Danish Ministry of the Environment

Eco-design Requirements for Televisions

How Ambitious is the Implementation of the Energy-using Product Directive?

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Eco-design Requirements for Televisions

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Preface

Today, electronic products are everywhere in our households. The quantity is increasing; and it is common to have a TV not only in the living room, but also in the bedroom, the kitchen and even in the children's rooms. According to the Danish Energy Agency the number of TVs in Danish households has grown from around 2.2 million in 1980 to around 5.5 million in 2010 (Danish Energy Agency, 2012). That equals a growth from approximately 1 TV per household to around one per person. Also the variety of products is increasing: families have TV, DVD player, Xbox, Play Station or Wii, PC, laptop, fixed line phone, several mobile phones and the list could go on. With this amount of products the environmental impact of a household cannot be traced back to a few major contributors, but is shared by many products.

The products are at the same time getting more complex both in terms of their functions and the components inside the product, but also in terms of their product chain and the stakeholders involved during the product lifetime. A product might be sold in Denmark, but it is produced in South Korea with suppliers and subsuppliers from China, Malaysia and Singapore delivering parts to the final product. Once the product is broken or the consumer simply finds it out of fashion it is thrown out – hopefully in a way so it can be disassembled, materials reused and toxic substances handled properly. Unfortunately, loads of old ICT equipment end up in scrap yards in India or Africa, where they are disassembled in a way being a danger both to the environment and the health of people.

This development has challenged the approach to regulate and stimulate the innovation of cleaner products. EU has introduced the Integrated Product Policy (IPP) in 2003. IPP is based on some key principles, first of all the life cycle perspective that means considering the environmental impacts of the entire product life cycle from the extraction of raw materials, production, transport, use, recycling and disposal. IPP is an integrated approach aiming at promoting measures to reduce the environmental impact of products at a point where this is most effective (European Commission, 2003a). Several policy instruments have been introduced such as new directives that partly aim at ecodesign, and other instruments such as energy- and eco-labelling has been expanded to include electronics.

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Rikke Dorothea Huulgaard & Arne Remmen, Aalborg University, 2012.

List of Abbreviations

BAT	Best Available Technology
EEI	Energy Efficiency Index
EIC	International Electrotechnical Commission
EuP Directive	Energy using products Directive
IM	Implementing Measure
IPP	Integrated Product Policy
PBB	Poly-brominated biphenyls, a substance restricted in the RoHS Directive
PBDE	Poly-brominated dephenyl ethers, a substance restricted in the RoHS Dierctive
RoHS Directive	Restriction of Hazardouos Substances Directive
WEEE Directive	Waste Electrical and Electronic Equipment Directive

Television Technologies:

CCFL	Cold Cathode Flourescent lamps. Technology used as backlight in LCD screens
CRT	Cathode Ray Tube. Technology which uses heat to create light by stricking large numbers of electrons against glass. The glass is leaded to block for X-rays generated by the high energy electrons inside the CRT. (Stobbe 2007e) The CRT technology is succeeded by the flat panel displays.
FDP	Flat Panel Display. PDP and LCD are both FDP technologies
HCFL	Hot Cathode Flourescent Lamp. Backlight technology used in LCD screens which have considerable benefits in terms of reduced energy consumption
HD	High definition. Refers to the resolution of the TV. A HD TV has a significant higher resolution than standard Tvs.
LCD	Liquid Crystial Display. Technology which uses a backlight as light source, such as CCFL or LED. LCD screens consist of a number of pixels which consist of liquid crystals that can alter their crystalline structure or orientation when voltage is applied. (Stobbe 2007e)
LED	Light Emitting Diode. Backlight technology used in LCD screens. Some of the advantages of LED are a thinner panel, lower power consumption, better heat dissipation, a brighter display, and better contrast levels.
OLED	Organic Light Emitting Diode. Technology which consists of organic materials i.e. layers of plastic. When currents run through an OLED display, each OLED emits light on its own, without the need of a backlight system. (Bush 2009) The advantages of OLED displays are a reduced energy and materials consumption compared to typical LCD screens due to a thinner panel and a deep black level. (Freudenrich 2005)

PDP	Plasma Panel Display. Self-emissive flat panel technology which creates light in a cell byosphors excited by a plasma discharge between two flat panels of glass. Each cell is filled with a gas and sandwiched between layers of electrodes. A voltage of 100 to 200V is required to ignite the plasma for individual pixels, and display heating as well as radio frequency emission has to be carefully controlled. The first generations of plasma sceens contained lead but by 2006 lead free plasma screen are available. (Stobbe 2007e)
RP	Rear Projection. RP is a common denominator for technologies where a projector or light source casts the image on the rear of the screen.
TFT	Thin Film Transistor. This technology on glass is used to drive or control the orientation of the liquid crystals (pixels) in and LCD screen.

Sammenfatning og konklusioner

Denne rapport omhandler implementeringen af EU Direktiv 2005/323/EF om rammerne om fastlæggelse af krav til miljøvenligt design af energiforbrugende produkter (EuP Direktivet), med særlig vægt på miljøkravene til fjernsyn. Målet er at undersøge gennemførelsesforanstaltningernes rækkevidde, hvor ambitiøse gennemførelsesforanstaltningerne (IM) er og i hvilken grad de vil promovere miljøvenlig innovation. I det følgende er rapportens hovedkonklusioner markeret med fede typer.

Rapporten består af fem dele:

- Definitionen af ecodesign
- EuP processen: fra forstudierne til gennemførelsesforanstaltningerne
- Forholdet mellem gennemførelsesforanstaltningerne og forskellige energi- og miljømærker
- Nye markeds- og teknologitrends sammenlignes med kravene i gennemførelsesforanstaltningerne og miljømærkerne.
- Analyse af den Europæiske energimærkningsordning for TV

I første del af rapporten defineres ecodesign som et koncept, der inkluderer alle miljøaspekter i hele et produkts livscyklus. EU har reageret på denne tilgang gennem integreret produkt politik (IPP). IPP inkluderer både frivillige og påkrævede instrumenter med det formål enten at sætte minimumskrav eller at skabe incitamenter for frontløber virksomheder til at forbedre deres produkter endnu mere.

I anden del af rapporten sammenlignes de anbefalede krav i forstudierne med kravene fra IM. Forstudierne, udarbejdet af et konsortium bestående fem partnere, ser bredt på et fjernsyns miljøpåvirkninger, dog bliver det kraftigt fremhævet, at energiforbruget i brugsfasen har den største miljøpåvirkning. **Gennemførelsesforanstaltningerne har derimod et snævert fokus på fjernsynets energiforbrug i standby, slukket og tændt tilstand.** I IM er anbefalingerne fra forstudierne blevet fulgt på standby, mens kravene til tændt tilstand er skærpet og kravene i slukket tilstand er slækket. Der bliver i IM ikke stillet krav til kemikalier og genbrug, men der henvises til kravene i RoHS og WEEE Direktiverne.

Arbejdet med forstudierne begyndte i 2005 og den endelige rapport blev fremlagt i 2007. IM blev vedtaget af Kommissionen som Forordning i juli 2009, og fjernsyn skal opfylde til de første krav i januar og august 2010. En proces på fire år til ikrafttrædelse af krav stiller udfordringer til forstudierne og IM om at være fremsynede og inkludere ny teknologi. Forstudierne har i vis grad inkluderet overvejelser om nye teknologier. Nogle forældede teknologier er ikke blevet medtaget i undersøgelserne, eksempelvis CRT, mens der blev fokuseret på teknologier, der af konsortiet bag forstudierne blev vurderet til at være førende på markedet, nemlig LCD og Plasma.
Gennemførelsesforanstaltningerne har dog ikke været i stand til at inkludere nyudviklede teknologier, som har en interessant miljømæssig profil. For eksempel er fjernsyn baseret på LED teknologi betydeligt mere energieffektive end kravene i IM (se figur 5-1 & 5-2), og på samme tid eliminerer teknologien

brugen af kviksølv. Denne teknologi blev for alvor introduceret på markedet i 2009, men har dog ikke haft indflydelse på minimumskravene i IM.

I tredje del af rapporten er ambitionsniveauet i EuP direktivet undersøgt ved at sammenligne de fire miljømærker (EU Blomsten, der Nordiske Svanemærke, Energy Star og TCO´06) med IM. Hovedkonklusionerne er, at IM har et smalt fokus på energiforbrug, mens de fleste miljømærker ser bredere på produktets miljøpåvirkning. **Som forventet stiller gennemførelsesforanstaltningerne lavere krav end alle miljømærkerne**, med undtagelse af til standbyforbruget, som svarer nogenlunde overens med miljømærkernes krav. Indholdet af kviksølv og flammehæmmere, forlængelse af levetid samt demonteringsdesign er eksempler på områder, som der stilles krav til i miljømærkerne, men som ikke berøres af IM.

Tabel 1 Forstudiernes, IM og miljømærkernes fokusområder. Den grønne farve illustrerer det primære fokus, mens den gule farve illustrerer det sekundære fokus.

	Forstudierne	IM	EU Blomsten	Nordiske miljømærke	Energy Star	TCO'06
Strømforbrug i tændt tilstand						
Strømforbrug i slukket tilstand						
Strømforbrug i passiv standby						
Strømforbrug i aktiv standby						
Maksimum energiforbrug						
Energieffektivitetsmærke						
Generelle ecodesignkrav						
Demontage						
Levetidsforlængelse						
Kemikalier						
Grønne indkøb						
Informationskrav						
Miljøledelsessystem						

En stærk markedstrend i øjeblikket er, at skærmstørrelserne bliver større og større. Forbrugsmønstret skifter fra mindre forholdsvis energieffektive skærmstørrelser <30" til større skærmstørrelser >40" med større energiforbrug (med mindre der sker teknologiskift). Mens miljømærkerne og Energy Star har taget højde for dette ved at sætte et maksimum krav på henholdsvis 200 W og 108 W i tændt tilstand, har IM har ikke taget højde for denne trend – nærmest tværtimod.

I fjerde del af denne rapport bliver nye teknologier sammenlignet med miljømærkerne og IM. Miljømærkede TV fra Samsung, Sony og Philips er analyseret. Samsung og Philips benytter den nye LED teknologi, hvorimod Sony og Philips har integreret forskellige energisparende funktioner i TV'et for at spare på energiforbruget. Alle TV kan nemt opfylde kravene i IM for standby og tændt tilstand og de øvrige krav i miljømærkerne. **Med andre ord har gennemførelsesforanstaltningerne ikke været i stand til at tage nyudviklede teknologier og nye energisparende funktioner i betragtning og derfor vil kravene heller ikke være innovationsdrivende på miljøområdet.** Derudover har de analyserede TV i 2011, et synligt lavere energiforbrug end kravene i miljø- og energimærkerne foreskriver. Enkelte TV producenter markedsfører TV uden miljømærke, som har lavere energiforbrug end TV med et miljømærke. Dette er problematisk eftersom formålet med miljømærkerne netop er at repræsentere og fremme de bedste produkter.

Derforuden er fjernsyn baseret på velkendte teknologier undersøgt, da det er forventet at disse måtte have sværest ved at kunne overholde kravene i IM. TV fra Samsung, Sony, LG, Grundig, Panasonic og Bang & Olufsen er undersøgt, repræsenterende Full HD og HD ready teknologier, forskellige skærmstørrelser samt LCD og plasma teknologier. Resultaterne er, at 16 af de 35 undersøgte TV kan overholde kravene til strømforbrug i tændt tilstand for 2012. 15 TV kan kun overholde kravene gældende fra 2010 og fire fjernsyn kan ikke overholde nogen af kravene. Med hensyn til krav til standbyforbrug har fire af de seks TV-producenter TV i deres produktportefolie, som kan overholde kravene i 2011, mens alle undersøgte fjernsyn kan overholde kravet, der trådte i kraft i januar 2010.

Konklusion

På baggrund af dette studie af de produktorienterede politikker rettet mod at forbedre fjernsyns miljømæssige egenskaber, så kan der især fremhæves tre hovedkonklusioner, samt en række styrker og svagheder ved især den måde kravene til fjernsyn implementers i EuP direktivet.

Den første hovedkonklusion er, at potentialet i EuP direktivet ikke er blevet udfoldet fuldt ud, idet fokus ud fra en livscyklusvurdering har været på de væsentligste miljøpåvirkninger, hvilket med de givne betingelser har været relateret til energi i brugsfasen. Dette har ført til opstilling af udelukkende energieffektivitetskrav, mens andre forbedringspotentialer ud fra et eco-design rationale er blevet negligeret. Tilsvarende er teknologi- og markedstrends ikke blevet vurderet tilbundsgående, hvilket fører frem til de to andre hovedkonklusioner.

Den anden hovedkonklusion handler om, at hvis målet er energibesparelser, så er EU kravene udformet på en måde, som kun kan betegnes som et selvmål. Tilbage i tiden før 2005 var relativt små skærme på over 21-27" de mest udbredte og havde samtidigt et forholdsvis begrænset energiforbrug under 100W (det tilladte i 2012 for 21" er 54W). Efter 2005 eksploderer markedet for fladskærme imidlertid, og skærme på 42-46" bliver de mest udbredte, og med et tilladt energiforbrug på mellem 180-210W i 2012. I og med at EU udformer energieffektivitetskravene, så at større skærme også er tilladt et større energiforbrug, så betyder markedstrenden med de store skærme, at energibesparelsen rundt regnet (og alt andet lige) er forduftet – eller måske ligefrem at energiforbruget ved TV vil blive større. Konklusionen er derfor, at kommisionen seriøst må overveje forbruger- og markedstrend, hvis de intenderede fordele skal opnås – og ikke opsluges af rebound effekter.

Så galt går det dog nok ikke, idet alt andet ikke kan holdes lige. Den tredje hovedkonklusion handler således om, at den teknologiske udvikling og producenterne er kommet kommisionen til hjælp, idet især LED back-light på fladskærmene betyder, at der i 2012 sælges nye LED TV, som faktisk ligger under det halve energiforbrug af de skærpede krav; hvor de bedste 42" TV har et forbrug på knap 60W, som er 1/3 af det tilladte i det skærpede krav i 2012. De opstillede krav til TV under EuP direktivet har (måske) været med til at øge fokus på energieffektivitet i produktudviklingen af nye fjernsyn, men kravene er allerede i dag tæt på at være forældede på grund af den teknologiske udvikling på området.

Baseret på de gennemførte undersøgelser kan følgende konklusioner om *styrkerne* i IM fremhæves:

- **EuP direktivet vil fjerne de mindst energieffektive produkter fra det europæiske marked.**

Minimumskravene i IM sikrer, at de mindst energieffektive produkter ikke vil blive solgt på det europæiske marked, og at der er et overordnet incitament til producenterne om at fabrikere energieffektive produkter.

- **Energieffektivitetsforbedringer er i fokus, og potentielt kan andre miljøforbedringer inkluderes**

Minimumskravene åbner for muligheden for en forbedret energieffektivitet, og potentielt kan øvrige miljøhensyn inkluderes i de generiske eller specifikke krav i IM. Det vil dog kræve et udvidet fokus i forhold til de nuværende IM.

- **Reguleringen er knyttet til innovation og tilgangen er dynamisk (kravene strammes gradvist)**

Minimumskravene strammes gradvist i henhold til den forventede teknologiske udvikling. På energieffektivitetsområdet for TV kender producenterne kravene fire til fem år, før de træder i kraft. De opstillede minimumskrav bliver revideret regelmæssigt for at tage højde for den teknologiske udvikling, (hvilket parantetisk bemærket i den grad er nødvendigt i forhold til TV).

- **Minimumskrav som i EuP kræver et koordineret samspil med andre politiske redskaber.**

Det er nødvendigt med en evaluering af synergien mellem forskellige politiske redskaber for at finde momentum mellem minimumskrav og markedsincitamenter til frontløbere via miljømærkerne og grønne indkøb.

På den anden side er der også *svagheder og begrænsninger* i den nuværende fremgangsmåde med opstilling af krav til energiforbrugende produkter (EuP):

- **Snævert fokus på energieffektivitet i stedet for miljømæssige forbedringer**

Inspireret af anbefalingerne i forstudierne fokuserer IM udelukkende på energieffektivitet. Åbenlyse miljømæssige forbedringer, såsom ressourceeffektivitet er ikke medtaget i IM. I stedet henviser IM til RoHS og WEEE direktiverne for regulering af kemikalier og affald. Som det eneste inkluderer IM en forpligtelse til producenterne om at informere forbrugeren, hvis TV'et indeholder kviksølv eller bly. Denne informationsforpligtigelse kunne udvides til at inkludere alle kemikalier noteret på listen over særligt problematiske stoffer i REACH forordningen.

- **Fokus på energieffektivitet i brugsfasen i stedet for hele produktets livscyklus**

I forstudierne blev energiforbruget i brugsfasen fremhævet som den største miljøpåvirkning fra et fjernsyn. Derfor fokuserer IM udelukkende på denne fase af produktets livscyklus. Et studie fra European Environmental Bureau fremhæver, at metoden brugt i forstudierne (MEEuP) overestimerer betydningen af brugsfasen på grund af de afgrænsninger der er gjort og den levetid fjernsyn er tildelt i metoden (van Rossem and Dalhammar, 2010). Der kan således sættes spørgsmålstegn ved resultaterne af den udviklede metode til vurdering af et produkts miljøpåvirkning, hvilket tilsyneladende er medvirkende til det yderst ensidige fokus i IM på energi i brugsfasen.

- **Gennemførelsesforanstaltningerne udfordrer ikke relationen mellem energieffektivitet og skærmstørrelse**

Skærmstørrelsen er en af parametrene i ligningen til udregning af kravet for energiforbruget i tændt tilstand, og IM accepterer uden videre at større skærme bruger mere strøm. Dette er et dilemma for energieffektiviteten, idet markedstrenden går mod større og større skærme. Med andre ord, kan de forventede energibesparelser blive modvirket af de større skærme. Det nordiske og europæiske miljømærke har begge taget højde for denne trend ved at sætte krav til et absolut maksimum energiforbrug på 200W uanset skærmstørrelse. Mens Energy Star har sat den øvre grænse ved 108 W. Dette er en udfordring for de fleste fjernsyn over 40", mens nye teknologier, som eksempelvis LED baserede TV kan overholde dette krav.

- EuP processen er for lang

I tilfældet med TV er en EuP arbejdsproces på fire år for lang. Resultaterne af denne rapport viser, at IM ikke har været i stand til at tage den hurtige teknologiudvikling i betragtning, selvom der blev forsøgt taget højde herfor i forstudierne. Reguleringsprocessens hastighed kan øges signifikant ved at opbygge en fælles informationsplatform og evidens base for produktrelaterede direktiver samt ved miljømærker og grønne indkøb.

- Nye teknologier er ikke blevet taget i betragtning

I forstudierne er det forsøgt at inkorporere overvejelser om nye teknologier, hvorfor forstudierne og IM fokuserer på LCD og plasma. Det er dog i denne rapport fundet at forstudierne og IM ikke har kunnet forudse introduktionen af nye teknologier som eksempelvis LED. Dette afspejles i IM og allerede i 2010-11 har mange fjernsyn et strømforbrug i tændt tilstand MARKANT under kravet i IM for 2012.

- IM kunne være mere ambitiøse særligt for krav til energiforbruget i tændt tilstand

Kravene i IM kan være mere ambitiøse på to områder; energiforbrug i tændt tilstand og for andre miljøkrav. Som vist kan tilnærmelsesvist alle undersøgte fjernsyn på markedet i 2011 overholde IM. Derfor vurderes det omkring TV, at IM ikke fremmer miljøvenlig innovation.

Endelig kan der fremføres en række kritikpunkter af mere *perspektiverende* karakter, som handler om det forholdsvis snævre fokus på produkter. Disse forhold har end ikke været overvejet i EU regi, så på den måde ligger de op til en udvidet forståelse af produktets funktion og dets livscyklus. Tre områder kan i denne sammenhæng fremhæves, som bør tages i betragtning ved det fremtidige arbejde med EuP Direktivet især i relation til IKT produkter:

- Produktintegration er ikke medtaget som et potentiale for miljøforbedringer

Der findes mange eksempler på produktintegration på markedet i dag, for eksempel fjernsyn med integreret DVD, USB etc. og inden for de næste år vil Internet og pc-funktionaliteter også blive integreret. Produktintegration er ikke en del af IM, selvom der er potentiale for miljøforbedringer både i forhold til energi- og ressourceeffektivitet.

- Indlejret energi og ressourceforhold er en "blind vinkel" i EuP

Den indlejrede energi i materialerne i et fjernsyn er ikke taget i betragtning. Dette kan fremover være ensbetydende med stigende brug af energiintensive materialer, som for eksempel aluminium. Ligesom sjældne jordarter og

begrænsede ressourcer heller ikke er overvejet. Disse forhold tematiseres først for alvor med EU's Roadmap for Ressourceeffektivitet fra efteråret 2011.

- Pædagogiske elementer er udeladt

Ved de første udkast til EuP direktivet var intentionen, at producenter skulle lave en miljøprofil af deres produkter og lade denne guide det videre arbejde med produktets miljøpåvirkning. Dette blev siden udeladt, og derfor der er således ingen vejledning til producenterne om hvilke aspekter ved produkterne der løbende kan forbedres som for eksempel øget brug af genanvendelige materialer, mv. Tilsvarende er der heller ikke tænkt synderligt i informative virkemidler i forhold til at påvirke forbrugernes sociale praksis omkring anvendelsen af fjernsyn, hvorved nogle oplagte besparelsespotentialer går tabt.

Summary and Conclusions

The focus of this report is the implementation of the EU Directive 2005/32/EC on ecodesign requirements for energy using products (the EuP Directive) with special attention to the ecodesign requirements for televisions (TV). The aim is to investigate the scope of the Implementing Measures (IM), how ambitious the requirements of the IM are, and to what degree they can promote eco-innovations of TVs. In the following the main conclusions are highlighted in bold.

