346 Method and with the capability to transition from On Mode to Sleep Mode via a signal over an  
347 Internet Protocol connection shall apply the allowance specified in Table 5.

348 **Table 5: Full Network Connectivity Allowance for Signage Displays**

$P_N$ (watts)
3.0

349

350 **Note:** Based on information from multiple stakeholders, EPA understands that signage displays and  
351 televisions are built with the same, or similar, network connection circuitry. As such, EPA proposes a  
352 3 watt allowance for signage displays to harmonize with the power allowance for network connectivity in a  
353 television's Standby-active, Low mode under the Televisions Version 7.0 specification. EPA expects that  
354 signage displays, similarly to televisions, will continue to reduce their power consumption in network-  
355 connected low-power states. As such, EPA anticipates reducing this allowance in future revisions to the  
356 specification.

357 At this time, EPA proposes to retain the Draft 2 TEC allowance for full network connectivity for computer  
358 monitors, which in contrast to signage displays or televisions, have demonstrated lower-power network  
359 connectivity.

360

361 3.5.3 Products tested with an Occupancy Sensor or Touch Technology active in Sleep Mode shall  
362 apply the allowances specified in Table 6.

363 **Table 6: Additional Functions Sleep Mode Power Allowance for Signage Displays**

Type	Screen Size (in)	Allowance (watts)
Occupancy Sensor $P_{OS}$	All	0.3
Touch Functionality $P_T$ <small>(applicable only to signage displays where screen size is greater than 30 inches)</small>	$\leq 30$	0.0
	$> 30$	1.5

**Note:** Previously, EPA proposed removing touch functionality allowances given lack of data in the EPA dataset indicating that touch functionality was either commonly employed or that it required additional power in Sleep Mode. Since the release of Draft 2, EPA has received new feedback that touch functionality used in larger displays requires more power than typically seen in monitors, and that this touch technology is enabled in Sleep Mode to allow products to wake from sleep in response to a touch and perform the requested work. Given this use case and the opportunity to encourage models to spend more time in Sleep Mode while not in use and to be woken up effectively by users, EPA is proposing a 1.5 W allowance in Sleep Mode for signage displays. EPA proposes this allowance based on new feedback and data received

### 3.6 Off Mode Requirements for all Displays

3.6.1 A product need not have an Off Mode to be eligible for certification. For products that do offer Off Mode, measured Off Mode power ( $P_{OFF}$ ) shall be less than or equal to the Maximum Off Mode Power Requirement ( $P_{OFF\_MAX}$ ) in Table 7.

**Table 7: Maximum Off Mode Power Requirement ( $P_{OFF\_MAX}$ )**

$P_{OFF\_MAX}$ (watts)
0.5

### 3.7 Luminance Reporting Requirements

3.7.1 Maximum Reported and Maximum Measured Luminance shall be reported for all products; As-Shipped Luminance shall be reported for all products except those with ABC enabled by default.

Note: Products intended for sale in the US market are subject to minimum toxicity and recyclability requirements. Please see ENERGY STAR® Program Requirements for Displays: Partner Commitments for details.

## 4 TEST REQUIREMENTS

### 4.1 Test Methods

4.1.1 Test methods identified in Table 8 shall be used to determine certification for ENERGY STAR.

**Table 8: Test Methods for ENERGY STAR Certification**

Product Type	Test Method
All Product Types and Screen Sizes	Final Draft ENERGY STAR Test Method for Determining Display Energy – Rev. Jul-2015
Enhanced Performance Monitors	International Committee for Display Metrology (ICDM) Information Display Measurements Standard – Version 1.03
Displays Claiming Full Network Connectivity	CEA-2037-A, Determination of Television Set Power Consumption

### 4.2 Number of Units Required for Testing

4.2.1 One unit of a Representative Model, as defined in Section 1, shall be selected for testing.

391 4.2.2 For certification of a Product Family, the product configuration that represents the worst-case  
392 power consumption for each product category within the Product Family shall be considered the  
393 Representative Model.

#### 394 4.3 International Market Qualification

395 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for  
396 each market in which they will be sold and promoted as ENERGY STAR.

### 397 5 USER INTERFACE

398 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard,  
399 IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices  
400 Employed in Office/Consumer Environments. For details, see <http://energy.lbl.gov/controls/>.

401 **Note:** EPA is reviewing the above User Interface requirements under this specification revision.  
402 In order to better track these data, EPA is proposing that EPA-recognized certification bodies  
403 report to EPA whether or not products they certify comply with the standard. The reporting  
404 requirement would be in the form of a "Yes/No."

405

### 406 6 EFFECTIVE DATE

407 6.1.1 Effective Date: The Version 6.0 ENERGY STAR Display specification shall take effect on **April**  
408 **30, 2016**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR  
409 specification in effect on its date of manufacture. The date of manufacture is specific to each unit  
410 and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

411 **Note:** EPA intends to finalize Version 7.0 in August 2015, where the specification would take  
412 effect on April 30, 2016.

413 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should  
414 technological and/or market changes affect its usefulness to consumers, industry, or the  
415 environment. In keeping with current policy, revisions to the specification are arrived at through  
416 stakeholder discussions. In the event of a specification revision, please note ENERGY STAR  
417 certification is not automatically granted for the life of a model

### 418 7 CONSIDERATIONS FOR FUTURE REVISIONS

419 7.1.1 On Mode DC Power Limit: EPA is interested in considering a separate On Mode Power  
420 Maximum requirement for Standard dc products that does not necessitate an ac-dc conversion  
421 calculation. EPA anticipates these products will become more popular on the market with the  
422 latest USB standard and looks forward to receiving additional direct dc-tested data for these  
423 products.

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