The report consists of five parts:

- Definition of ecodesign
- The EuP process: from preparatory study to Implementing Measures
- The relations between EuP Implementing Measures and the different energy and environmental labelling schemes
- New market and technology trends compared to requirements of Implementing Measures and ecolabelling
- Analysis of the EU Energy labelling scheme for TVs

In the first part, the ecodesign concept is defined as including all environmental aspects in a products entire life cycle. The EU has responded to this approach through integrated product policy (IPP). This approach includes both voluntary and mandatory measures, aiming at either setting minimum requirements or creating incentives for frontrunner companies to move even further.

In the second part, the scope of the recommended requirements of the preparatory study and the IM are compared. The preparatory study takes a comprehensive approach to the environmental impacts of TVs, though strongly emphasising that the most important environmental impact is the power consumption in the use phase. However, **the Implementing Measure has a narrow focus on power consumption of television in standby, off- and on-mode.** The IM followed the recommendations on standby power consumption set forth in the preparatory study. The preparatory study was completed by a consortium considtsinting of five partners, and Fraunhofer IZM as project leader. In the IM the requirement for on-mode power consumption are tightened and the requirement for off-mode slackened compared to the recommnedations in the preparatory study. When it comes to requirements on for instance chemicals and recycling, the IM refer to the RoHS Directive and the WEEE Directive in general terms.

The preparatory study began in February 2006 and the consortium presented the final study in August 2007. The European Commission passed the IM as Commission Regulation in July 2009; and televisions have to fulfil the first requirements from January and August 2010. A EuP process of four years put high demands on the preparatory study and IM to investigate emerging technologies. The preparatory study has to some extent considered obsolete and new technologies. Some obsolete technologies were excluded from the research such as CRTs, and the emphasis was put on technologies that by the consortium were assessed to be market leading in the future such as LCD and Plasma. However, **the preparatory study and IM have not been able to take**

into account new emergent technologies with interesting properties from an environmental viewpoint. For example, TV's based on LED technology are significantly more energy efficient (see Figure 5-1 and Figure 5-3) than the requirement of the IM, and at the same time without mercury, but this technology – with a significant market introduction in 2009 – have not influenced the minimum requirements, since it was assessed too immature to have an influence.

In the third part of this report, the level of ambitions of EuP Directive is investigated by comparing the four ecolabels (European Ecolabel, Nordic Ecolabel, Energy Star and TCO'06) to the IM. The main findings are that the IM have a narrow focus on energy consumption, whereas most of the ecolabels focus more holistically on environmental impacts of the product. As expected, **the Implementing Measures set less strict requirements than all the ecolabels,** except for standby power consumption, where the requirements fit approximately with the ecolabels. Content of mercury, flame retardants as well as life time extension and dismantling are all examples on criteria from ecolabelling that are not dealt with in the IM.

TABLE 0.1 FOCUS OF THE PREPARATORY STUDY, THE IM AND ECOLABELS. THE GREEN COLOUR ILLUSTRATES THE PRIMARY FOCUS AND THE YELLOW COLOUR ILLUSTRATES THE SECONDARY FOCUS.

Subject	Preparatory Study	IM	European Ecolabel	Nordic Ecolabel	Energy Star	TCO'06
Power consumption on-mode						
Power consumption in off-mode						
Power consumption in passive standby						
Power consumption active standby low						
Maximum energy consumption						
Energy efficiency label						
General eco-design requirements						
Dismantling						
Life-time extension						
Chemicals						
Green procurement						
Information requirements						
Environmental Management system						

A significant market trend is towards bigger and bigger flat screens. The consumption pattern is changing from small, rather energy efficient screens <30" to large screens >40" with high energy consumption. The IM is not considering this market trend, while the ecolabels and the Energy Star have put a maximum of 200 W and 108 W, respectively, as an upper limit for energy consumption.

In the fourth part, new technology trends are compared to ecolabels and IM. Ecolabelled TVs from Samsung, Sony and Philips are anlysed. Samsung and Philips make use of the new LED technology, whereas Sony and Philips have implemented different energy saving functions in order to reduce power consumption. All brands can easily comply with the IM regarding on-mode and standby power consumption and with the other demands of ecolabels. In other words, **the Implementing Measures have not managed to take into account emergent technologies and new energy efficiency functions, and therefore the requirements will not be a direct trigger for eco-innovations.**

Furthermore, the TVs analysed in 2011 have visibly lower power consumption than the requirements of the ecolabels and some brands have non-ecolabelled TVs, which perform better than the ecolabelled TVs. This is challenging since the purpose of the ecolabels is to represent the best performing products.

Furthermore, TVs based on well-known technologies are investigated as they could have difficulties in complying with the IM. TVs from Samsung, Sony, LG, Grundig, Panasonic and Bang & Olufsen are analysed, representing both full HD and HD ready technologies, different screen sizes and plasma and LCD technologies. The findings are that 16 of the 35 investigated TVs can comply with the 2012 requirements for on-mode power consumption. 15 TVs can only comply with the 2010 requirement and four cannot comply with any of the on-mode power consumption requirements. With regards to standby power consumption, four of the six TV manufacturers have TVs in their product portfolio, which can comply with the 2011 requirements, and all analysed TVs can comply with the standby requirements that came into force January 2010.

The final chapter of the report analyses the requirements of EU's mandatory energy labelling scheme for TVs. The labelling scheme includes all TVs on the market and allocates a label from A+++ to G to TVs depending on their energy efficiency. It is interesting to note that also in this scheme the EuP IM are clearly minimum requirements, as the products that just can comply with the IM have low efficiency labels. Also it is interesting that the schemes' most efficient labels demand significantly higher energy efficiency than ecolabels,. However, the time span of the EU energy-labelling scheme is also longer than any of the ecolabels.

Conclusion

Based on this study of the product-oriented policies in the EU regarding the improvement of TVs' environmental properties, three main conclusions will be hightlighted as well as some strengths and weaknesses especially regarding the way the requirements are set up in the EuP Directive.

The first main conclusion is that the potential of the EuP Directive has not been fully realized, since the focus based on a life cycle assessment has been on the most significant environmental impacts, which from delimitations of the study has been related to energy consumption in the use stage. On this background, only requirements related to energy efficiency have been set up, while other improvement potentials based on an ecodesign rationale have been neglected. In the same way, the technology and market trends have not been carefully investigated, which leads to the following main conclusions.

The second main conclusion is, if the overall objectives of the EU are energy savings, then the minimum requirements have been set up in a way that makes this rather unlikely. Before 2005, televisions were rather small with screens between 21"-27" as the most common, and with relatively low energy consumption below 100W (the required in 2012 for 21" is 54W). After 2005 the market for flat screens "exploded" and screens between 42"-46" has today become the most common, and with a maximum allowed energy consumption between 180-210W in 2012. In other words, since EU has set up the requirements in a way that allows bigger screens to have a bigger energy consumption, then the market trend with bigger and bigger screens turned on for longer periods means that the energy savings have

"disappeared" (all things being equal) – or perhaps even that the energy consumption from TVs will grow. The commission seriously needs to investigate the consumer and market trends, if the intended potentials of energy savings shall be achieved – and not be counteracted by rebound effects.

These risks are however marginal, since everything else can't be kept equal. The third main conclusion is that the technological development and the manufacturers have secured that the energy savings potentials can be achieved. Especially, the development of LED backlight ultra-thin flat screens means significant energy efficiency of the new TVs. In 2012 the requirements in the IM on TVs are tightened significantly, but already in 2011 the energy efficiency of the major brands were easily able to comply with the new requirements as energy consumption was just half of the tightened requirements. One of the best performing 42" TVs had in fact an energy consumption of nearly 60W, which is around 1/3 of what is allowed with the tightened requirements. The requirements of the EuP Directive has (perhaps) been part of getting more focus on energy efficiency of TV, but the requirements are today close to being outdated due to technological developments.

Based on the investigations, the following conclusions on the *strengths* of the IM are emphasised:

- The IM will expel the most energy inefficient products from the European market

The minimum requirements of the IM will ensure that the most energy inefficient products are not sold on the European market.

- Improvement of energy efficiency is the core focus, and potentially environmental improvements could be included

Regulation with minimum performance standards opens up for improvement of energy efficiency. Potentially, environmental improvements can be incorporated in the requirements as well, but this will require a change of the current scope of IM.

- Regulation is connected to innovation and with a dynamic approach (gradually stricter requirements)

The minimum performance requirements are gradually tightened according to the expected technological development. In the case of energy efficiency of TV, the manufacturers will know the standards four-five years ahead. The EuP Directive and the IM are also revised on a regular basis to grasp the technological improvements.

- Minimum performance demands as in EuP requires a coordinated interplay with other policy instruments

An evaluation of the synergy between the different policy instruments is needed in order to find the momentum between minimum performance requirements (IM) and market incentives to frontrunners as in the case of ecolabelling and green procurement.

On the other hand, there are also weaknesses and limitations in the current approach to EuP:

- Narrow focus on energy efficiency instead of environmental improvements

Based on recommendations from the preparatory study the IM only focuses on energy efficiency. Obvious potentials for environmental improvements for instance on resource efficiency are not included. The IM refer to the RoHS and WEEE Directive for matters concerning chemicals and recycling of TVs. The IM already require producers to inform the consumers if the TV contains mercury or lead. This information requirement could be expanded to cover all the Substances of Very High Concern of the REACH regulation.

- Focus on energy efficiency in the use phase instead of the entire life cycle of the TV

In the preparatory study, energy consumption in the use phase was highlighted as the most important environmental impact of TV. Therefore, the IM exclusively focus on this phase of the products life cycle. In a recent study by the European Environmental Bureau, it is argued that the MEEuP in the case of televisions, computers and monitors the methodology is overestimating the use phase, due to the boundaries of the methodology and the life span applied (van Rossem and Dalhammar, 2010). It is unfortunate, if it is possible to question the results of the very method used for assessing the products environmental impact, and that it possibly is the reason for the IM narrow focus on the use phase.

- The IM does not challenge the relation between energy efficiency and screen size

The screen size is one parameter in the equation for calculating the power consumption requirement, and IM accepts that larger screens use more power. This is a dilemma in terms of energy improvements due to the significant market trend towards larger screen sizes. In other words, the energy saving potentials due to the energy efficiency requirements in IM can be counteracted by the bigger TV screens. Both the Nordic and the European Ecolabel has taken this into account and set a maximum power consumption of 200 W, whereas the Energy Star has set the upper limit to 108 W. This is a challenge for most screens bigger than 40'', but new technologies such as LED are able to comply with the requirement.

- The EuP process is too long

In the case of TVs, a EuP work process of four years is too long. From the findings of this report it is clear that the IM have not been able to take into account the fast technological development, even if it was considered in the preparatory studies. The speed of the process needs to be improved significantly for instance through building up a common information platform and evidence base for EuP, ecolabels and green public procurement.

- Emergent technologies have not been taken into account

In the preparatory study, the authors have tried to incorporate considerations on emergent technologies, and therefore the study focuses on LCD and Plasma. However, as shown in this study, the EuP preparatory study and IM has not foreseen the market introduction of emergent technologies such as LED. Hence the IM do not reflect these new technologies and many TVs have already today on-mode power consumption significantly lower than the requirements for 2012 of the IM. Naturally, it is a balance which technologies that should set the standard as for what can be considered a minimum environmental performance. On one hand new technologies should be included in order to constantly follow the technological development and update the requirements accordingly. On the other hand smaller producers do often not have access to the new technologies as soon as the bigger producers

and if minimum requirements are set too high to soon because of new technological developments there is a risk that smaller producers are excluded from the market.

- The IM could be more ambitious especially regarding on-mode power consumption

The IM can be more ambitious on two points; on-mode power consumption and other environmental requirements. As shown, almost all the analysed TV on the market today can already comply with the IM, and therefore the regulation will not promote eco-innovations directly.

Finally, based on the experience gained from this study at least three issues can be highlighted that future work related to EuP has to take into account:

- Product integration is not considered as a potential for environmental improvements

Today, tendencies towards product integration are present such as TV with DVD, USB, etc. integrated, and within the next years integration with computers and the internet will be common. Product integration is not reflected in IM, even though this could have potentials for environmental improvements both in terms of energy efficiency and material savings.

- Embedded energy is another "blind spot" in EuP

The embedded energy in the materials applied in TV is not taken into account, which can become significant in the future with the increasing use of high energy intensive materials such as aluminium, etc.

- Pedagogical elements are left out

Since the first drafts of the EuP Directive the intention of having the manufacturers make an eco-profile of their products and let this guide the design solutions has vanished. Now the manufacturers only have to take into account the requirements of the IM and are no longer forced to learn more about their products' life cycle impact on their own. See also (van Rossem and Dalhammer, 2010).

1 Ecodesign

Once a product leaves the production facilities the producer has little influence on how the product is being used and its environmental impact. However, through smart design of the product, where the producers in the design phase integrate environmental considerations of the product's entire life cycle, the producers do have the opportunity to influence the product's environmental impact after it leaves the factory. This integration of environmental criteria in the design is also called ecodesign.

Basically, ecodesign means environmentally conscious product development (Tischner, 2006). In practice, environmental considerations are added to the other considerations in the design of new products such as economic, safety and quality issues. Ecodesign covers the product's entire life cycle, from the extraction of raw materials, production, transport, use, recycling and disposal. All relevant environmental properties should be addressed, including material and energy efficiency, emissions and hazardous substances. The aim of ecodesign is to fulfil a need with the least environmental impact, meaning that the function of the product should be the point of departure for product development (Tischner, 2006).

One of the first guidelines for businesses on how to do ecodesign was made in 1997 by Han Brezet and Carolien van Hemel (Brezet and van Hemel, 1997). The authors presented the ecodesign strategy wheel, which visualises the steps and strategies that can be followed in ecodesign (see Figure 1-1).

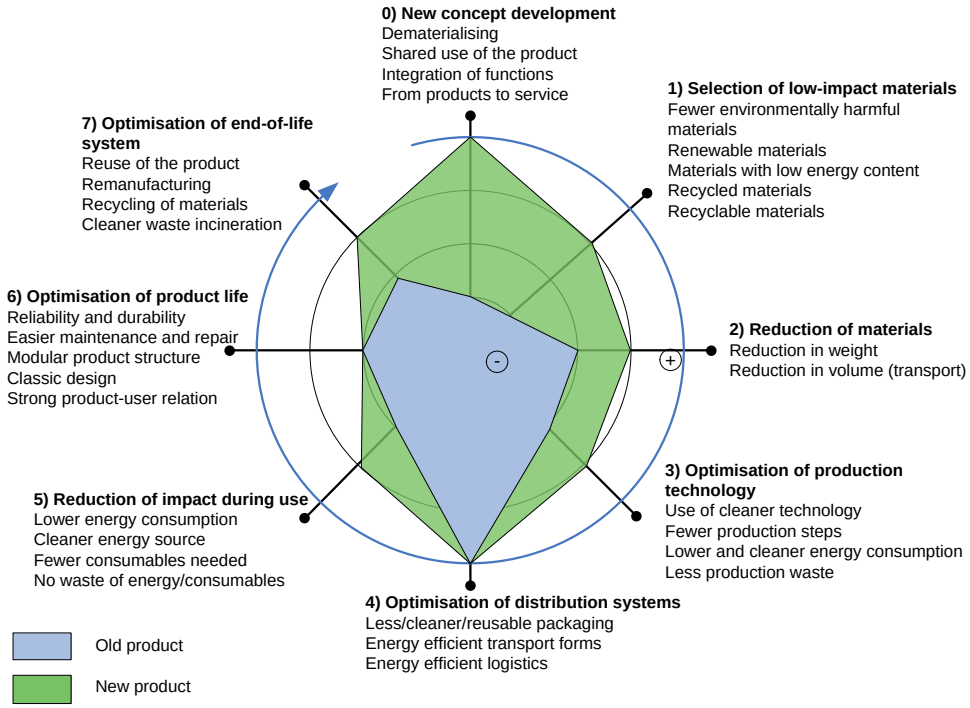

Figure 1-1 The ecodesign strategy wheel (Brezet and van Hemel, 1997)

From Figure 1-1, life cycle thinking in ecodesign becomes visualized, and the different strategies are highlighted in order to improve the environmental

properties of the product at different stages. The centre of the figure is a spider web, illustrating the environmental profile of the product. In this case the blue shape illustrates the profile of the existing product and the green shape the new ecodesigned product. Right from the beginning, eco-design has focused on improvement potentials of products and services, and not just on analysis of the environmental impacts as in life cycle assessment.

1.1 Integrated Product Policy

The EU has introduced life cycle thinking in their Integrated Product Policy (IPP) that was developed in cooperation between the Commission and stakeholders in the late 1990's. IPP was first discussed at a meeting in 1998 and is based on five key principles. The first is *life cycle thinking* and means considering the entire product life cycle and its environmental impacts. This aims at considering both the cumulative environmental impacts and avoiding burden shifting, where environmental impacts in a single life cycle phases are addressed with the result of increasing the impact in another life cycle phase. IPP is an integrated approach aiming at promoting measures to reduce the environmental impact of products at a point where this is most effective. (European Commission, 2003a)

Further key principles of IPP are:

- *Working with the market* meaning that IPP should create incentives for business to be innovative and forward thinking.
- *Stakeholder involvement* means that IPP should encourage all stakeholders e.g. industry, consumers and governments to use their influence in promoting greener products.
- *Continuous improvement*, where business can set the pace, rather than setting specific limits and goals.
- *A variety of policy instruments* is the final principle. The instruments to be used within IPP are manifold from voluntary initiatives to regulations. (European Commission, 2003a)

IPP was introduced by EU as a reaction to the fact that the quantity, variety and complexity of products is increasing, new types of products are constantly introduced to the market and products are now more than ever traded globally. This means that more actors are involved throughout the products' lifetime and have an influence on the environmental impact of the product. (European Commission, 2003a)

1.1.1 Implementation of IPP

Since the IPP approach was first introduced several legislations have been implemented. In particular three Directives are relevant for this report:

- Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- Directive 2002/96EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE)
- Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products (EuP)

The three legislations have been implemented in different ways, and some more successful than others. When adopting new or revising existing legislation it is a constant concern not to introduce double regulation, where several legislations regulate the same issue. It is a subtle balance to develop regulations on issues closely related without confusing regulators, businesses and consumers. In the following the aim and actual implementation of the three directives is briefly described. The purpose is to illustrate the synergies and lack thereof between the three regulations and hence investigate if double regulation is a problem.

The RoHS Directive

The RoHS Directive restricts the use of certain chemical substances in electronic and electrical equipment. The restriction concerns cadmium, lead, mercury, hexavalent chromium, poly-brominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE), in quantities exceeding maximum concentration values. The aim of the Directive is in this way "*to contribute to the protection of human health and the environmentally sound recovery and disposal of waste electrical and electronic equipment"* (European Commission, 2003b, p. 1). If electrical and electronic products do not comply with the Directive, the products are not allowed to be sold in the EU, and the national authorities are cooperating on spotting such products and removing them from the market (Europa, 2008).

According to the Commission the RoHS Directive has prevented several thousand tonnes of the prohibited substances from being placed in the products and design practices in this matter have changed also in countries outside the EU. However, compliance checks in EU member states have revealed that up to 44% of the EEE that was checked for compliance does still not comply with the Directive. (European Commission, 2008)

The WEEE Directive

The WEEE Directive sets marking requirements to producers and importers and establishes an individual producer responsibility for the take-back and treatment of WEEE. The latter makes the producer economically responsible for the take-back and environmentally friendly treatment of WEEE. The producer can comply with this regulation individually or by joining collective schemes. The WEEE directive also sets requirements as to the recovery rates of the products in scope. The purpose of the WEEE Directive is, *"as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment"* (European Commission, 2003c: art. 1).

The idea behind the Directive is to make the producer responsible for the end of life stage of their products. In principle, this gives an economic incentive for the producer to integrate considerations about the product's end of life phase and recycling options in the design phase of the product. A recent study has however revealed that only seven member states have fully implemented the individual producer responsibility and seven member states have ignored the implementation of the individual producer responsibility completely (van Rossem and Dalhammar, 2010). In the latter countries the producers can join collective schemes, where they are not financially responsible for the take-back

of exactly their products, but the payments are based on averages. In these member states, the incentives for ecodesign are diminished significantly (van Rossem and Dalhammar, 2010), and it is questionable whether the WEEE Directive serves its purpose on ecodesign at all.

The EuP Directive

The EuP Directive establishes a framework for setting ecodesign requirements for energy using and energy related products. The ecodesign requirements are set up in implementing measures. The objective of the Directive is to ensure free movement on the market of products in compliance with the ecodesign requirements and *"it contributes to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply"* (European Commission, 2009a: art. 1.2).

Analysing the implementation of the Directive, then the focus in the Implementing Measures is highly towards only setting requirements for the energy consumption in the use phase, and hence not at all on an integrated life cycle thinking. A more thorough analysis of the implementation of the Implementing Measures for televisions is presented in Chapter 3 of this report. Based on findings in this study and the study of van Rossem and Dalhammar (2010) it can be argued that the EuP Directive does not fulfil the objective of the Directive, as it does not set up requirements for more than energy efficiency in the use phase.

The three directives focus rather narrowly on different aspects: hazardous substances, waste and energy consumption. Plus different product stages are in focus: choise of materials in the design stage, handling of waste at the end of life stage, and energy efficiency in the use stage. These different focuses are further strengthened by involving different professionals that are even employed in different agencies. This can be illustrated as in Figure 1-2.

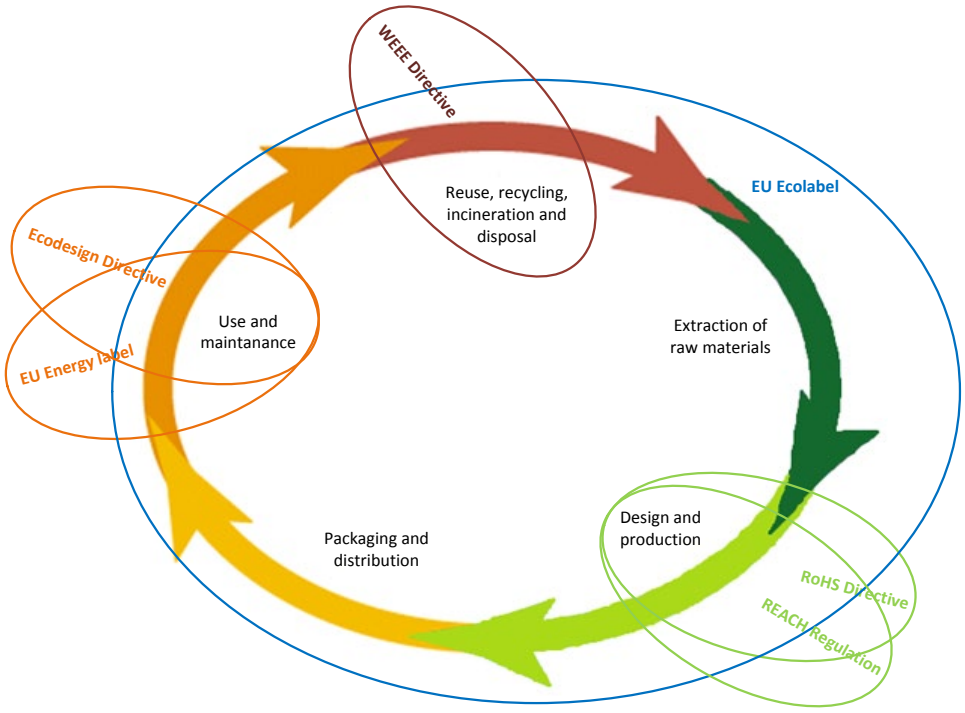

FIGURE 1-2 THE FOCUS AREA OF THE DIFFERENT REGULATIONS

In other words, the common objective on ecodesign – environmental improvement in all life cycle stages – has faded away, and in stead each directive focus on one issue and in one life cycle stage. This creates a challenge of securing synergy between the different directives and avoiding double regulations as well as obtaining the linkage between legislative regulations with minimum requirements and voluntary measures with incentives for front-runners.

Synergy between the three directives

It is a balance on the one hand to develop regulations that regulate the environmental impacts of products in a life cycle perspective and on the other hand not to create inexpedient double regulation. However, the objective of the EuP Directive cannot be fulfilled without looking at the entire life cycle of the product and setting requirements to several environmental impact categories.

From the above overview, especially the WEEE Directive does not fulfil its objective on ecodesign, and more specific requirements on design for recyclability, etc. can be put forward in the EuP Implementing Measures without compromising with the current WEEE Directive. The RoHS Directive has to some degree fulfilled its objectives, but improvements can be made. If chemical requirements should be included in the IM it could be with references to the existing regulation and/or it could be an information requirement on the chemical content of the product.

As the existing regulations only to some degree fulfil their objectives regarding eco-design it is our assessment that the EuP Directive, without compromising with other regulations, could encompass requirements on the environmental impact of the entire life cycle of the products. This can also be done without creating confusion among regulators, producers and consumers.

As indicated in Figure 1-2 above, two other policy instruments are important: the EU mandatory energy label and the different ecolabels.

Synergy between the Directives, Energy-labelling and Voluntary Measures

The EuP, RoHS and WEEE Directives are the mandatory legislations, but also Energy-labelling has become mandatory for most electronics. The European Ecolabel, the Nordic Swan and Green Public Procurement are all voluntary measures. The intention is that both mandatory and voluntary measures are needed to create incentives for production and marketing of cleaner products. The mandatory measures set minimum requirements (except WEEE), whereas voluntary measures focus on criteria that go beyond compliance and create incentives for front-runners.

In this report the EuP requirements of the Implementing Measures for televisions are compared to the requirements of the different ecolabels for televisions. The intention is to see how a synergy can be created between the minimum requirements in EuP and the criteria for ecolabelling – in other words, how to strike a balance between minimum requirements that expel product with bad performance from the market and then criteria that give a competitive edge to the "good guys" in industry. The two policy instruments aims at completely different target groups and serve different purposes, but still a the relation between minimum requirements and criteria for eco-labelling is important in order to create synergy and fullfill the overall aim of

the different policy instruments. Figure 1-3 illustrates the scope for the two types of policy measures.

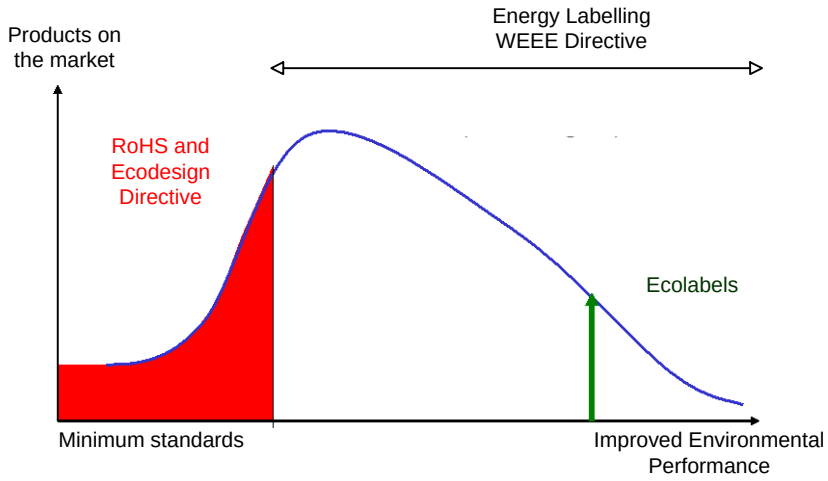

FIGURE 1-3 SCOPE FOR DIFFERENT IPP MEASURES

As Figure 1-2 illustrates, RoHS and EuP set minimum standards for products' environmental performance, thereby removing the worst performing products from the market. On the other side of the scale the ecolabels set criteria with the aim that only the best performing products on the market can fullfil. The ecolabels are continuously updated and tightened to ensure that only the best performing products can comply with the requirements. In this way the ecolabels create incentives that push the market towards more environmentally friendly products. The Energy Labelling covers the entire span of products on the market with the aim of informing the consumer of the performance level of the given product. The specifics of the Energy Labelling are analysed in Chapter 6.

The comparison of the IM and ecolabels is made in order to analyse, which environmental aspect the ecolabels have setup requirements for and which are not regulated in the IM of the EuP Directive. By applying the approach it is acknowledged that behind the ecolabels lies years of work and experience with setting environmental requirements that could have been utilised in the process of setting requirements in the IM.

2 Preparatory Study LOT 5 – Consumer Electronics: TV

In this chapter the preparatory study of televisions is analysed. The aim is to assess, which environmental impact categories were included in the IM for televisions, and to analyse how these requirements were set up.

2.1 Description of LOT 5

The preparatory study on LOT 5 Consumer Electronics: TV was launched in February 2006 and the final report was published in August 2007. A consortium consisting of five partners completed the study. Fraunhofer IZM was the project leader; further partners were Öko-Institut, BIO Intelligence Service, Deutsche Umwelthilfe, PE Europe, and CODDE. (ecotelevision, 2010).

The preparatory study for LOT 5 consists of the following eight tasks:

- Task 1 "Definition"
- Task 2 "Economic and Market Analysis"
- Task 3 "Consumer Behaviour and Local Infrastructure"
- Task 4 "Technical Analysis"
- Task 5 "Definition of Base Cases"
- Task 6 "Technical Analysis BAT"
- Task 7 "Improvement Potential"
- Task 8 "Scenario, Policy, Impact, and Sensitivity Analysis"

Throughout the process relevant stakeholders among others the European Information & Communications Technology Industry Association (EICTA), Sharp, Pioneer and Panasonic were consulted, and they provided data and input to the study and gave comments on drafts before final publication. In each task the authors have published the stakeholder comments and commented them. The specific methodology for the study will not be elaborated in detail here, but a complete presentation is available on the European Commission's homepage http://ec.europa.eu/enterprise/eco_design/ecodesign.htm.

In Task 1 the authors investigated and defined the products in scope of the LOT 5. By investigating existing product categories and definitions for instance from ecolabels it was found that a homogeneous picture does not exist. On the contrary, a television (TV) can include many different functions and equipment types, and can be combined in several ways. This complexity is illustrated in Table 2.1.

Table 2.1 TV functions and typical equipment types. From (Stobbe, 2007a, p. 15)

Function	In Scope of Lot 5			Not in Scope of Lot 5	
	TV Set	TV/Video Combo	TV Component Unit	TV Peripherals	TV Capable
Receiver				Set-Top-Box stand-alone	PC accessory Mobile
Monitor				PC-Monitor Video Beamer	PC Media Laptop Mobile
Speaker				Audio-System stand-alone	
Video				VCR/DVD stand-alone	

The scope of the LOT 5 is TV sets, TV/Video combination units and TV component units. Stobbe (2007a) argues that TV sets are the most economically significant product category[1] and therefore the main focus of the study. TV/Video combination units and TV component units are also within scope of the study as they are in widespread use. By including the TV component units LOT 5 recognises a modular approach to TVs. The study argues that it can be included as among other the Energy Star program includes the component units as a system if they can meet the same criteria as a stand alone TV. (Stobbe, 2007a)

After determining the scope of LOT 5, Stobbe (2007a) investigated the technical parameters that influence the environmental impact of the product. Especially, differentiation of the different display technologies and screen sizes are significant when measuring the TV's environmental impact. Stobbe (2007a) therefore differentiated between "self-emissive displays", such as Cathode Ray Tubes (CRT) and Plasma Panel Display (PDP) and "non-self emissive displays" such as Liquid Crystal Display (LCD) and Rear Projection (RP). In order to include the importance of the screen size the authors have divided the screen sizes into different ranges. (Stobbe, 2007a) See Table 2.2. The table shows the full range of TV screen sizes, but X-small and X-large are not in the scope of the study.

Table 2.2 Differentiation between screen sizes and display technologies. From (Stobbe, 2007a: p. 45)

	X Small <14"	Small 14" – 26"	Medium 27" – 39"	Large 40" – 65"	X Large >65"	
Self-Emissive Display		CRT		PDP		TV set/unit TV/Video
Non-Self Emissive Display		LCD		RP		TV set/unit TV/Video
		Standard Resolution		Advanced Resolution		

Based on these findings Stobbe (2007a) focuses on two base cases; a 32" LCD-TV and a 42" PDP-TV. By selecting these to types of TVs the

[1] In 2005 more than 31 Million units where sold in the European Union, representing a value of more than 18 Billion Euro (Stobbe, 2007a, p. 14).

most prominent flat panel display technologies in the respective screen size are covered according to Stobbe (2007a). The products have been selected on the basis of expected future sales, as it would not represent a valid picture of the future environmental impacts if the investigation only focused on the products available on the market in 2006. Hence, the technologies CRT and RP are less important for the preparatory study as the CRT's are being phased out and the RP is not considered to have a growing market as are the LCD and PDP technologies. (Stobbe, 2007a)

2.2 Preparatory study on LOT 5

In the preparatory studies for LOT 5 five different areas have been identified as having an influence on TV sets' environmental impact (Stobbe, 2007c):

- Power consumption in on-mode
- Power consumption in standby
- Introduction of an energy efficiency label
- General eco-design requirements
- Chemicals

Furthermore, Stobbe (2007c) recommends requirements regarding environmental information and green procurement on the product. The authors recommend requirements for each of the mentioned areas, but it is strongly emphasising that the energy consumption has the most significant environmental impact (Stobbe, 2007c). In the following the seven areas will be elaborated

2.2.1 Power Consumption in On-mode

According to the study, the power consumption in the use phase is the cause of the primary environmental impact of TVs. In the study it is pointed out that in the past years power consumption in the use phase in European households has increased and reference is made to studies that show that it will continue to increase. Two reasons are emphasised: European households tend to increase the number of TVs in the household, and two TVs in every household in 2010 is feasible. The other reason for increased power consumption is the introduction of flat panel display (FPD) technologies, such as LCD and PDP, the higher resolution and picture quality and the increasing screen sizes. (Stobbe, 2007c)

Stobbe (2007c) recommend a two-tier approach, i.e. the industry is given two years from the time the requirements are adopted to the time they enter into force. This should give the industry enough time to develop the technology and redesign their products. Furthermore, Stobbe (2007c) recommend differentiating between High Definition (HD) ready and full HD due to the novelty of the full HD technology. (Stobbe, 2007c)

The recommendation for minimum requirements is expressed in an equation, which consists of four elements; the screen size in square inch (a_{Screen}) multiplied with 0.275 W/in^2, which is the calculated power consumption of 1 square inch screen surface area. A constant value (40W) for the power consumption of the receiver is added and finally a value ($P_{feature}$) can be added in case the TV includes additional features, for instance digital tuner or DVD/VDR.

The recommendation for tier 1 for HD ready TV is:
PTVon, minimum req. HD-ready = a_{Screen} · 1 · 0.275 W/in² + 1 · 40 W + $P_{feature}$

Whereas the recommendation for tier 1 for full HD TV is:
PTVon, minimum req. full HD = a_{Screen} · 1.4 · 0.275 W/in² + 1 · 40 W + $P_{feature}$

An example of how to calculate the $P_{feature}$ is given in the preparatory study (Stobbe, 2007c):

$P_{feature}$ = $n_{feature}$ (number of additional functions)* P_{basic}/10

where
$n_{feature}$ = 3 (DVB-S, HDR, W-LAN)
P_{basic} = 40 W

<=>
$P_{feature}$ = $n_{feature}$ (3)* 40/10
$P_{feature}$ = 12 Watt

For further explanation of the equation, please see the LOT 5 preparatory studies, Task 8.

In Figure 2-1 the recommended minimum requirements for power consumption in on-mode are illustrated.

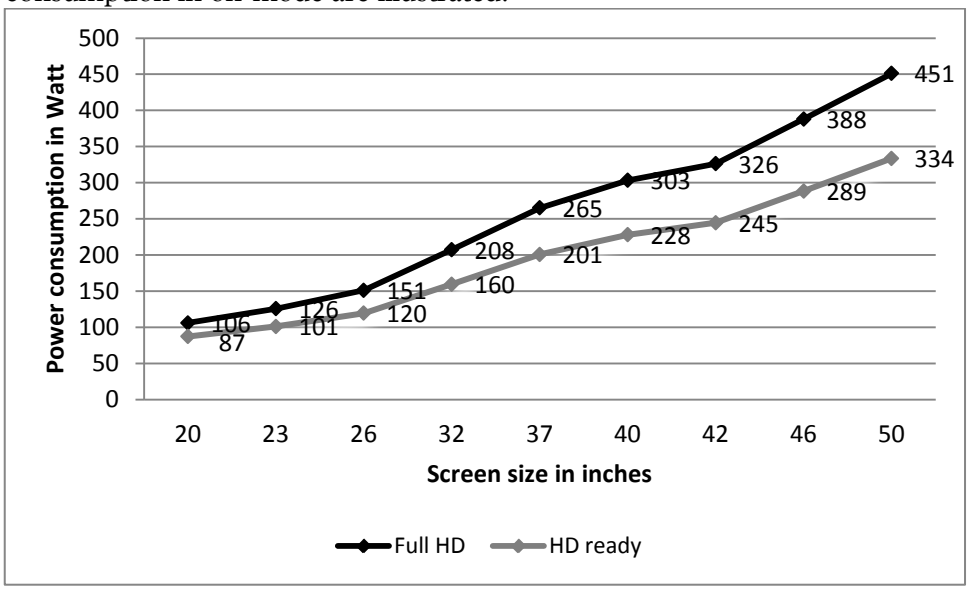

FIGURE 2-1 RECOMMENDED MINIMUM REQUIREMENTS FOR POWER CONSUMPTION IN ON-MODE BY THE PREPARATORY STUDY. BASED ON (STOBBE, 2007C).

Finally, Stobbe (2007c) recommend applying the IEC 62087[2] dynamic broadcast-content video signal test method when testing the on-mode power consumption of TVs. It is also recommended that the EIC standardization body should include the definition of a "standard mode" in which the TVs on-mode power consumption should be measured. For instance, in the current definition, the standard does not define how the contrast and brightness should be adjusted; both of which influences the power consumption in on-mode. (Stobbe, 2007c) There are no recommendations the default setting being the most energy efficient mode.

[2] IEC is the International Electrotechnical Commission (International Electrotechnical Commission, 2010)

2.2.2 Power Consumption in Off-mode and Standby

Stobbe (2007c) recommends setting up minimum requirements for off-mode and three types of standby. The two types of standby are: passive standby[3] and active standby low[4]. Also for these requirements a two-tier approach is recommended, where tier 1 requirements should not come into effect earlier than two years from the publication in the Official Journal, and tier 2 should come into effect two years after the tier 1 requirements come into effect. Table 2.3 lists the recommended requirements.

Table 2.3 Recommended minimum requirements for power consumption in off-mode and standby (Stobbe, 2007c p. 30-33).

	Preparatory Study
Off-mode tier 1	Compliance in 2010: ≤ 0,5 W
Off mode tier 2	Compliance in 2012: ≤ 0,2 W
Off mode	Primary hard off switch (0 W) is optional
Passive standby tier 1	Compliance in 2010 ≤ 1 W
Passive standby tier 2	Compliance in 2012 ≤ 0,5 W
Active standby low tier 1	Compliance in 2010 ≤ 3 W
Active standby low tier 2	Compliance in 2012 ≤ 2 W
Active standby low tier 3	Compliance in 2015 ≤ 1 W
	Automatic transition into active standby low after the main function ended

2.2.3 Introduction of an Energy Efficiency Label

The introduction of an energy efficiency label is recommended in order to promote the best performing products, stimulate the market and give the industry further incentives to improve the energy efficiency of their products. The authors argue that the trend is towards an increase in power consumption in on-mode rather than a decrease, therefore the energy efficiency label is recommended as a supplement to the minimum requirements. (Stobbe, 2007c)

The energy efficiency label should only focus on the on-mode power consumption, and it is recommended to base the label criteria on an equation that considers the screen size similar to the equation set for the minimum requirement for power consumption in on-mode. (Stobbe, 2007c)

2.2.4 Chemicals

The study emphasises the importance of compliance with the RoHS Directive 2002/95/EC. Further, it is recommended that the development of new technologies should focus on reducing potentially hazardous substances in the products. However, this should not be at the expense of the energy efficiency as power consumption is the most significant environmental impact of the product. (Stobbe, 2007c)

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[3] Passive standby is defined as: Reactivation; remote control reactiviation, self reactivation (e.g. timer), switch reactivation and continuos functions; information/status display, energy for information storage, sensor-based safety functions. (Stobbe, 2007b)

4 Active standby low is defined as: Network integrity communication (e.g. search for channels or software updates), wake-up over network (e.g. reactivation for program download recording). (Stobbe, 2007b)

Table 2.4 lists the recommended requirements for chemicals in TVs. The RoHS Directive 2002/95/EC exempts the use of mercury in certain applications. Therefore the requirements focus on information to the consumer rather than prohibition of substances. (Stobbe, 2007c)

Table 2.4 Recommended requirements for chemicals in TVs (Stobbe, 2007c: p. 40-41).

	Preparatory Study
Substances regulated in the RoHS Directive 2002/95/EC	Components must comply with the RoHS Directive 2002/95/EC
	The cover of the Back Light Unit (BLU) should indicate the contents of mercury
	For PDP and CRT: As long as the execemption under RoHS is valid, it is recommended to require a declaration of the lead content in the Plasma Display

2.2.5 General Eco-design Requirements

The study recommends specific eco-design requirements solely regarding chemicals in TVs – see section 1.2.4. On a more general level the study recommends that the standard ECMA 341 – *Environmental Design Considerations for ICT and CE Products* or IEC 62430 - *Environmentally conscious design for electrical and electronic product* is considered when setting general eco-design requirements. However, as the two standards focus on Information and Communication Technologies (ICT) and Consumer Electronics (CE) in general, the development of a more detailed eco-design guidance document based on the findings of the preparatory study is recommended. The guidance document could include guidance on mandatory requirements. (Stobbe, 2007c)

2.2.6 Green Procurement

In connection with the requirements of the RoHS Directive, the authors recommend that industry applies green procurement procedures and investigate RoHS compliance of their purchased components. (Stobbe, 2007c)

2.2.7 Environmental Information

The final recommendation for requirements concerns environmental information, which the industry should make available to the consumers and the recycling industry, respectively. Table 2.5 lists the information, which the industry should make available.

Table 2.5 Recommended information requirements (Stobbe, 2007c).

Preparatory Study
Mandatory energy efficiency labelling
Mode-specific power consumption data in sales advertisements and user manuals
Rated power consumption in user manuals
Explanations of power modes and energy saving options in user manuals
Warning of mercury content in baclights (to the recycling industry)

2.2.8 Overview of Recommended Requirements

Table 2.6 presents an overview of the recommended requirements. For clarity reasons, the detailed description of the requirements is not presented here. Instead colours indicate the areas in which the study has recommended setting

requirements. The green colour illustrates primary focus of the study and the yellow colour illustrates the secondary focus.

Table 2.6 Overview of the recommended requirements

Subject	Preparatory Study
Power consumption on-mode	
Power consumption in off-mode	
Power consumption in passive standby	
Power consumption active standby low	
Introduction of energy efficiency label	
General eco-design requirements	
Chemicals in products	
Green procurement	
Information requirements	

The preparatory study has a strong focus on energy efficiency both in on-mode, standby and off mode see Table 2.6. The study emphasised several times that energy consumption is the most significant environmental impact, compared to the other mentioned areas.

In the process of analysing the potential requirements, Stobbe has investigated both the existing technology, and the technology assessed to be most used in the future. Therefore, the primary focus was put on the LCD and PDP technology, whereas the CRT technology has been analysed as a reference product.

However, some emergent technologies have not been given the necessary attention in the study, and these technologies have gained in importance on the market shortly after the study was completed. Especially, the LED technology used as backlight system in LCD TV's would have been relevant to analyse in depth the preparatory study, as this technology has a significant improved energy efficiency compared to PDP and traditional LCD. The OLED technology is also an energy efficient technology, which has not been investigated in depth. This technology is, however, still mostly used in small display equipment, which is not in the scope of the study.

3 Implementing Measures: TV

In this chapter the Implementing Measures (IM) are analysed and compared to the recommendations of the preparatory study. The aim is to investigate to what extent the IM follow the recommendations of the preparatory study.

The IM for TVs was passed as Commission Regulation (EC) No 642/2009 of 22 July 2009. The scope of the IM is TVs, including both TV monitors and TV sets. (European Commission, 2009c)

The Directive defines a TV monitor as "*a product designed to display on an integrated screen a video signal from a variety of sources, including television broadcast signals, which optionally controls and reproduces audio signals from an external source device, which is linked through standardised video signal paths including cinch (component, composite), SCART, HDMI, and future wireless standards (but excluding non-standardised video signal paths like DVI and SDI), but cannot receive and process broadcast signals".* (European Commission, 2009c, art. 2.3)

TV sets are defined as *"a product designed primarily for the display and reception of audiovisual signals which is placed on the market under one model or system designation, and which consists of (a) a display and (b) one or more tuner(s)/receiver(s) and optional additional functions for data storage and/or display such as digital versatile disc (DVD), hard disk drive (HDD) or videocassette recorder (VCR), either in a single unit combined with the display, or in one or more separate units".* (European Commission, 2009c: art. 2.2)

The focus of the IM is illustrated and compared to the recommendations of the preparatory study in Table 3.1. The green colour illustrates primary focus of the study and the yellow colour illustrates the secondary focus.

Table 3.1 Focus area of the IM compared to the focus of the preparatory study.

Subject	Preparatory Study	Implementing Measures
Power consumption on-mode		
Power consumption in off-mode		
Power consumption in passive standby		
Power consumption active standby low		
Introduction of energy efficiency label		
General eco-design requirements		
Chemicals in products		
Green procurement		
Information requirements		

The arguments for focusing solely on power consumption are presented in the comments to the Regulation. It is emphasised that in the preparatory study it was assessed that the relevant environmental impact, for the purpose of the regulation, is the power consumption in the use phase. It is argued in the comments that environmental impacts related to hazardous substances in the TVs and waste from disposed TVs are not addressed by the regulation as this

is addressed in the Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) and Directive 2002/96/EC on waste electrical and electronic equipment (WEEE), respectively.

Furthermore, it is argued that the regulation should not benchmark best available technology, as this is addressed in Commission Decision 2009/300/EC establishing the revised ecological criteria for the award of the Community ecolabel to TVs (the European Ecolabel). In the following the requirements of the IM are elaborated.

In Article 6 of the IM a review clause is presented. The Commission must within three years of the entry into force of the IM review the regulation and here take into account the technological development. The results of the review must be presented to the Ecodesign Consultation Forum. (European Commission, 2009c)

3.1 Power Consumption in on-mode

As recommended in the preparatory study the IM have a multi tier approach to the implementation of the on-mode power consumption requirements. In the first tier applicable from 20th August 2010 the requirement differentiates between full HD and other resolutions, whereas all resolutions must comply with the same requirement in the second tier applicable from 1st April 2012.

The requirement consists of some of the same elements as the recommended requirement from the preparatory study; the screen size (A) is multiplied with a constant for the calculated power consumption of 1 dm^2 screen surface area and a constant is added. However, the requirement unit is dm^2 instead of square inch, and instead of adding a constant value ($P_{feature}$) as recommended in the preparatory study, the requirement differentiates between TV sets and monitors, see Table 3.2 and Table 3.3.

Table 3.2 On-mode power requirements applicable from 20 August 2010 (European Commission, 2009c: Annex 1).

	Full HD	All other resolutions
TV sets	20 W + A · 1,12 · 4,3224 W/dm2	20 W + A · 4,3224 W/dm 2
Monitors	15 W + A · 1,12 · 4,3224 W/dm2	15 W + A · 4,3224 W/dm 2

Table 3.3 On-mode power consumption applicable from 1 April 2012 (European Commission, 2009c: Annex 1).

	All resolutions
TV sets	16 W + A · 3,4579 W/dm 2
Monitors	12 W + A · 3,4579 W/dm 2

The on-mode power consumption requirement for TV sets is illustrated in Figure 3-1 together with the recommendations of the preparatory study.

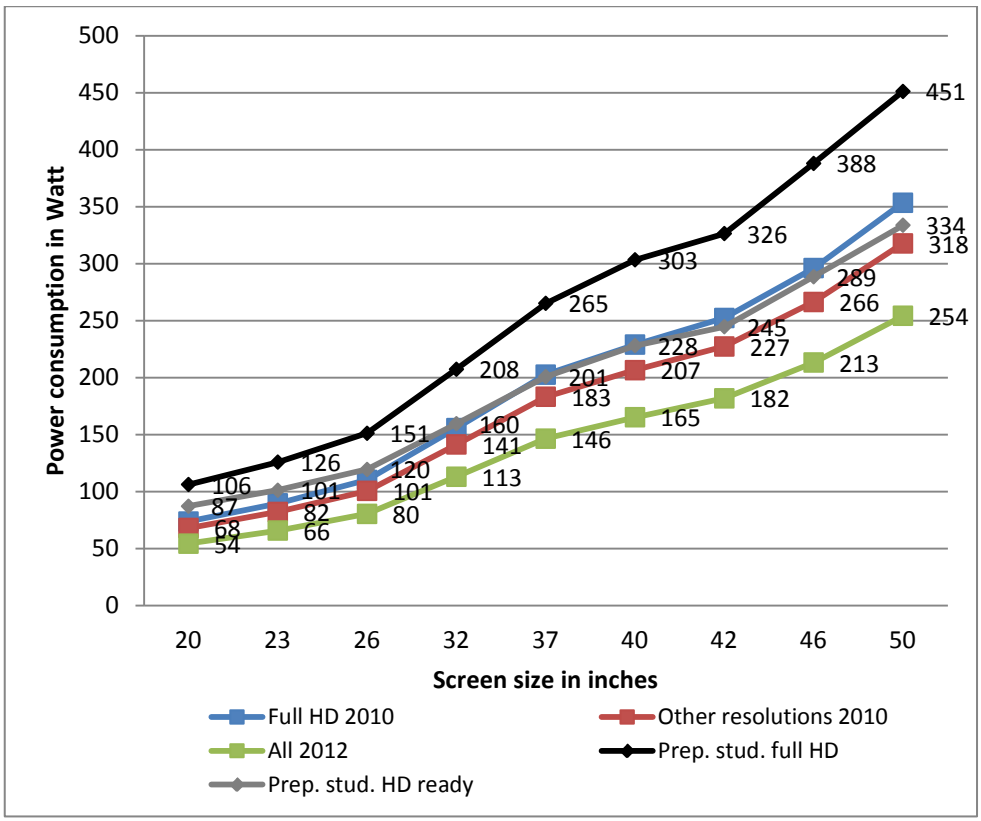

FIGURE 3-1 ON-MODE POWER CONSUMPTION REQUIREMENTS COMPARED TO THE RECOMMENDATIONS OF THE PREPARATORY STUDY. BASED ON (STOBBE, 2007C) AND 2010 (EUROPEAN COMMISSION, 2009C: ANNEX 1).

Compared to the recommendations of the preparatory study it is clear that the IM have tightened the requirements. Taking a closer look at the equation it seems that the IM have been inspired by the ecolabels. Both the constant (20W, 15 W) and the 4.3224 W/dm^2 are the same as in the European Ecolabel and the Nordic Ecolabel (see Chapter 3). Comments from stakeholders wanting to lower the constant from 40W to 15-20 W have also been heard (Stobbe, 2007d).

In addition to the on-mode power requirements the IM sets requirements for TVs with a forced menu[5] and the peak luminance of the TV. Applicable from 20 August 2010; "*TVs with forced menu or initial activation of the television shall provide a "home-mode" in the forced menu, which shall be the default choice on initial activation of the television. If the user selects a mode other than "home-mode" on initial activation of the television, a second selection process shall be prompted to confirm this choice*" (European Commission, 2009c). Home-mode is the TV setting that is recommended by the manufacturer for normal home use (European Commission, 2009c).

From August 20, 2010 the following requirements are applicable regarding the peak luminance ratio (European Commission, 2009c, Annex 1):

- TVs without forced menu: the peak luminance of the on-mode condition of the TV as delivered by the manufacturer shall not be less than 65 % of the peak luminance of the brightest on-mode condition provided by the TV.

[5] Forced menu is defined as "*a set of television settings predefined by the manufacturer, of which the user of the television must select a particular setting upon initial start-up of the television*" (European Commission, 2009b).

- TVs with forced menu: the peak luminance of the home-mode condition shall not be less than 65 % of the peak luminance of the brightest on-mode condition provided by the TV.

The preparatory study recommends the use of the IEC 62087 standard on dynamic broadcast-content video signal test method for testing the on-mode power consumption. In Annex II of the Regulation the conditions for measuring on-mode power consumption, standby and peak luminace are listed. (European Commission, 2009c)

3.2 Power consumption in off-mode and standby

In Table 3.4 the requirements on power consumption in off-mode and standby are listed and compared to the recommendations of the preparatory study. The requirements come into force in two steps. The first requirements have been applicable since January 7 2010, and the second step will be applicable from 20 August 2011.

Table 3.4 Off-mode and standby requirements of the IM

	Preparatory Study	Implementing Measures
Off-mode	Compliance in 2010: ≤ 0,5 W	Compliance in 2010: ≤ 1,00 W
Off mode tier 2	Compliance in 2012: ≤ 0,2 W	Compliance in 2011: ≤ 0,5 W if the TV has an easily visible off switch putting the TV in off-mode using ≤ 0,01 W Otherwise: ≤ 0,3 W
Off mode	Primary hard off switch (0 W) is optional	TVs shall have an off-mode and/or standby-mode, and/or another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode when the TV is connected to the mains power source.
Passive standby tier 1	Compliance in 2010 ≤ 1 W	Compliance in 2010: ≤ 1,00 W ≤ 2,00 W if the TV is providing information or status display
Passive standby tier 2	Compliance in 2012 ≤ 0,5 W	Compliance in 2011: ≤ 0,50 W ≤ 1,00 W if the TV is providing information or status display
Passive standby		For TV sets which consist of a display, and one or more tuner(s)/receiver(s) and optional additional functions for data storage and/or display such as digital versatile disc (DVD), hard disk drive (HDD) or videocassette recorder (VCR) in one or more separate units, points (a) to (c) apply for the display and the seperate unit(s) individually
Active standby low tier 1	Compliance in 2010 ≤ 3 W	
Active standby low tier 2	Compliance in 2012 ≤ 2 W	
Active standby low tier 3	Compliance in 2015 ≤ 1 W	
Automatic power down	Automatic transition into active standby low after the main function ended	Compliance in 2011: After no more than 4 hours in on mode following the last user interaction and/or a channel change, the TVs shall be automatically switched from on mode to: — standby-mode, or, — off-mode, or, — another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode
		TVs shall display an alert message before the automatic switch from on mode to the applicable condition/modes. This function shall be set as default.
Home-Mode		TVs with forced menu on initial activation of the television shall provide a 'home-mode' in the forced menu, which shall be the default choice on initial activation of the TV. If the user selects a mode other than 'homemode' on initial activation of the TV, a second selection process shall be prompted to confirm this choice

The IM are to some degree aligned with the recommendations of the study, as it appears from Table 3.4. One important difference is that the IM do not formulate specific requirements for each of the standby modes presented by the preparatory study. On the contrary, the IM defines only one standby mode. The requirement for standby is aligned with the recommended requirement for passive standby, which indicates that the standby requirements of the IM are slightly stricter than what is recommended by the study. On the other hand, the requirement set up for power consumption in off-mode is less strict than recommended.

Finally, the recommendation on an automatic power down function was followed and a requirement on a "home-mode" for TVs' with a forced menu was added.

3.3 Environmental Information

The requirements on Environmental Information are listed and compared to the recommendations of the preparatory study in Table 3.5

Table 3.5 Requirements on environmental information of the IM.

Preparatory Study	Implementing Measures
Mandatory energy efficiency labelling	
Mode-specific power consumption data in sales advertisements and user manuals	The product's power consumption in on-mode, standby and off-mode
Rated power consumption in user manuals	
Explanations of power modes and energy saving options in user manuals	
Warning of mercury content in backlights (to the recycling industry)	If the product contains mercury or lead
	The ratio of the peak luminance of the on-mode or home-mode condition of the TV as delivered by the manufacturer and the peak luminance of the brightest on-mode condition provided by the TV, expressed in percentage, rounded to the nearest integer

Some elements regarding the requirements on environmental information have been adopted from the recommendations. This goes for the requirements on information about the product's power consumption in on-mode, standby and off-mode, and for the information about lead and mercury in the product. There are no requirements set up for rated power consumption and an explanation of power modes and energy savings options. In connection with the requirement on peak luminance, a requirement on information about the ratio of the peak luminance has been introduced.

3.4 Comparison of Implementing Measures and Preparatory Study

The IM follow the recommendations of the preparatory studies rather closely in the sense that only requirements on power consumption have been set up. This was emphasised in the study to be the most significant environmental impact of TVs and the IM refers to the RoHS and WEEE Directives with

regards to the requirements on chemicals, recycling and waste arguing that these issues are regulated here.

Comparing the requirements that have been set up to the recommended requirements of the preparatory study it is clear that these are inspired by the recommendations, but they have been developed further. For instance, the requirements for on-mode power consumption are tightened and the equation for calculating the requirements has been changed. The new equation seems to be inspired by the calculation method of the European Ecolabel and stakeholder comments have been taken into account. On the other hand, the requirements for off-mode power consumption are less tight and there are only set up requirements for one type of standby, compared to the two types recommended by the preparatory study. The standby requirements are though identical to the strictest of the standby requirements recommended by the preparatory study, indicating that the IM set stricter requirements on standby power consumption. Finally, with regards to power consumption the IM have set requirements to an automatic power down system and a default "home-mode" which both are functions that should lower the power consumption of the TV.

The only requirement of the IM not related to power consumption is an information requirement on the content of lead and mercury in the TV, which partly is recommended by the preparatory study.

4 Ecolabels and TVs

In this chapter, different ecolabels for TVs will be analysed with the aim of investigating where the ecolabels have "set the bar" on what is being considered environmentally friendly. Authorities, consumers and producers acknowledge Ecolabels; e.g. when buying an ecolabelled product the consumer can be confident that the product is among the best environmentally performing products in its product category. All ecolabels presented in this chapter, except the Energy Star consider the entire life cycle of the product. This includes aspects of the life cycle from the extraction of raw materials to the product is being disposed of or recycled and sets requirements to all relevant life cycle phases. Besides their focus on the environment, the ecolabels also ensure that the quality is not impaired. Consequently, it is relevant to investigate which environmental requirements ecolabels can set without compromising with the quality of the product.

In the following sections the ecolabels relevant for TVs will be presented. These are:

- The European Ecolabel
- The Nordic Ecolabel
- Energy Star
- TCO'06

For each label the scope and the criteria will be presented.

4.1 The European Ecolabel

The European ecolabel was established by the European Commission in 1992 and is used all over Europe (Ecolabelling Denmark, 2010). A wide range of products can be awarded the European Ecolabel from campsite services to paint and refrigerators. Figure 4-1 shows the European Ecolabel.

Figure 4-1 The European Ecolabel (European Commission, 2011).

The latest Commission Decision on establishing the revised ecological criteria for the award of the Community Ecolabel to TVs was made in March 2009. The decision applies from November 1, 2009 and is valid until October 31

2013. The scope of the flower is *"Mains powered electronic equipment, the primary purpose and function of which is to receive, decode and display TV transmission signals"*. (European Commission, 2009b: art. 1)

Table 4.1 lists the focus areas of the European Ecolabel compared to the focus areas of the IM. In comparison to the focus areas of the IM it is clear that the European Ecolabel has a broader focus including also other environmental issues than just power consumption. In the following each of the focus areas will be elaborated.

TABLE 4.1 OVERVIEW OF THE FOCUS AREAS OF THE EUROPEAN ECOLABEL.

Subject	Implementing Measures	European Ecolabel
Power consumption on-mode		
Power consumption in off-mode		
Power consumption in standby		
Maximum energy consumption		
Dismantling		
Life-time extension		
Chemicals in products		
Information requirements		

4.1.1 Power Consumption in On-mode

A three-tier approach is chosen to the energy efficiency requirement for on-mode power consumption, where the requirements are tightened in three steps. As it appears from the below equations the European Ecolabel requirement consists of the tier 1 requirement for "other" resolutions of the IM multiplied with a constant.

For tier 1, which is valid from 1 November 2009, the following equation is the requirement:
$0.64 \cdot (20\ W + A \cdot 4.3224\ W/dm^2)$

The requirement is gradually tightened:
Tier 2, which is valid from 1 January 2011:
$0.51 \cdot (20\ W + A \cdot 4.3224\ W/dm^2)$

and tier 3, which is valid from 1 January 2013:
$0.41 \cdot (20\ W + A \cdot 4.3224\ W/dm^2)$

Figure 4-2 illustrates the requirement for on-mode power consumption for the Flower.

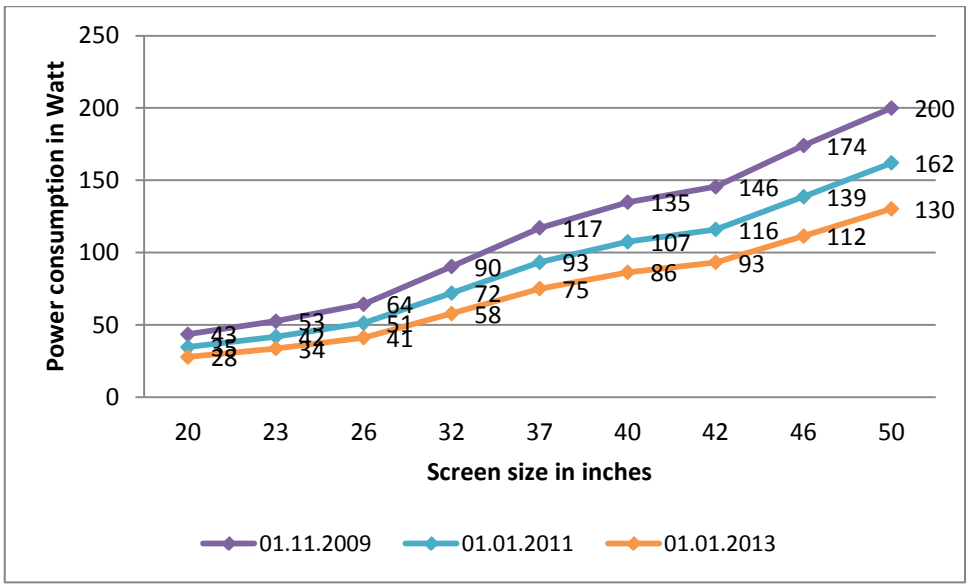

FIGURE 4-2 THE ENERGY EFFICIENCY REQUIREMENT IN ON-MODE FOR THE EUROPEAN ECOLABEL. BASED ON (EUROPEAN COMMISSION, 2009B)

A further requirement has been set up regarding the on-mode power consumption, which is a maximum for power consumption in on-mode. This is set to a maximum of 200 W. (European Commission, 2009b)

Compared to the requirements of the IM, the European Ecolabel does not distinguish between HD ready and full HD, both technologies have to comply with the same criteria. Furthermore, the European Ecolabel sets far more strict requirements than recommended in the IM. For instance, 42" TV is in the IM 2010 required to use no more than 252 W in full HD and no more than 227 W in other solutions. If a 42" TV complies with the European Ecolabel the power consumption shall be no more than 146 W. This is around 100 W below the requirement of the IM.

4.1.2 Power Consumption in Off-mode and Standby

The European Ecolabel sets no specific requirements regarding off-mode power consumption. However, if the TV has an off-on switch this has an influence on the requirement for the power consumption in passive standby. If the TV has an off switch and the off-mode power consumption is less than 0.01 W, then the criteria for passive standby is $P_{standby} \leqq 0.5$ W. For all other TV's the passive standby consumption criteria is $P_{standby} \leq 0.3$ W.

Comparing the requirements of the European Ecolabel with the requirements of the IM it is clear that the standby criterion of the European Ecolabel is significantly stricter than those of the IM, see Table A.1 in Appendix A. The standby requirement is actually the same as the requirement in off-mode of the IM. This strict requirement could be the reason for that no requirements are set up for other standby or off-mode including the automatic power down, which is required by the IM.

4.1.3 Chemicals

Unlike the IM the European Ecolabel has strong emphasis on chemicals in the product. The European Ecolabel criteria for chemicals in TVs are listed in Table 4.2.

Table 4.2 Requirements on chemical content in product labelled with the European Ecolabel (European Commission, 2009b)

	European Ecolabel
Substances regulated in the RoHS Directive 2002/95/EC	The product must comply with the RoHS Directive 2002/95/EC
	Mercury content in fluorescent lamps: The total, amount of mercury in all lamps, per screen, shall be no greater than 75 mg Hg for screen sizes up to 40 inches, and no greater than 99 mg Hg for screen sizes above 40 inches
	Plastic parts may not contain flame retardants, or preparations that are assigned or may be assigned the risk phrases: R40 (possible risk of cancer), R45(may cause cancer), R46 (may cause heritable generic damage), R50 (very toxic to aquatic organisms), R51 (toxic to aquatic organisms), R52 (harmful to aquatic organisms), R53 (may cause long term adverse effects in the aquatic environment), R60(may impair fertility) and R61 (may cause harm to unborn child), R62 (possible risk of impaired fertility), R63 (possible risk of harm to the unborn child)

As mentioned, the IM sets no requirements on chemical content of products, as the IM refers to the RoHS and WEEE Directive for these types of requirements. This is in contrast to the European Ecolabel, which sets very specific requirements regarding chemical content in TVs. In this way the European Ecolabel clearly demonstrate its comprehensive life cycle focus.

4.1.4 General Eco-design Requirements

Apart from the criteria on energy efficiency and chemicals, the European Ecolabel sets up general eco-design criteria within the two areas, see Table 4.3. The aim of the dismantling requirement is to be able to repair and replace worn-out parts, upgrade older or obsolete parts, and finally to separate different materials for recycling.

The following points should be considered in this respect (European Commission, 2009b):

- Fixtures within the products shall allow for this disassembly, e.g. screws, snap fixes, especially of parts containing hazardous substances
- Plastic parts shall be of one polymer or be of compatible polymers for recycling and have the relevant ISO 11469 marking if greater than 25g in mass
- Metal inlays that cannot be separated shall not be used
- Data on the nature and amount of hazardous substances in the TV will be gathered in accordance with the Dangerous Substances Directive 67/548/EEC and its subsequent amendments and the Globally Harmonised System of Classification and Labelling of Chemicals (GHS)

Table 4.3 General ecodesign requirements of the European Ecolabel (European Commission, 2009b)

	European Ecolabel
Dismant-ling	The manufacturer shall demonstrate that the product can be easily dismantled by professional recyclers
Life-time extension	The manufacturer shall offer a commercial guarantee to ensure that the product will function for the least two years
	The availability of compatible electronic replacement parts shall be guaranteed for seven years from the time the production ceases

Comparing the European Ecolabel criteria with the requirements of the IM, the European Ecolabel looks more holistically on environmental impacts of a TV. Where the preparatory study slightly touches upon ecodesign, the IM have completely left this part out of the requirement setting. The European Ecolabel, on the other hand, sets specific requirements that help prolong the lifetime of the product and ease the dismantling and recyclability of the TV.

4.1.5 Environmental Information

The final type of criteria that the European Ecolabel sets up concern information to the end user and recyclers. In general, the requirement states that the product must be sold with information about the product's proper environmental use. This information must be available in the instructions where it is easy to find and also the webpage of the producer. (European Commission, 2009b) Table 4.4 lists the information requirements compared to the information requirements of the IM.

Table 4.4 General information requirements of the European Ecolabel (European Commission, 2009b)

Implementing Measures	European Ecolabel
	Information that the product has been awarded the flower
The product's power consumption in on-mode, standby and off-mode	The product's power consumption information in various modes; on, off and passive standby, including information on energy savings possible in different modes
	Explanations of how to reduce power consumption when the product is not being used
If the product contains mercury or lead	
The ratio of the peak luminance of the on-mode or home-mode condition of the TV as delivered by the manufacturer and the peak luminance of the brightest on-mode condition provided by the TV, expressed in percentage, rounded to the nearest integer	

Some requirements regarding environmental information are overlapping (see Table 4.4). However, the European Ecolabel has a stronger focus on how the consumer can reduce the power consumption of the TV.

4.1.6 Discussion of the European Ecolabel Criteria

In the above sections the European Ecolabel criteria are presented and compared to the requirements of the IM. Briefly summing up on the analysis, the European Ecolabel differentiates from the IM on the following points:

- Equal focus on all environmental requirements
- Stricter requirements on energy efficiency
- Stricter requirements on chemical content
- Specific ecodesign requirements to improve dismantling and prolong life-time of the product
- More information to the consumer on his/her responsibility

The European Ecolabel looks more comprehensively on all environmental impacts of TVs than the IM; in general the requirements are stricter with respect to energy efficiency, chemicals, ecodesign and environmental information. With regard to the environmental information there are overlapping requirements, but the European Ecolabel focuses more on the responsibility of the consumer. It could be argued though that the IM have set requirements for automatic power down that reduces the need for consumer awareness as the product on its own turns off after while with no user interaction. On the one hand, one can be sure of energy reduction, but on the other hand the learning element for the consumer, where he needs to think about his actions, is missing in the IM.

4.2 The Nordic Ecolabel

The Nordic Council of Ministers established the Nordic Ecolabel in 1989. The label is primarily directed towards the Nordic market; Denmark, Norway, Sweden, Finland and Iceland. The Nordic Ecolabel is, to a wide extent, harmonised with the European Ecolabel, which means that if a product already has been awarded the European Ecolabel only a few extra criteria must be fulfilled in order to obtain the Nordic Ecolabel. The European Ecolabel was developed after the Nordic Ecolabel, with the aim of gathering all national ecolabels in one. Therefore there are not many differences between the labels. The reason for there still being two labels is partly practical, as still more product groups can be labelled with the Nordic Ecolabel than with the European Ecolabel. (Ecolabelling Denmark, 2010)

A wide range of product groups can be awarded the ecolabel, such as shampoo, toilet paper and TVs. Figure 4-3 shows the Nordic Ecolabel.

Figure 4-3 The Nordic Ecolabel (Ecolabelling Denmark, 2010).

The newest criteria for Audiovisual equipment (Version 4.0) are valid in the period December 15 2009 – December 31 2013. The following product groups, within the scope of the Nordic Ecolabel for Audiovisual equipment, are relevant for this report: TVs and TVs in combination with other equipment, for instance DVD and Blue-ray players. Appliances powered by batteries and equipment with CRT displays are excluded from the scope. (Nordic Ecolabelling, 2009)

The focus areas of the Nordic Ecolabel are the same as the focus areas of the European Ecolabel, with one addition; power consumption in off-mode, see Table 4.1. In the following, each of the areas will be elaborated.

4.2.1 Power Consumption in on-mode

The requirement for on-mode power consumption is completely aligned with the European Ecolabel requirements for 01.01.2011 and 01.01.2013 (see Figure 4-2). Also the maximum power consumption is aligned with the European Ecolabel, i.e. that the product must have an absolute maximum power consumption of no more than 200 W. As the European Ecolabel, the Nordic ecolabel does not distinguish between HD ready and full HD, but both technologies must comply with the same criteria. Compared to the IM the allowed power consumption is significantly lower no matter the screen size.

4.2.2 Power Consumption in Off-mode and Standby

The requirements for power consumption in standby are identical to the requirements of the European Ecolabel, namely: if the TV has an off switch and the off-mode power consumption is less than 0.01 W, then the criteria for passive standby is $P_{standby} \leqq 0.5$ W. For all other TV's the passive standby consumption criteria is $P_{standby} \leq 0.3$ W.The Nordic ecolabel does, however, set one further requirement i.e. that TV sets must have a clearly visible on-off switch.

As is the case for the European Ecolabel, the requirements of the Nordic Ecolabel are significantly stricter than the requirements of the IM, see Table A.1 in Appendix A. The criterion on a visible on-off switch is added compared to the European Ecolabel, but this was actually a requirement in the recent outdated the European Ecolabel criteria (European Commission, 2002).

4.2.3 Chemicals

Several criteria have been set up regarding the chemical content of the products awarded the Nordic Ecolabel. The criteria are similar to the chemical criteria of the European Ecolabel with a few execptions. The Nordic Ecolabel does not allow any mercury content in the background lighting of TVs, and does not allow the use of chlorinated paraffin. The European Ecolabel has stricter requirements towards plastic parts containing flame-retardants with certain risk phrases.

Comparing the criteria to the IM it is clear that the Nordic Ecolabel has a holistic view and includes requirements on the chemical content of TVs. In Table A.2 in Appendix A the chemical requirements of The Nordic Ecolabel are compared to the other ecolabels.

4.2.4 General Eco-design Requirements

Apart from the criteria on energy efficiency and chemicals The Nordic Ecolabel sets up general eco-design criteria in the following areas:

- Dismantling

- Lifetime extension

The criteria are completely aligned with the requirements of the Flower, see section 3.1.4.

As the ecodesign criteria are completely identical with the European Ecolabel, the Nordic Ecolabel takes a broader approach to a TVs environmental impact than the IM. Where the preparatory study slightly touches upon ecodesign, and the IM completely leaves this issue out, the Nordic Ecolabel sets concrete requirements that help prolong the life-time of the product and ease the dismantling and recyclability of the TV. In Table A.3 in Appendix A the general eco-design requirements of the ecolabels are compared to each other.

4.2.5 Environmental Information

As in the European Ecolabel requirements the Nordic Ecolabel also sets requirements on information to the end user and the recycler. The requirements are to a large extent aligned with the requirements of the European Ecolabel. The Nordic Ecolabel does, however, not set requirements on information about possible energy savings in different modes, that energy efficiency cuts energy consumption and hence saves money on the electricity bill and the position of the hard-off switch, as does the European Ecolabel.

There is a convergence between the two ecolabels and also to some degree with the requirements of the IM, although the European Ecolabel sets stricter requirements, see Table A.4 in Appendix A. Compared to the IM, the Nordic Ecolabel has a stronger focus on how the consumer can reduce the power consumption of the TV, and information on issues that helps prolong the lifetime of the TV and improve the recyclability of the TV.

4.2.6 Discussion of the Nordic Ecolabel Criteria

In the above sections the Nordic Ecolabel criteria are presented and compared to the requirements of the IM. As the Nordic Ecolabel to a large degree is aligned with the European Ecolabel, it differentiates in the same way from the IM, see Section 4.1.6.

4.3 Energy Star

The Energy Star is a voluntary program established by the U.S. Environmental Protection Agency and the U.S. Department of Energy in 1992. As the name indicates, the label focuses on the energy efficiency of products. The first products to be labelled where personal computers and monitors and gradually the product range of the label has expanded. Since 1998, TVs can be labelled with the Energy Star (Energy Star).

Figure 4-4 The Energy Star label (Energy Star)

In September 2009, the revision of the Energy Star specifications for TVs was finalised. Both a version 4.0 and a version 5.0 were adopted. Version 4.0 is effective from May 2010 and Version 5.0 will be effective from May 2012. The scope of the Energy star is defined as: *"Any TV, TV combination Unit [6] or Component Television Unit [7] that is marketed to the consumer as such (i.e., focusing on television as the primary function […], and is capable of being powered from either a wall outlet or a battery unit that is sold with an external power supply".* (Energy Star, 2009: p. 4)

Table 4.5 lists the focus areas of the Energy Star programme compared to the requirements of the IM. In the following each of the areas will be elaborated.

Table 4.5 Overview of the focus areas of the Energy Star

Subject	Implementing Measures	Energy Star ver. 4.0 and 5.0
Power consumption on-mode		
Power consumption in off-mode		
Power consumption in passive standby		
Power consumption active standby low		
Maximum energy consumption		
Information requirements		

4.3.1 Power Consumption in On-mode

The requirements for on-mode power consumption of the Energy Star are expressed in an equation, which takes the screen size into consideration – as in all other cases.

Table 4.6 shows the maximum on-mode power consumption and Figure 4-5 illustrates the requirement for the different screen sizes.

Table 4.6 Requirement on maximum power consumption in on-mode for Energy Star (Energy Star, 2009)

	Screen Area	Maximum on-mode power consumption
Version 4.0	A < 275 square inches	PMax = 0.190*A + 5
	A ≥ 275 square inches	PMax = 0.120*A + 25
Version 5.0	A < 275 square inches	PMax = 0.130*A + 5
	275 ≤ A ≤ 1068 square inches	PMax = 0.084*A + 18
	A > 1068 square inches	PMax = 108

[6] TV Combination Unit is defined as: *"A television system in which the TV and an additional device(s) (e.g., DVD player, Blu-ray Disc player, Hard Disk Drive [HDD], VCR, etc.) are combined into a single unit and which meets all of the following criteria: the additional device(s) is included in the television casing; it is not possible to measure the power requirements of the two (or more) components separately without removal of the television casing; and the system is connected to the wall outlet through a single power cable."* [ES criteria]

[7] Component Television Unit is defined as: *"A television system composed of two or more separate components (e.g., display device and tuner) marketed and sold as a television under one model or system designation. The system may have more than one power cord. The total power consumption of all components in the system is considered for purposes of ENERGY STAR qualification."* [ES criteria]

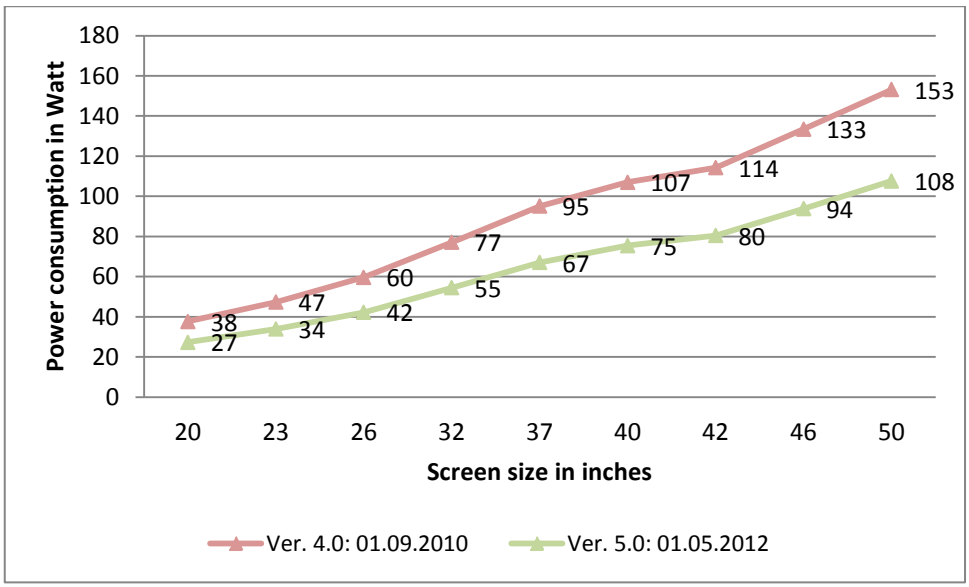

FIGURE 4-5 REQUIREMENTS FOR MAXIMUM POWER CONSUMPTION IN ON-MODE OF THE ENERGY STAR PROGRAMME. BASED ON (ENERGY STAR, 2009)

As an extra requirement the Energy Star has set up special requirements for TVs with Automatic Brightness Control (ABC). TVs with this function have a reduced power consumption compared to other TVs and this is taken into consideration in the requirement:

$$P_{a1\_broadcast} = (0.55 \cdot P_{o\_broadcast}) + (0.45 \cdot P_{abc\_broadcast})$$

The Energy Star defines the elements of the equation as the following (Energy Star, 2009: p. 6):

$P_{a1\_broadcast}$ is the average on-mode power consumption in watts rounded to nearest whole number, taking into consideration that the TV will be in low ambient light level conditions 45% of the time.

- *$P_{o\_broadcast}$ is the average On Mode power consumption in watts and rounded to the nearest whole number, and tested with a minimum ambient light level of 300 lux entering directly into the sensor.*
- *P_{abc}_broadcast is the average On Mode power consumption in watts and rounded to the nearest whole number, with an ambient light level of zero (0) lux measured at the face of the sensor.*

As a further requirement the Energy Star specifies that the peak luminance of the TV, when in default mode, must not be less than 65% of the retail-mode, which is the brightest possible mode of the TV (Energy Star, 2009)

Comparing the Energy Star requirements with the IM, the Energy Star requirements are significantly stricter. The requirement for on-mode power consumption is almost 50% lower and in some cases even stricter. The requirement is even stricter than the other ecolabels, except the tier 2 and 3 of the European Ecolabel. The Energy Star does not distinguish between full HD and HD ready, as does the IM in tier 1, 2010.

The Energy Star does take into account the new technology with automatic brightness control, where the average on-mode power consumption should be calculated, under the condition that the TV is in low ambient light level in 45 % of the time. As the European Ecolabel and the Nordic Ecolabel, the Energy Star sets a maximum requirement on energy consumption in the 5.0

version. This is 108 Watt, which is significantly lower than the maximum of 200 Watt by the other ecolabels. The Energy Star also sets a requirement on peak luminance, which is identical to the requirement of the IM on peak luminance.

4.3.2 Power Consumption in Off-mode and Standby

The Energy Star sets no requirements for power consumption in off mode. Standby mode is in Energy Star is called Sleep mode. Products awarded the Energy Star must consume no more than 1 Watt in sleep mode and this goes for both Version 4.0 and 5.0. Furthermore, the manufacturer must set the lowest power consumption in sleep mode to default mode of the product. (Energy Star, 2009)

The Energy Star has defined a further mode; the Download Acquisition Mode (DAM), which to some degree is comparable to the active standby defined in the preparatory study. DAM is a mode the TV automatically switches to when communication through network, for instance updating channel listing information (Energy Star, 2009). If the TV has a DAM function the TV is allowed additional power consumption. The maximum additional power consumption is from 01.05 2010: ≤0.08 kWh/day and from 01.05 2012: ≤0.02 kWh/day.

Unlike the IM the Energy Star differentiates between active and passive[8] standby. The requirement for sleep mode is identical to the standby requirement of the IM, and in active standby the TV is even allowed to use slightly more power. Compared to the IM the Energy Star include less strict requirements, which is also underlined by the fact that no requirements are set for of-mode and automatic power down. In Table A.1 in Appendix the standby and off-mode requirements are compared to the IM and other ecolabels.

4.3.3 Environmental Information

The Energy Star emphasises the importance of the consumers' awareness of the impact and benefits of keeping the TV in the default modes. Hence, the Energy Star requires manufacturers to sell the Energy Star awarded products together with information about the Energy Star and an insert about the benefits of keeping the product in the default mode and information about the fact that enabling different features may increase the power consumption of the product. (Energy Star, 2009)

The requirements for environmental information in the Energy Star label focus on what the consumer can do to reduce power consumption, but it does not inform on the power consumption of the product. Again the focus on energy is obvious. See Table A.4 in Appendix A for a comparison with IM and other ecolabels.

4.3.4 Discussion of the Energy Star Criteria

In the above sections the Energy Star criteria are presented and compared to the IM. Different, from the other ecolabels presented, Energy Star focuses exclusively on energy efficiency. The main points of the Energy Star compared to the IM are the following:

[8] Passive standby is termed sleep mode in the Energy Star requirements.

- Focuses only on energy efficiency
- Stricter requirements on energy efficiency in on-mode
- Less strict requirements on standby and off mode

The only focus of the label is energy efficiency, which fits well with the scope of the IM. However, the requirements on on-mode power consumption are significantly stricter than what is recommended in the IM. On the other hand, the standby power consumption seemed to be less strict as no requirements are set for off-mode and the standby requirement is higher in 2010, and for active standby the TV may consume slightly more power.

4.4 TCO'06

TCO is short for Tjänstemännens Centralorganisation (the Swedish Confederation of Professional Employees) and was originally founded in Sweden (TCO Development). The first labelling program was established in 1992 and since then the program has grown to cover many different product groups (Rudling and Nordin, 2006).

A specific TCO label for TVs does not exist, but the label for media displays covers some TVs, which is why the label is found relevant in this report. The scope of the TCO'06 Media Display label is *a Flat Panel TV or a multifunction display intended to be used for e.g. monitoring or in other ways render moving images* (Rudling and Nordin, 2006). Figure 4-6 illustrates the TCO'06 label for media displays.

FIGURE 4-6 THE TCO'06 LABEL FOR MEDIA DISPLAYS (TCO DEVELOPMENT)

The latest criteria document for media displays dates back to August 2006. The TCO label includes many different areas, such as visual ergonomics, emissions from electric and magnetic fields, electrical safety, ecology and energy. However, in this study only the areas ecology and energy will be examined. Table 4.7 lists the focus areas of the TCO'06 label marked with green colour, compared to the focus areas of the IM. In the following each of the focus areas will be elaborated.

Table 4.7 Overview of the focus areas of the TCO'06 label for media displays

Subject	Implementing Measures	TCO'06
Power consumption on-mode		
Power consumption in off-mode		
Power consumption in passive standby		
General eco-design requirements		
Dismantling		
Chemicals in products		
Information requirements		
Environmental Management system		

4.4.1 Power Consumption in Off-mode and Standby

The TCO label only set requirement for power consumption in standby, which is ≤ 1W. Standby mode is defined by the TCO label as *"the power being used when the product is connected to a power source, but produces neither sound nor picture, does not transmit nor receive program information and/or data (excluding data transmitted to change the unit's condition from "standby mode" to "active mode"), and is waiting to be switched to "on" (active/play mode) by a direct or indirect signal from the consumer, e.g. with the remote control."* (Rudling and Nordin, 2006: p.43)

The requirement on standby consumption is identical to the requirement of the Energy Star, and comparing to the IM the requirement on standby is on the same level as the standby requirement in 2010. As was the case with the Energy Star no requirements are set for off-mode and automatic power down, and there is no second tier on standby tightening the requirements. This all indicates that the TCO'06 requirement on standby is slightly less strict than the IM, see Table A.1 in Appendix A.

4.4.2 Chemicals

The TCO label encompasses several requirements on chemicals in the product. These are to a high degree aligned with the requirements from the EU RoHS Directive, but additional requirements have been set up. Table 4.8 lists these criteria.

Table 4.8 Requirements on chemicals in the products labelled with the TCO label. (Rudling and Nordin, 2006)

	TCO'06
Substances regulated in the RoHS Directive 2002/95/EC	Components must comply with the RoHS Directive 2002/95/EC and its amendments. Excempted are mercury in background lighting systems and PBB and PBDE in printed wiring boards
	decaBDE is not allowed even if EU has decided to excempt it from the RoHS Directive 2002/95/EC
Other flame retardants	Plastic parts weighing more than 25 g. shall not contain flame retardants that contain bromine or chlorine. Printed Wiring Boards are excempted.
	The material specifications shall be provided for plastic parts and PWB laminates that weigh more than 25 grams and which have flame retardant concentrations above 0.5 percent by weight.
Batteries	Limit values per listed part: Mercury = 2ppm Cadmium = 5 ppm Lead = 50 ppm

Compared to the IM the TCO'06 label has a strong focus on chemical content in the product, which even includes requirements for batteries, see Table A.2 in Appendix A. Emphasis is put on RoHS compliance, though with an exemption on mercury content in backlighting systems. It even forbids the use of decaBDE completely, even though this has been exempted from the RoHS directive.

4.4.3 General Eco-design Requirements

Besides the requirements on chemicals and power consumption the TCO label sets up quite a few requirements on the dismantling of the product. As the European Ecolabel and the Nordic Ecolabel, the TCO label requires that FPD must be easy to disassemble. See Table A.3 in Appendix for further ecodesign requirements.

Compared to the IM the TCO'06 has a strong emphasis on design for disassembly, but it does not take into consideration requirements to prolong the lifetime of the product, as does the Nordic Ecolabel and the European Ecolabel.

4.4.4 Environmental Information

With regards to environmental information to consumers, the TCO label primarily focuses on a proper disposal of the large amounts of electronic waste, wherefore the producers must inform the consumer of the proper disposal of the product. This should be done in the form of a product declaration for the FDP and in the user's manual information on the possibility to dispose of the FDP by environmentally acceptable recycling should be provided.

The environmental information requirements of the TCO'06 label are very different from the requirements of the IM. The focus here is on a product declaration, and on disposal of the product. There is neither focus on power consumption nor energy efficiency; see Table A.4 in Appendix A.

4.4.5 Environmental Management System

For the plants manufacturing flat panel displays the TCO'06 label requires these factories to have implemented an environmental management system, either by an ISO 14001 certification or an EMAS registration (Rudling and Nordin, 2006).

Compared to both the IM and the other ecolabels this is a new requirement.

4.4.6 Discussion of the TCO'06 label

In the above sections the TCO'06 label criteria are presented and compared to the IM. The main differences from the IM are the following:

- Energy consumption: focuses solely on power consumption in standby
- Strong focus on chemicals
- Detailed requirements on dismantling properties
- Requires a certified Environmental management system

As the European Ecolabel and the Nordic Ecolabel, the TCO'06 label focuses more holistically on the environmental impact of TV and there is equal focus on all criteria. In general the requirements set up are stricter than the requirements of the IM, which is the case for energy efficiency, chemicals, ecodesign and environmental information. With regards to energy consumption though, the requirements are not as detailed and many as in the IM and other ecolabels.

4.5 Comparison of the Implementing Measures and the Ecolabels

In this section, the requirements of the IM and the ecolabels are compared to each other. In Table 4.9 the focus areas of the IM and the ecolabels are listed. The narrow focus of the IM on energy consumption in the use phase becomes very clear.

For a more detailed comparison on the requirements in each focus area see Appendix A.

Table 4.9 Comparison of focus areas of the IM and Ecolabels.

Subject	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star	TCO'06
Power consumption on-mode	■	■	■	■	
Power consumption in off-mode	■		■		
consumption in passive	■	■	■	■	■
Power consumption				■	
Maximum energy		■	■	■	
General eco-design		■	■		■
Dismantling		■	■		■
Life-time		■	■		
Chemicals in products		■	■		■
Information requirements	■	■	■	■	■
Environmental Management system					■

A closer look at the energy requirements on on-mode power consumption of the IM and the ecolabels is illustrated in Figure 4-7. As expected due to the role of the different policy instruments, the requirements of the IM are not as strict as the requirements of the ecolabels.

Furthermore, it should be noted that the IM do not challenge the dilemma of the direct relation between power consumption and screen size, i.e. the bigger screen sizes the higher the power consumption. With the trend of increasing screen sizes, the EuP Directive might not reduce the power consumption in on-mode, but just keep it in a steady level. This has been considered by the European and the Nordic ecolabel and the Energy Star, which all have set a maximum level for power consumption in on-mode regardless of screen size.

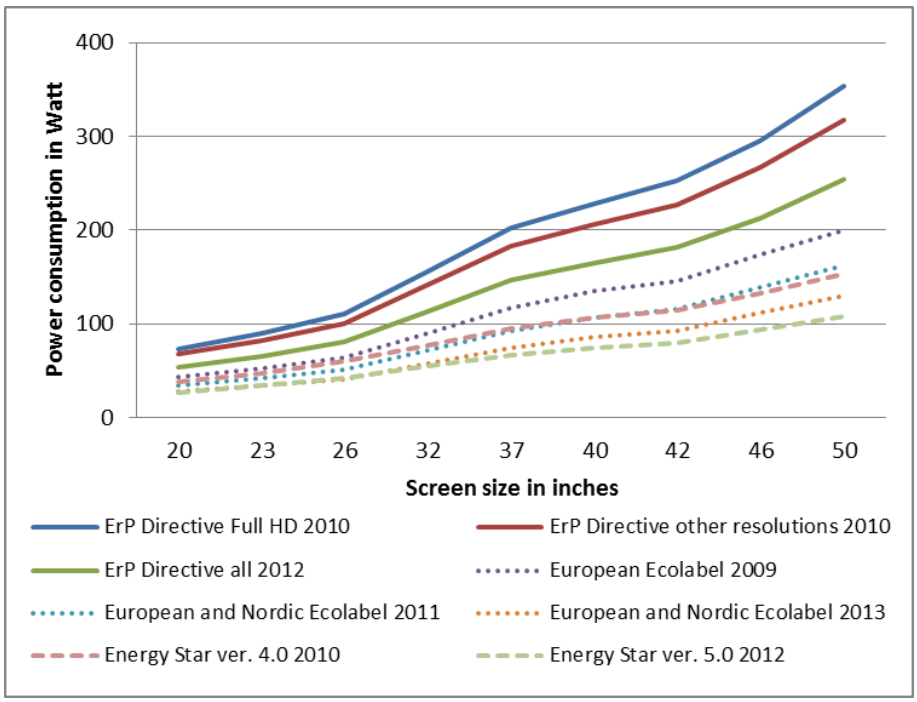

Figure 4-7 Comparison of on-mode power consumption. Based on (Eurpean Commission, 2009c: Annex 1), (European Commission, 2009b) and (Energy Star, 2009)

5 Performance of TVs on the Market

Existing and recommended environmental criteria for TVs were analysed in the earlier chapters. This chapter analyses what TV technologies actually exist on the market and to what extent they can fulfil the requirements of the IM and the different labels.

5.1 Methodology

The analysis presented in this chapter was performed in two steps. The first analysis was performed in the winter 2009/2010, approximately six months before the requirements stepped into force. The second analysis was performed in spring 2011, approximately six months after the requirements entered into force. This approach was taken firstly, to analyse the level of ambition of the EuP Directive and the Implementing Measures and secondly, to be able to assess how fast the technological innovation is.

Two groups of TVs are analysed. These are TVs with an ecolabel and TVs without an ecolabel. The TVs with an ecolabel are assessed to include Best Available Technolgies (BAT) and hence it is the assumption that these TVs have few or no problems in complying with the requirements from the IM and different labels. The analysis of TVs with an ecolabel aims at pointing out what the actual potentials are in terms of lowering the environmental impact of TVs. The TVs without an ecolabel are expected to have most difficulties complying with the requirements of the IM and the different labels. These TVs are analysed to find out what the potentials are for the IM to expel products from the market.

The TV brands analysed are presented in Section 5.2 and 5.3. The analysis of the performance of the TVs has been performed as desk research. This imples that all information used in the analysis is found on the homepages of the TV manafacturers.

5.2 Currently Avalable TVs with an Ecolabel

In this section TVs with an ecolabel, which are assessed to include BAT, are analysed. When investigating the market three types of technologies are continuously pointed out as the new environmental friendly technologies (see for example Philips Electronics N.V, 2009; Samsung Electronics Nordic AB, n.d and Sony, 2010). These technologies are LED (Light Emitting Diode), OLED (Organic Light Emitting Diode) and HCFL (Hot Cathode Fluorescent Lamp). The three technologies will briefly be described below.

5.2.1 LED and OLED Technologies

The LED technology is used in the backlight system of LCD TVs. This implies that the TV display still is a traditional LCD panel. The environmental benefit of LED technology is first and foremost the reduced energy consumption. Traditionally, LCD displays uses CCFL (Cold Cathode Fluorescent Lamps), which, besides light, also can emit heat. As the LED technology generates so called “cold” light, where no energy is wasted on production of heat the energy saving potential is according to Samsung up to

40 % (Samsung Electronics Nordic AB, n.d.). Further positive aspects of the LED technology are the long lifetime – up to 50.000 hours, and that no mercury is used in contrast to the CCFL being replaced (Philips Electronics N.V, 2009; Samsung Electronics Nordic AB, n.d.).

The OLED technology consists of organic material i.e. layers of plastic (Bush, 2009). When current runs through an OLED display, each OLED emits light on its own, without the need of a back light system (Bush, 2009). This is an advantage both in terms of reduced power consumption and reduced material use, as the display is much thinner and lighter than a typical LCD display (Freudenrich, 2005).

Even though OLED appears to have clear advantages, the technology still needs further development on certain points. To produce different colours, manufacturers place several organic films on the same OLED, where each film produces a different colour. For the blue organic film the lifetime of the OLED is substantially reduced (around 14,000 hours) compared to the lifetime of the red and the green OLED (46,000 to 230,000 hours) (Freudenrich, 2005). Furthermore, the technology is very sensitive to moisture, which reduces the lifetime even further (Bush, 2009). Finally, the size of the OLED displays should be mentioned. The technology is often used in small screen devices, such as digital cameras and cell phones. The largest available screen size in 2010 appears to be 11", produced by Sony.

The HCFL technology is used as backlight system in among others Sony Bravia TVs. With this technology Sony has been able to reduce the energy consumption with up 50 % compared to LCD displays with traditional CCFL backlight technology. (Sony, 2010)

In the 2011 analysis a new technology seems to have gained ground – the 3D technology. Samsung launched the very first 3D TFT-LCD (Thin film transistor liquid crystal display) monitor in 1999 (Samsung, 2011a). This technology displays the images in 3-dimentional fields. Since, many other TV manufacturers have 3D TVs in their product portfolio, for example Panasonic, LG and Sony (Panasonic Europe Ltd, 2010; LG, 2010 and Sony 2011). In this analysis only 3D televisions from Samsung have been analysed.

After this brief introduction of the technologies, some of the available products will be analysed in the following sections.

5.2.2 Samsung

In 2007, Samsung launched its first LED based LCD TV (Samsung, n.d.). In 2009/2010 three series of ecolabelled LCD TVs are available based on the LED technology. These are Samsung LED TV series 8 (available in 40" and 46"), series 7 (available in 32", 40", 46" and 55") and series 6 (available in 32", 40" and 46"). All three series have been awarded the Nordic Ecolabel and the European Ecolabel (Samsung Electronics Nordic AB, n.d.).

In May 2011, the series 6, 7 and 8 included televisions that were labelled with the European Ecolabel. However, the power consumption was stated only for the series 6 and 8 and only for the screen sizes 32" and 40". This is reflected in Figure 5.1. All presented TVs are with the LED technology and 3D technology. In the 40" TV from the 8 series Samsung has introduced an Eco sensor, which is a sensor that measures the light in the room and automatically

adjusts the backlight accordingly. This feature provides a better picture quality and saves energy. (Samsung, 2011)

In the following sections Samsungs LED TVs are compared to the ecolabel requirements and the IM. The complete overview of the comparison is presented in section 5.2.5 and Appendix B, whereas more overall comments to the comparison are given in the following sections.

Power Consumption in On-mode
As mentioned, LCD TVs based on LED technology has an advantage in terms of energy efficiency. This becomes clear when looking at the power consumption in on-mode, see Figure 5-1.

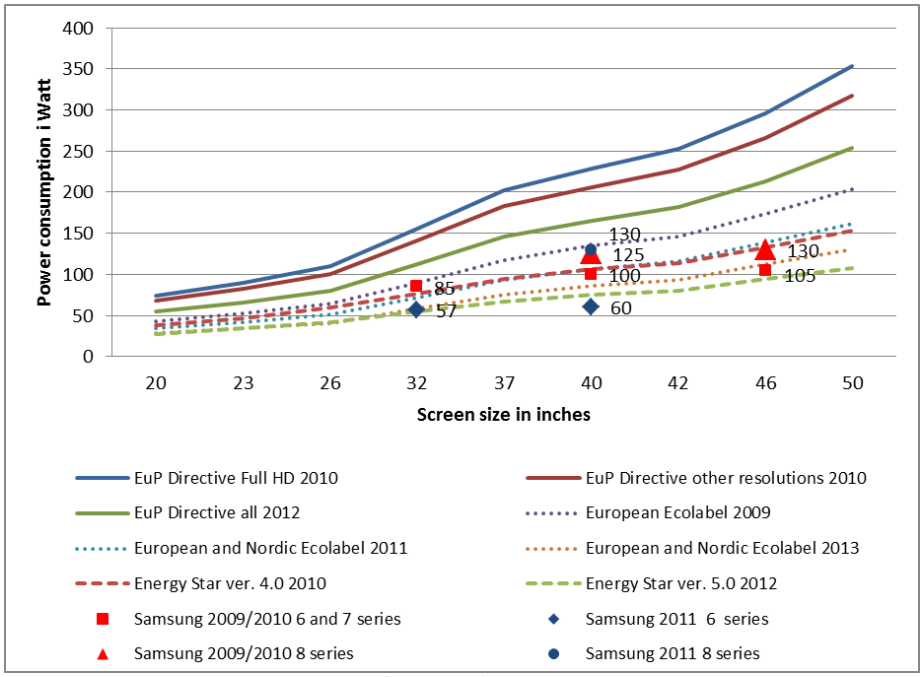

FIGURE 5-1 POWER CONSUMPTION OF SAMSUNG'S LED TVS, COMPARED TO THE REQUIREMENTS OF DIFFERENT ECOLABELS AND IM. (SAMSUNG ELECTRONICS NORDIC AB, N.D.; SAMSUNG, 2011)

All Samsung TVs can easily comply with the IM, the European Ecolabel and the Nordic Ecolabel, as shown in Figure 5-1. The Samsung Series 6 and 7 40" and 46 can even comply with the Energy Star 4.0 and tier 2 of the Flower criteria. The 46" also complies with tier 3 of the Flower criteria. All LED TVs can comply with the requirement of the European Ecolabel and the Nordic Ecolabel of a maximum energy consumption of 200 W. Even with the new 3D technology the 2011 32" TV of the 6 series can comply with the European Ecolabel 2013 and the 40" can comply with even the strictest requirements.

Power Consumption in Off-mode and Standby
As in the case of on-mode power consumption, the standby consumption is also low and the TVs do comply with all four ecolabels and recommendations from the preparatory study with regards to passive standby. It has however not been possible to find information on all power consumption categories. Table B1 in Appendix B summarises Samsung's LED TV Series 6, 7 and 8 performances on standby and off-mode power consumption

Chemicals
Due to the use of LED technology instead of fluorescent lights it has been possible for Samsung to eliminate the use of mercury. In Table B.2 in Appendix B the performance of Samsung's LED TVs on chemicals is compared to ecolabels and the requirements of the IM.

General Eco-design Requirements
It has been difficult to obtain all relevant information to determine Samsung's LED TVs compliance with the different ecolabels. However, as the TVs have been awarded the Nordic Ecolabel in 2009/2010 and the European Ecolabel in 2011 it is assumed that the requirements are met even though no information has been available for this study. Table B.3 in Appendix B summarises the compliance of Samsung's LED TVs with the ecolabels and the requirements of the IM.

Environmental Information
Data on environmental information to the consumer has been obtained though studying the user manuals of the TVs and studying the web pages of Samsung. In Table B.4 in Appendix Samsung's compliance with ecolabels and the IM is presented.

5.2.3 Sony

Sony produces several TV models, where Sony Bravia WE5 models are promoted as especially environmental friendly. The models Sony Bravia KDL 40WE5W and KDL 46WE5W (available in 40" and 46" respectively) are in 2010 awarded the European Ecolabel (Sony, 2010).

In January 2011, an analysis of Sonys TV portfolio was performed again and the analysis showed that the ecolabelled TVs performed worse in terms of power consumption than other Sony TVs. Hence in the analysis of BAT 2011 the TVs presented are not ecolabelled. The TVs investigated are KDL-40EX700 and KDL-46EX710 (available in 40" and 46"). (Sony, 2011)

In the following sections Sony's TVs will be compared to the ecolabel requirements and the IM. The complete overview of the comparison is presented in section 5.2.5, whereas more overall comments to the comparison are given in the below sections.

Power Consumption in on-mode
Sony Bravia is a LCD TV, which uses energy efficient backlight technology: micro-tubular Hot Cathode Fluorescent Lamp (HCFL). With this technology it has been possible to reduce power consumption with 50% compared to previous Bravia TVs (Sony, 2010).

Besides the energy efficient backlight technology, a number of features are installed that helps to reduce the power consumption even further. An intelligent presence censor detects body heat and movement in front of the TV, so if you leave the room the TV turns off the picture and only the sound is left on. The picture comes back when the presence censor detects movements again or it switches to standby if no movement has been registered in a longer period. A light censor registers the light in the room and adjusts the backlight accordingly to achieve highest energy efficiency. (Sony, 2010)

Sony Bravia has two modes; Shop mode and Home mode. In Shop mode the TV uses 38-46% more power in on-mode compared to Home mode depending on the screen size. Figure 5-2 illustrates the on-mode power consumption of Sony Bravia in Home mode.

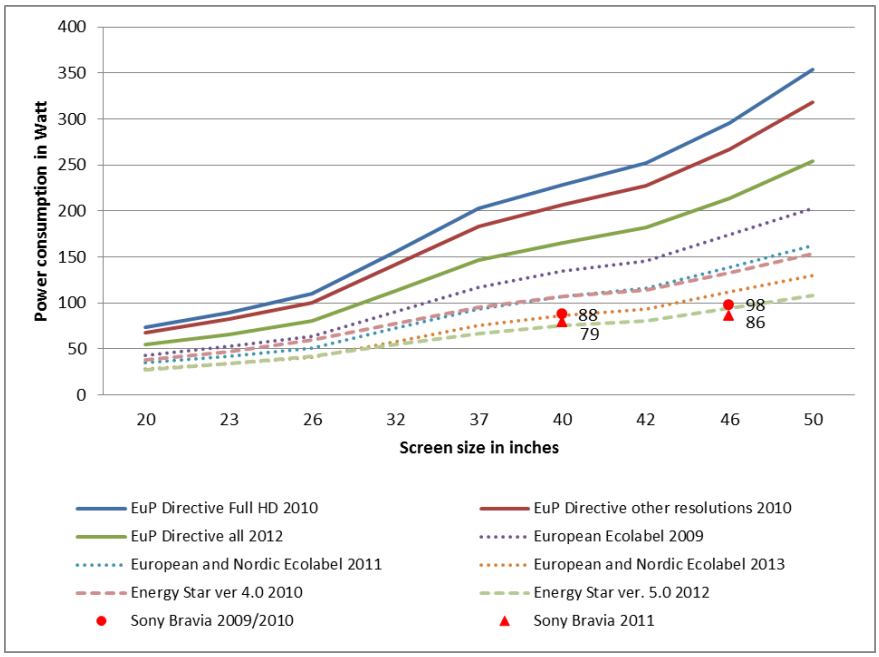

FIGURE 5-2 SONY BRAVIA POWER CONSUMPTION IN ON-MODE COMPARED TO ECOLABELS AND THE REQUIREMENTS OF THE IM (SONY, 2010; SONY, 2011).

Power Consumption in Off-mode and Standby
Sony Bravia performs very well when it comes to standby and off-mode power consumption. The TVs analysed in 2009/10 had a off-mode power consumption close to zero, information off-mode power consumption was not available in 2011. The standby power consumption was 0.17 W and 0.2 W in 2009/10 and 2011, respectively. As it appears from Table B.1 in Appendix B Sony Bravia does comply with all of the ecolabels.

Chemicals
With regards to the chemicals in the product it is assumed that Sony Bravia complies with the RoHS Directive, as non-compliant products cannot be put on the market in the EU, and hence complies with most of the requirements. It has, however, not been possible to find information on many of the TCO'06 requirements, see Table B.2 in Appendix B.

General Eco-design Requirements
It has been difficult to obtain information on Sony Bravia's compliance with the general eco-design requirements. As Sony Bravia 2009/2010 has been awarded the Nordic ecolabel and the European Ecolabel compliance is assumed even if no information was available. Table B.3 in Appendix B summarises compliance of Sony Bravia with the ecolabels and the requirements of the IM.

Environmental Information
Data on environmental information to the consumer has been obtained though studying the user manuals and studying the web pages of Sony. In Table B.4 in Appendix B Sony Bravia's compliance with ecolabels and the IM is presented.

5.2.4 Philips

In the 2011 analysis, it was found important to include Philips TVs in the study as Philips has achieved significant results in terms of low power consumption for TVs, see Figure 5-3. The TVs investigated are Philips Econova 42" and Philips 46" of the 7000 series, which have been awarded the European Ecolabel. Both TVs are based on the LED technology and several features ensure low power consumption. These features are 0 Watt Power-off-switch, light sensor, eco mode and picture mute (for radio), auto switch-off timer and the Econova further has an Eco settings menu. (Philips, 2010; Philips, 2011)

In the following sections Philips' TVs will be compared to the ecolabel requirements and the IM. The complete overview of the comparison is presented in section 5.2.5, whereas more overall comments to the comparison are given in the below sections.

Power Consumption in on-mode
As illustrated in Figure 5-3 both TVs perform very well on power consumption in on-mode. Philips Econova can comply with all of the requirements, while the 46" from the 7000 series can comply with all requirements except the Energy Star 2012 requirement.

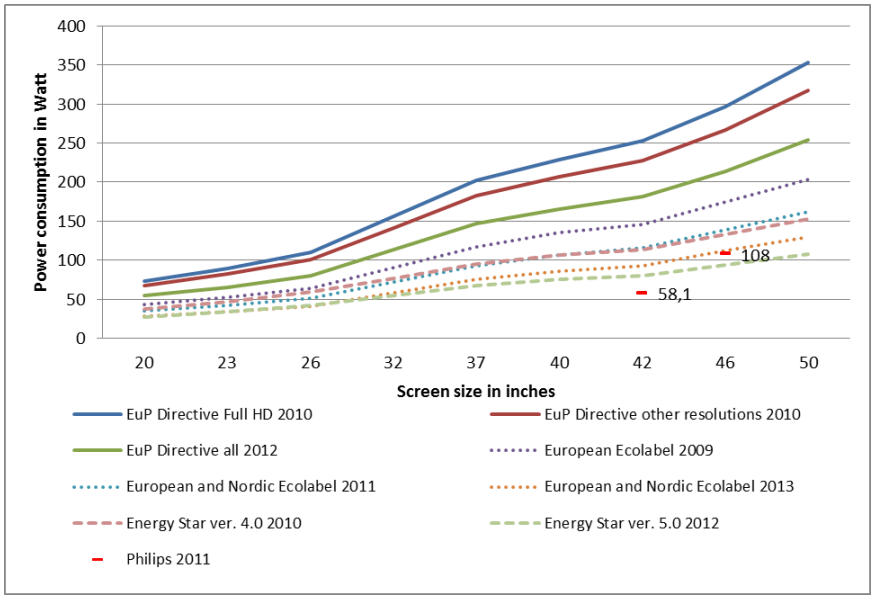

FIGURE 5-3 PHILIPS ECONOVA AND 7000 SERIES POWER CONSUMPTION IN ON-MODE COMPARED TO ECOLABELS AND THE REQUIREMENTS OF THE IM (PHILIPS, 2010; PHILIPS 2011)

Power Consumption in Off-mode and Standby
Philips Econova and 7000 series perform very well when it comes to standby and off-mode power consumption. The off-mode power consumption is 0.01 W and the standby power consumption is 0.15 W and 0.07 W, respectively for the two analysed TVs. As it appears from Table B.1 in Appendix B, Philips complies with all of the ecolabels.

Chemicals
With regard to the chemicals in the product it is assumed that Philips complies with the RoHS Directive, as non-compliant products cannot be put on the market in the EU and hence complies with most of the requirements. It

has, however, not been possible to find information on many of the TCO'06 requirements, see Table B.2 in Appendix B.

General Eco-design Requirements
It has been difficult to obtain information on Philips' compliance with the general eco-design requirements. As the investigated Philips TVs are awarded the European Ecolabel compliance is assumed even if no information was available. Table B.3 in Appendix B summarises compliance of Philips with the ecolabels and the requirements of the IM.

Environmental Information
Data on environmental information to the consumer has been obtained though studying the user manuals and studying the web pages of Philips. In Table B.4 in Appendix B Philips TVs' compliance with ecolabels and the IM is presented.

5.2.5 Comparison of BAT, Implementing Measures and Ecolabels

In the above sections, the performance of best available technologies (BAT) in this case Samsung's LED TVs and Sony Bravia and Philips Econova and 7000 series has been compared to the IM and Ecolabels. Appendix B summarises the comparison in tables.

Not surprisingly, the TVs including BAT's can easily comply with the requiremenst of the IM and several of the ecolabels, both when it comes to on-mode and standby power consumption. Looking at the development that has happened between the 2009/2010 and 2011 analysis it is clear that it is possible to visibly lower the power consumption within a year. For instance, Samsung 6 series has achieved a 40W reduction on the 40" TV.

Especially for the on-mode power consumption requirement, it becomes clear that the IM has not taken the performance level of new technologies into account, as all analysed TVs have significantly lower power consumption than what is required. Further, it should be noted that in the Sony case the best performing TVs in terms of power consumption where in 2011 not the ecolabelled TVs. Many of the TVs, especially in 2011 also perform better than what the European and Nordic Ecolabel require. This could be an indicator that the process of setting requirements in the ecolabels cannot follow the fast technological development and that the process of obtaining the label is too slow or complicated.

With regard to the performance on other environmental areas, the TVs including BATs also perform well as they have obtained different ecolabels. However, it has not been possible to find information on all areas.

5.3 Currently available TVs without ecolabels

This section focuses on current available TVs without an ecolabel and hence the group of TV expected to have most difficulties complying with the requirements of the EuP Directive. TVs from Samsung, Sony, Panasonic, LG, Grundig and Bang & Olufsen have been investigated.

The TVs are randomly selected covering different screen sizes and technologies. It is chosen only to investigate on-mode power consumption, standby and off-mode power consumption as these are the focus areas of the requirements of the EuP Directive and this information is easily available at

the producers' web pages. In the following sections the three areas will be elaborated.

5.3.1 Power Consumption in On-mode

In Figure 5-4 the on-mode power consumption of several TVs without ecolabels is compared to the requirements of the EuP Directive and ecolabels.

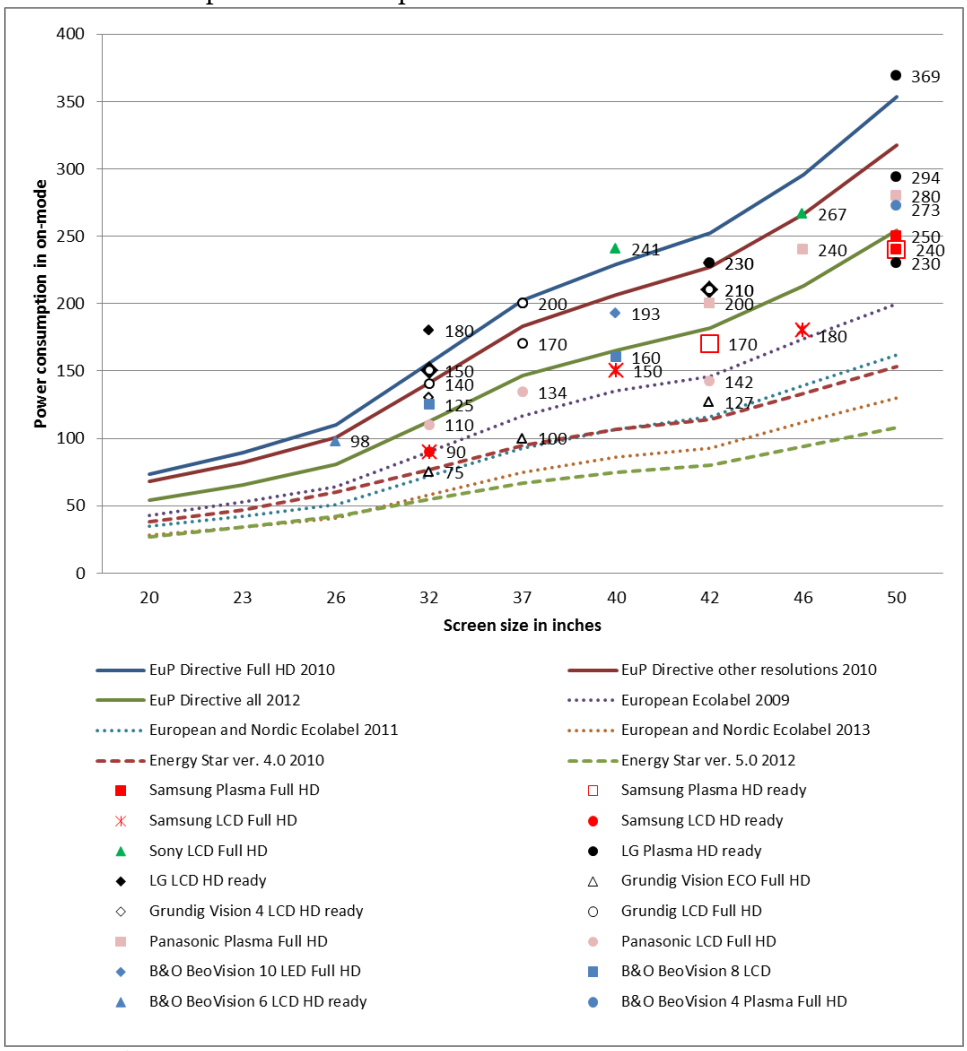

FIGURE 5-4 ON-MODE POWER CONSUMPTION OF CURRENTLY AVAILABLE TVS NOT AWARDED AN ECOLABEL COMPARED TO THE REQUIREMENTS OF THE EUP DIRECTIVE AND ECOLABELS.[9] (LG ELECTRONICS, 2010), (GRUNDIG, 2010A), (GRUNDIG, 2010B), (PANASONIC EUROPE LTD, 2010), (SONY, 2010), (SAMSUNG, 2010) AND (BANG & OLUFSEN, 2010)

From Figure 5-4 it appears that all investigated TVs from Samsung, Grundig, Panasonic and Bang & Olufsen can comply with the requirements of the EuP Directive of 2010. For Samsung, the Ecovision from Grundig, the LCD TVs from Panasonic and Bang & Olufsen's 40" BeoVision 8 can even comply with the requirement coming into force in 2012.

For the TVs from Sony the picture is slightly different; the 40" TV cannot comply with any of the EuP requirements, whereas the 46" TV can comply with the 2010 requirements. Also for the LG TVs the requirements are a challenge; for the three investigated plasma TVs only one (the 50" 230 W) can comply with the 2012 requirement, and two can comply with the 2010

[9] The on-mode power consumption values for Panasonic are the average on-mode power consumption, based on IEC 62087 Ed.2 measurement method.

requirement (the 50" 230 W and 294 W). For the LG LCD TVs the two investigated 32" (180 W and 150 W) cannot comply with any of the requirements. Regarding the 42" TVs, one can comply (210 W) and one cannot comply (230 W) with the 2010 requirement.

It is interesting to notice that already 50 % of all investigated TVs already comply with the IM for 2012. Of course the IM will lead to a fade out of the products that do not comply with the requirements, but it seems questionable how much further the IM will trigger ecoinnovation, than what the producers already are doing on their own.

5.3.2 Power Consumption in Off-mode and Standby

The investigated standby and off-mode power consumption of the selected TVs by Samsung, Panasonic and the Eco TV from Grundig can comply with the tier 1 and tier 2 passive standby requirements of the EuP Directive. See table C.1 in Appendix C.

Samsungs TVs can even comply with the standby requirements of all the ecolabels. Sony TVs cannot comply with the EuP requirements as the media receiver consumes too much power. The investigated TVs from Grundig, LG and Bang & Olufsen can comply with the 2010 requirement of the IM, but not the 2012 requirement. Unfortunately, it has not been possible to find information on other requirements than standby.

5.3.3 Comparison of available TVs, Implementing Measures and Ecolabels

In Section 5.3.1 and 5.3.2 the performance TVs without an ecolabel have been compared to the requirements of the IM and ecolabels, as these TVs were expected to have the most difficulties on complying with the requirements. Interestingly, our analysis showed that many TVs already comply with the IM requirements of 2012, both for standby and on-mode power consumption. Of course, the TVs must comply with the standby requirement as it stepped into force January 2010. It can also be assumed that the producers have taken measures to comply with the on-mode power consumption requirement, which steppes into force in August 2010. It is though puzzling that so many TVs already comply with requirements for 2012, both for standby and on-mode.

5.4 Subconclusion

From the above analysis two main conclusions can be drawn. Firstly, since all BAT TVs can easily comply with the IM and around half of the currently available technology TVs can comply with the IM, it seems that IM have not been able to adapt to the fast technological development. It appears clearly that for instance the LED technology has not been considered mature enough in the preparatory study phase to have an influence on the requirement development.

Secondly, in the case of BAT it seems that especially the European and Nordic Ecolabel have not either been able to keep up to date with the technological development. Many of the BAT TVs particularly in the 2011 analysis had on-mode power consumptions that were visibly lower than the requirements. This is problematic as precisely the ecolabels are supposed to represent the best on the market in terms of environmental performance.

Hence, the question seems obvious; do the requirements of the IM really trigger substantial eco innovation? The question is relevant regardless whether the producers have already implemented measures to comply with the requirements or not. In both cases, the requirements set up by the IM could have been more ambitious, if the goal is to improve eco-innovations on TVs substantially.

However, it is important to be aware of that small producers of TVs may have a more difficult access to new technology than the big producers. If the requirements are tightened that only the best performing technologies can comply it might distort the competition between the small and big producers, in an undesired way, which is not the purpose if the IM and the EuP Directive.

6 Energy Labelling for TVs

In this chapter the Energy Labelling Directive and its IM for TVs are analysed and compared to the requirements of the IM of the EuP Directive and the different ecolabels. The Energy Labelling for TVs was adopted in 2010 and serves as a supplement to the IM of the EuP Directive. This means that where the IM of the EuP Directive are minimum requirements, expelling the worst performing products from the market, the Energy Labelling are meant as incentives for the companies to achieve higher energy efficiency of their products. This difference in scope is illustrated in Figure 1-2 in Section 1.1.1.

In 1992 the first energy-labelling Directive was adopted. The Directive set a framework for mandatory energy labelling requirements for household appliances, such as refrigerators and washing machines. In 2008, a revision of the Directive began with the aim of including energy related products in the scope.

As in the EuP Directive the requirements of the Energy Labelling Directive are set up in Implementing Measures. TVs are also included in the scope in the revised Directive and in September 2010 the regulation with the requirements was adopted (European Commission, 2010).

The labelling requirements are that televisions placed on the European market must be supplied with a label containing the following information (European Commission, 2010):

1. the suppliers name or trade mark
2. the energy efficiency class
3. the on-mode power consumption and the annual on-mode energy consumption
4. the screen diagonal

The energy efficiency class is based on an energy efficiency index (EEI), which is calculated as follows (European Commission, 2010):

$EEI = P/P_{ref}(A)$, where

$P_{ref}(A) = P_{basic} + A \cdot 4.3224$ Watts/dm^2
P_{basic} = 20 Watts for television sets with one tuner/receiver and no hard disc
P_{basic} = 24 Watts for television sets with hard disc(s)
P_{basic} = 24 Watts for television sets with two or more tuners/receivers
P_{basic} = 28 Watts for television sets with hard disc(s) and two or more tuners/receivers
P_{basic} = 15 Watts for television monitors
A is the visible screen area in dm^2
P is the on-mode power consumption of the television in Watts

The energy efficiency class and index is illustrated in Table 6.1.

Table 6.1 The proposed energy efficiency class of TVs (European Commission, 2010: Annex 1)

Energy Efficiency Class	Energy Efficiency Index
A+++ (most efficient)	EEI < 0.10
A++	0.10 > EEI < 0.16
A+	0.16 > EEI < 0.23
A	0.23 > EEI < 0.30
B	0.30 > EEI < 0.42
C	0.42 > EEI < 0.60
D	0.60 > EEI < 0.80
E	0.80 > EEI < 0.90
F	0.90 > EEI < 1.00
G (least efficient)	1.00 > EEI

The label is be gradually tightened, meaning that on the label applicable 12 months after the publication of the Implementing measure the most energy efficient label possible to obtain is A. From 2014, it will be possible to obtain the label A+ and the F will be the least efficient label. In 2017, A++ will be the most efficient label and E will be the least efficient label. Finally in 2020 the most efficient label is A+++ and E will be the least efficient label. (European Commission, 2010)

6.1 Comparison of the Energy Efficiency label with the EuP Directive and ecolables

Compared to the EuP Directive and the ecolabels presented in this report the Energy labelling Directive has a new approach as the label is assigned on the basis of an energy efficiency index. It does not forbid the entry into the market if certain energy consumption values are not met, but the manufacturers are forced to label their products correctly. In this way the Energy labelling Directive can be seen as similar to ecolabels – only with the difference that the label is mandatory.

In Figure 6-1 the requirements of the Energy Labelling Directive for TV sets are compared to the requirements of the EuP Directive and the ecolabels. As the Energy Labelling Directive works with an energy efficiency index that is divided in intervals, the lines in Figure 6-1 represent the maximum power consumption the products must have in order to obtain the given label. As an example, in order for the product to obtain the energy efficiency label A+ the product must have a power consumption that is between the A+ line and the A++ line. In order to obtain the label G the power consumption of the product must be above the line of F.

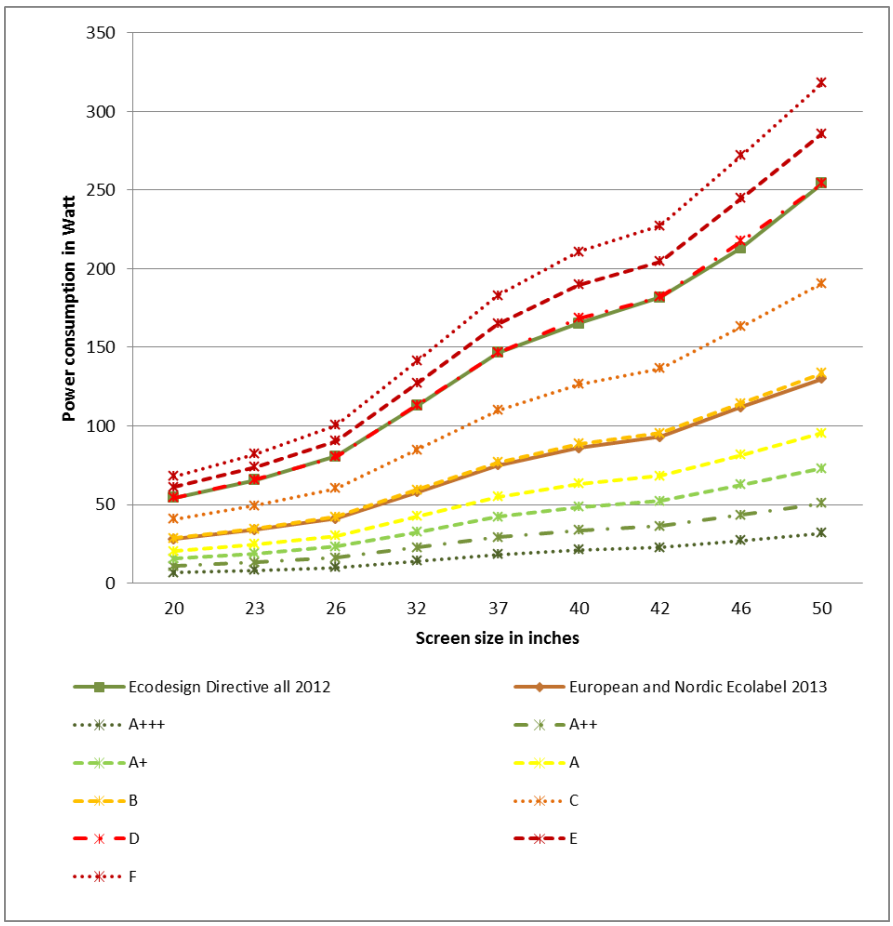

FIGURE 6-1 COMPARISON OF THE ON-MODE POWER CONSUMPTION REQUIREMENTS OF THE ENERGY LABELLING DIRECTIVE WITH THE EUP DIRECTIVE AND ECOLABELS. BASED ON (EUROPEAN COMMISSION, 2009C: ANNEX 1), (EUROPEAN COMMISSION, 2009B), (ENERGY STAR, 2009) AND (EUROPEAN COMMISSION, 2010).

Figure 6-1 illustrates that the energy efficiency label covers all TVs from the most inefficient that cannot comply with the requirements of the EuP Directive to TVs that are much more efficient than the ecolabels. The role of the EuP Directive as minimum directive removing the worst performing products from the market also becomes clear. The 2010 Full HD requirement would comply with a G label, which is the least energy efficient; the 2010 requirement for other resolution is approximately on the same line as the maximum of the F label. Even the 2012 EuP requirement would only comply with a D label.

When comparing the Energy efficiency label to the requirements of the ecolabels, it is interesting to see that even the strictest European Ecolabel requirement applicable from 2013 is on the level of the B label of the energy efficiency label and the A label is stricter. Both the European and the Nordic Ecolabel are continuously updated and tightened, but it seems that despite this mechanism the energy efficiency label has a stricter point of departure, thereby setting higher demands on the products. A simple solution is that the eco-label always should be equivalent to minimum A-label or better.

It can be argued that where the role of EuP Directive as driver for eco-innovations of TVs is rather unclear, then the energy-labelling scheme will take over and create incentives for producers to improve their products' energy efficiency. However, once again the focus of the label is solely on energy efficiency in on-mode and other significant environmental impacts are

not addressed in the label. Therefore, while the energy efficiency label might create the right incentives for producer to improve their TVs' energy efficiency other measures are necessary in order to improve the environmental performance of TVs in a life cycle perspective.

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Comparison of Implementing Measures and Ecolabels

Table A.1 Comparison of standby and off-mode requirements of Implementing Measures and ecolabels

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Off-mode tier 1	Compliance in 2010: ≤ 1,00 W				
Off mode tier 2	Compliance in 2011: ≤ 0,5 W if the TV has an easily visible off switch putting the TV in off-mode using ≤ 0,01 W Otherwise: ≤ 0,3 W				
Off mode	TVs shall have an off-mode and/or standby-mode, and/or another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode when the TV is connected to the mains power source.		All products shall have a clearly visible on-off switch		
Passive standby tier 1	Compliance in 2010: ≤ 1,00 W ≤ 2,00 W if the TV is providing information or status display	≤ 0,50 W if energy consumption in off mode < 0,01 W All other equipment: ≤0,3 W	≤ 0,50 W if energy consumption in off mode < 0,01 W All other equipment: ≤0,3 W	sleep mode: ≤ 1 W	≤ 1W

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Passive standby tier 2	Compliance in 2011: ≤ 0,50 W ≤ 1,00 W if the TV is providing information or status display				
Passive standby	For TV sets which consist of a display, and one or more tuner(s)/receiver(s) and optional additional functions for data storage and/or display such as digital versatile disc (DVD), hard disk drive (HDD) or videocassette recorder (VCR) in one or more separate units, points (a) to (c) apply for the display and the separate unit(s) individually				
Active standby low tier 1				Additional: 01.05.2010 ≤ 0.08 kWh/day	
Active standby low tier 2				Additional: 01.05.2012 ≤ 0.02 kWh/day	

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Automatic power down	Compliance in 2011: After no more than 4 hours in on mode following the last user interaction and/or a channel change, the TVs shall be automatically switched from on mode to: — standby-mode, or, — off-mode, or, — another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode				
	TVs shall display an alert message before the automatic switch from on mode to the applicable condition/modes. This function shall be set as default.				
Home-Mode	TVs with forced menu on initial activation of the television shall provide a 'home-mode' in the forced menu, which shall be the default choice on initial activation of the TV. If the user selects a mode other than 'home mode' on initial activation of the TV, a second selection process shall be prompted to confirm this choice.				

Table A..2 Comparison of chemical requirements of the Implementing Measures and ecolabels

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Substances regulated in the RoHS Directive 2002/95/EC	The product must comply with the RoHS Directive 2002/95/EC	Products must not contain cadmium, lead, mercury, chromium 6+, DecaBDE (deca brominated diphenyl ether), PBB (polybrominated biphenyls) and PBDE (polybrominated diphenyl ethers). Unless their maximum concentration value of is equal to or lower than the threshold laid down in Directive 2002/95/EC and subsequent amendments. In the case of PBB and PBDE the maximum concentration value is <0.1%.		Components must comply with the RoHS Directive 2002/95/EC and its amendments Exempted are mercury in background lighting systems and PBB and PBDE in printed wiring boards
	Mercury content in fluorescent lamps: The total, amount of mercury in all lamps, per screen, shall be no greater than 75 mg Hg for screen sizes up to 40", and no greater than 99 mg Hg for screen sizes above 40"	The background lightning in the TV-screen can not have any mercury (Hg) content.		decaBDE is not allowed even if EU has decided to except it from the RoHS Directive 2002/95/EC
		Chlorinated paraffin may not be used in products.		

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Other flame retardants		Flame retardants containing organohalogen compounds are not permitted		Plastic parts weighing more than 25 g. shall not contain flame retardants that contain bromine or chlorine. Printed Wiring Boards are exempted.
	Plastic parts may not contain flame retardants, or preparations that are assigned or may be assigned the risk phrases: R40 (possible risk of cancer), R45(may cause cancer), R46 (may cause heritable generic damage), R50 (very toxic to aquatic organisms), R51 (toxic to aquatic organisms), R52 (harmful to aquatic organisms), R53 (may cause long term adverse effects in the aquatic environment), R60(may impair fertility) and R61 (may cause harm to unborn child), R62 (possible risk of impaired fertility), R63 (possible risk of harm to the unborn child)	Plastic parts may not contain flame retardants which are assigned or may be assigned the risk phrases: R45(may cause cancer), R46 (may cause heritable generic damage), R60(may impair fertility) and R61 (may cause harm to unborn child)		The material specifications shall be provided for plastic parts and PWB laminates that weigh more than 25 grams and which have flame retardant concentrations above 0.5 percent by weight.
Batteries				Limit values per listed part: Mercury = 2ppm Cadmium = 5 ppm Lead = 50 ppm

Table A.3 Comparison of general ecodesign requirements of the Implementing Measures and ecolabels

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Dismantling	The manufacturer shall demonstrate that the product can be easily dismantled by professional recyclers	The manufacturer shall demonstrate that the product can be easily dismantled by professional recyclers		Connections to be separated during disassembly of FDP must be easy to take apart in order to not damage the mercury lamps. This means that gluing and welding must not be used to bond parts.
				Plastic parts weighing more than 25 g must be material-coded in accordance with ISO 11469 and ISO 1043-1, -2, -3, and -4. Exempted are laminates for printed Wiring board
				The total amount of mercury must be declared in a table
				No more than two different types of plastic materials are accepted for parts weighing more than 100 g in each unit. The light guide in FPD panels are exempted
				There shall be no internal or external metallization of the FPD outer plastic casing and foot
				Moulded-in or glued metal parts are not accepted

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
Life-time extension	The manufacturer shall offer a commercial guarantee to ensure that the product will function for the least two years	The manufacturer shall offer a commercial guarantee to ensure that the product will function for the least two years		
	The availability of compatible electronic replacement parts shall be guaranteed for seven years from the time the production ceases	The availability of compatible electronic replacement parts shall be guaranteed for seven years from the time the production ceases		

Table A.4 Comparison of information requirements of the Implementing measures and ecolabels

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
	Information that the product has been awarded the flower	Information that the product has been awarded the Nordic Ecolabel	Information about the Energy Star	

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
The product's power consumption in on-mode, standby and off-mode	The product's power consumption information in various modes; on, off and passive standby, including information on energy savings possible in different modes	The product's power consumption information in various modes; on, off and passive standby		
	Explanations of how to reduce power consumption when the product is not being used	Explanations of how to reduce power consumption when the product is not being used	Information about the benefits of keeping the TV in its default mode	
If the product contains mercury or lead				
	The television's average annual energy consumption expressed in kWh, calculated on the basis of the on-mode power consumption, operating 4 hours a day and 365 days a year	Average annual energy consumption		
	Information that the energy efficiency cuts energy consumption and thus saves money by reducing the electricity bill			
	The position of the hard off switch			

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06
	Repair information regarding who is qualified to repair products	Repair information regarding who is qualified to repair products		
				A product declaration shall be provided for the FPD
	End-of-life instructions for proper disposal	End-of-life instructions for proper disposal		Information in the user's manual of the possibility to dispose of the FPD by environmentally acceptable recycling.
The ratio of the peak luminance of the on-mode or home-mode condition of the TV as delivered by the manufacturer and the peak luminance of the brightest on-mode condition provided by the TV, expressed in percentage, rounded to the nearest integer				

References: (Energy Star, 2009), (European Commission, 2009a), (European Commission, 2009b), (Nordic Ecolabelling. 2009) and (Rudling, Jan and Helena Nordin, 2006)

Comparison of Best Available Technologies Implementing Measures and Ecolabels

Table B.1 Comparison of Samsung LED TVs, Sony Bravia, Philips, Implementing Measures and Ecolabels on standby and of-mode power consumption.

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series 2009/2010	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Off-mode tier 1	Compliance in 2010: ≤ 1,00 W					No information available	No information available	~ 0 Watt	No information available	<0.01 W (Econova)
Off mode tier 2	Compliance in 2011: ≤ 0,5 W if the TV has an easily visible off switch putting the TV in off-mode using ≤ 0,01 W Otherwise: ≤ 0,3 W					No information available	No information available	~ 0 Watt	No information available	<0.01 W(Econova)

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series 2009/2010	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Off mode	TVs shall have an off-mode and/or standby-mode, and/or another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode when the TV is connected to the mains power source.		All products shall have a clearly visible on-off switch			Off switch on the front of the television	No information available	Energy Saving Switch on the side of the television	No information available	0 Watt Power-off-switch
Passive standby tier 1	Compliance in 2010: ≤ 1,00 W ≤ 2,00 W if the TV is providing information or status display	≤ 0,50 W if energy consumption in off mode < 0,01 W All other equipment: ≤0,3 W	≤ 0,50 W if energy consumption in off mode < 0,01 W All other equipment: ≤0,3 W	sleep mode: ≤ 1 W	≤ 1W	<0.1 W	<0.3 W - 0.06 W	0,17 W	0.2 W	0.15 W (7000) 0.07 W (Econova)
Passive standby tier 2	Compliance in 2011: ≤ 0,50 W ≤ 1,00 W if the TV is providing information or status display					<0.1 W	<0.3 W - 0.06 W	0,17 W	0.2 W	0.15 W (7000) 0.07 W (Econova)

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series 2009/2010	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Passive standby	For TV sets which consist of a display, and one or more tuner(s)/receiver(s) and optional additional functions for data storage and/or display such as digital versatile disc (DVD), hard disk drive (HDD) or videocassette recorder (VCR) in one or more separate units, points (a) to (c) apply for the display and the separate unit(s) individually									
Active standby low tier 1				Additional: 01.05.2010 ≤ 0.08 kWh/day		No information available	No information available	No information available	No information available	No information available
Active standby low tier 2				Additional: 01.05.2012 ≤ 0.02 kWh/day		No information available	No information available	No information available	No information available	No information available

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series 2009/2010	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Automatic power down	Compliance in 2011: After no more than 4 hours in on mode following the last user interaction and/or a channel change, the TVs shall be automatically switched from on mode to: — standby-mode, or, — off-mode, or, — another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode					No information available	No information available	No information available	No information available	Auto switch-off timer
	TVs shall display an alert message before the automatic switch from on mode to the applicable condition/modes. This function shall be set as default.					No information available	No information available	No information available	No information available	No information available

	Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series 2009/2010	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Home-Mode	TVs with forced menu on initial activation of the television shall provide a 'home-mode' in the forced menu, which shall be the default choice on initial activation of the TV. If the user selects a mode other than 'homemode' on initial activation of the TV, a second selection process shall be prompted to confirm this choice.					No information available	No information available	No information available	No information available	No information available

Table B.2 Comparison of Samsung LED TVs, Sony Bravia, Philips and Ecolabels on chemicals in the product

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Substances regulated in the RoHS Directive 2002/95/EC	The product must comply with the RoHS Directive 2002/95/EC	PBB, PBDE, or chlorinated paraffins may not be used in the products unless the concentration value is ≤ the		Components must comply with the RoHS Directive 2002/95/EC and its amendments Excempted are	Complies with the RoHS Directive 2002/95/EC and its amendments	Complies with the RoHS Directive 2002/95/EC and its amendments	Complies with the RoHS Directive 2002/95/EC and its amendments	Complies with the RoHS Directive 2002/95/EC and its amendments	Complies with the RoHS Directive 2002/95/EC and its amendments

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
		threshold specified in Directive 2002/95/EC		mercury in background lighting systems and PBB and PBDE in printed wiring boards					
	Mercury content in fluorescent lamps: The total, amount of mercury in all lamps, per screen, shall be no greater than 75 mg Hg for screen sizes up to 40", and no greater than 99 mg Hg for screen sizes above 40"	Mercury content in LCD displays: In total, the lamp shall contain no more than 75 mg Hg for screen sizes up to 40", and no more than 99 mg Hg for screen sizes above 40"		decaBDE is not allowed even if EU has decided to excempt it from the RoHS Directive 2002/95/EC	There are no fluorescent lamps as the LED technology is being used, hence no mercury is used	There are no fluorescent lamps as the LED technology is being used, hence no mercury is used	Sony Bravia complies with the European Ecolabel	There are no fluorescent lamps as the LED technology is being used, hence no mercury is used	Philips complies with the European Ecolabel

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
		Flame retardants containing cadmium, lead, mercury, chromium 6+, PBB, PBDE shall not used in the products unless the concentration value is ≤ the threshold specified in Directive 2002/95/EC			Samsung complies with the Nordic Ecolabel regarding flame retardants	Samsung complies with the Euroepan Ecolabel regarding flame retardants in plastics	Complies with the RoHS Directive 2002/95/EC and its amendments	No information available	Philips complies with the Euroepan Ecolabel regarding flame retardants in plastics
Other flame retardants		Flame retardants containing organohalogen compounds are not permitted		Plastic parts weighing more than 25 g. shall not contain flame retardants that contain bromine or chlorine. Printed Wiring Boards are	Samsung complies with the Nordic Ecolabel regarding flame retardants No information available on	Samsung complies with the Euroepan Ecolabel regarding flame retardants in plastics	There are no halogens in the packaging or the parts of Sony Bravia No information available on TCO'06 compliance	There are no halogens in the packaging or the parts of Sony Bravia No information available on TCO'06 compliance	No information available

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
				excempted.	TCO'06 compliance				
	Plastic parts may not contain flame retardants, or preparations that are assigned or may be assigned the risk phrases: R40 (possible risk of cancer), R45(may cause cancer), R46 (may cause heritable generic damage), R50 (very toxic to aquatic organisms), R51 (toxic to aquatic organisms),	Plastic parts may not contain flame retardants which are assigned or may be assigned the risk phrases: R45(may cause cancer), R46 (may cause heritable generic damage), R60(may impair fertility) and R61 (may cause harm to unborn child)		The material specifications shall be provided for plastic parts and PWB laminates that weigh more than 25 grams and which have flame retardant concentrations above 0.5 percent by weight.	Samsung complies with the Nordic Ecolabel regarding flame retardants in plastic parts May contain plastic parts, which are assigned the risk phrase R40 (possible risk of cancer), R62 (possible risk of impaired fertility) and R63 (possible risk of harm to unborn child)	Samsung complies with the Euroepan Ecolabel regarding flame retardants in plastics	Sony Bravia complies with the European Ecolabel No information available on TCO´06 compliance	No information available	Philips complies with the European Ecolabel No information available on TCO´06 compliance

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
	R52 (harmful to aquatic organisms), R53 (may cause long term adverse effects in the aquatic environment), R60(may impair fertility) and R61 (may cause harm to unborn child), R62 (possible risk of impaired fertility), R63 (possible risk of harm to the unborn child)				No information available on TCO'06 compliance				
Batteries				Limit values per listed part: Mercury = 2ppm Cadmium = 5 ppm	No information available	No information available	No information available	No information available	No information available

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
				Lead = 50 ppm					

Table B.3 Comparison of Samsung LED TVs, Sony Bravia, Philips and Ecolabels on general eco-design requirements

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Dismantling	The manufacturer shall demonstrate that the product can be easily dismantled by professional recyclers	The manufacturer shall demonstrate that the product can be easily dismantled by professional recyclers		Connections to be seperated during dissassembly of FDP must be easy to take apart in order to not damage the mercury lamps. This means that gluing and welding must not be used to bond parts.	Samsung complies with the Nordic Ecolabel regarding dismantling	Samsung complies with the European Ecolabel regarding dismantling	Sony Bravia complies with the European and the Nordic Ecolabel	No information available	Philips complies with the European Ecolabel

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
				Plastic parts weighing more than 25 g must be material-coded in accordance with ISO 11469 and ISO 1043-1, -2, -3, and -4. Excempted are laminates for printed Wiring board	No information available	No information available	All parts complies with ISO 11469	No information available	No information available
				The total amount of mercury must be declared in a table	There are no flourescent lamps as the LED technology is being used, hence no mercury is used	There are no flourescent lamps as the LED technology is being used, hence no mercury is used	No information in the user manuals	There are no flourescent lamps as the LED technology is being used, hence no mercury is used	There are no flourescent lamps as the LED technology is being used, hence no mercury is used

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
				No more than two different types of plastic materials are accepted for parts weighing more than 100 g in each unit. The light guide in FPD panels are excempted	No information available	No information available	No information available	No information available	No information available
				There shall be no internal or external metallization of the FPD outer plastic casing and foot	No information available	No information available	No information available	No information available	No information available
				Moulded-in or glued metal parts are not accepted	No information available	No information available	No information available	No information available	No information available

	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
Life-time extension	The manufacturer shall offer a commercial guarantee to ensure that the product will function for the least two years	The manufacturer shall offer a commercial guarantee to ensure that the product will function for the least two years			Samsung complies with the European and the Nordic Ecolabel regarding commercial guarantee	Samsung complies with the European Ecolabel regarding commercial guarantee	Sony Bravia complies with the EU Flower and the Nordic Ecolabel	No information available	Philips complies with the European Ecolabel regarding commercial guarantee
	The availability of compatible electronic replacement parts shall be guaranteed for seven years from the time the production ceases	The availability of compatible electronic replacement parts shall be guaranteed for seven years from the time the production ceases			Samsung complies with the European and the Nordic Ecolabel regarding replacement parts	Samsung complies with the European Ecolabel regarding commercial guarantee	Sony Bravia complies with the EU Flower and the Nordic Ecolabel	No information available	Philips complies with the European Ecolabel regarding replacement parts

Table B.4 Comparison of Samsung LED TVs, Sony Bravia, Philips, Implementing Measures on information requirements

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
	Information that the product has been awarded the flower	Information that the product has been awarded the Nordic Ecolabel	Information about the Energy Star		Samsung complies with the European and the Nordic Ecolabel regarding information on awarded ecolabels	Samsung complies with the European and the Nordic Ecolabel regarding information on awarded ecolabels	Sony Bravia complies with the European Ecolabel	Not in compliance, sinse it is not ecolabelled	Philips complies with the European Ecolabel regarding information on awarded ecolabels
The product's power consumption in on-mode, standby and off-mode	The product's power consumption information in various modes; on, off and passive standby, including information on energy savings possible in different modes	The product's power consumption information in various modes; on, off and passive standby			Samsung complies with the European and the Nordic Ecolabel regarding information on the product's power consumption	Samsung complies with the European and the Nordic Ecolabel regarding information on the product's power consumption	Sony Bravia complies with the European Ecolabel	Information on power consumption in standby and on-mode is provided	Philips complies with the European Ecolabel regarding information on the product's power consumption

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
	Explanations of how to reduce power consumption when the product is not being used	Explanations of how to reduce power consumption when the product is not being used	Information about the benefits of keeping the TV in its default mode		It is in the user manuals recommended to unplug the set from the mains and aerial when being away for longer periods of time, for instance on holiday	It is in the user manuals recommended to	The different energi savings functions are described in the user manual	No information available	It is in the user manuals explained how to access the energy saving functions
If the product contains mercury or lead					No mercury is being used in the LED technology	No mercury is being used in the LED technology	No information available	No information available	No mercury is being used in the LED technology
	The television's average annual energy consumption expressed in kWh, calculated on the basis of the on-mode power	Average annual energy consumption			Samsung complies with the European and the Nordic Ecolabel regarding information on the product's average	Samsung complies with the European and the Nordic Ecolabel regarding information on the product's average	Sony Bravia complies with the European Ecolabel	No information available	Philips complies with the European Ecolabel regarding information on the product's average annual energy consumption

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
	consumption, operating 4 hours a day and 365 days a year				annual energy consumption	annual energy consumption			
	Information that the energy efficiency cuts energy consumption and thus saves money by reducing the electricity bill				No information in the user manuals	No information in the user manuals	No information on the user manual	No information available	Philips complies with the European Ecolabel
	The position of the hard off switch				The position of the hard off switch is illustrated in the user manuals	The position of the hard off switch is illustrated in the user manuals	The position of the hard off switch is illustrated in the user manuals	No information available	The position of the hard off switch is illustrated in the user manuals
	Repair information regarding who is qualified to repair	Repair information regarding who is qualified to repair			No information in the user manuals	No information in the user manuals	It is in the user manual written that you should contact your	No information available	Philips complies with the European Ecolabel

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
	products	products					Sony Service Center or dealer when the televisions is broken		
				A product declaration shall be provided for the FPD	No information in the user manuals	No information in the user manuals	No information in the user manuals	No information available	No information available
	End-of-life instructions for proper disposal	End-of-life instructions for proper disposal		Information in the user's manual of the possibility to dispose of the FPD by environmentally acceptable recycling.	No information in the user manuals	No information in the user manuals	No information in the user manuals	No information available	Philips complies with the European Ecolabel

Implementing Measures	European Ecolabel	Nordic Ecolabel	Energy Star ver. 4.0 and 5.0	TCO'06	Samsung 6, 7, 8 series	Samsung 6, 8 series 2011	Sony Bravia 2009/2010	Sony Bravia 2011	Philips
The ratio of the peak luminance of the on-mode or home-mode condition of the TV as delivered by the manufacturer and the peak luminance of the brightest on-mode condition provided by the TV, expressed in percentage, rounded to the nearest integer					No information available	No information in the user manuals	No information available	No information available	No information available

References: (Sony, 2010), (Sony, 2011), (Samsung Electronics Nordic AB, n.d.), (Samsung, 2011), (Philips 2010) and (Philips 2011).

Comparison of Currently Available Technologies, Implementing Measures and Ecolabels

Table c.1 Standby and Off-mode power consumption of currently available TVs not awarded an ecolabel compared to the requirements of the EuP Directive and ecolabels.

	Implementing Measures	European Ecolabel ver. 4.0 and 5.0	Nordic Ecolabel	Energy Star	TCO'06	Samsung LCD and Plasma	Sony 40" and 46"	LG	Grundig	Panasonic	Bang & Olufsen
Off-mode tier 1	Compliance in 2010: ≤ 1,00 W					No information available	No information available	No information available	No information available	No information available	No information available
Off mode tier 2	Compliance in 2011: ≤ 0,5 W if the TV has an easily visible off switch putting the TV in off-mode using ≤ 0,01 W Otherwise: ≤ 0,3 W					No information available	No information available	No information available	No information available	No information available	No information available

	Implementing Measures	European Ecolabel ver. 4.0 and 5.0	Nordic Ecolabel	Energy Star	TCO'06	Samsung LCD and Plasma	Sony 40" and 46"	LG	Grundig	Panasonic	Bang & Olufsen
Off mode	TVs shall have an off-mode and/or standby-mode, and/or another condition which does not exceed the applicable power consumption requirements for off-mode and/or standby-mode when the TV is connected to the mains power source.		All products shall have a clearly visible on-off switch			No information available	No information available	No information available	No information available	No information available	No information available
Passive standby tier 1	Compliance in 2010: ≤ 1,00 W ≤ 2,00 W if the TV is providing information or status display	≤ 0,50 W if energy consumption in off mode < 0,01 W All other equipment: ≤0,3 W	≤ 0,50 W if energy consumption in off mode < 0,01 W All other equipment: ≤0,3 W	sleep mode: ≤ 1 W	≤ 1W	< 0.3 W	0.45 W (screen) 3.4 W (Media receiver)	1 W	< 1 W < 0.1 W (Vision Eco)	0.3-0.45 W	0.8-1 W
Passive standby tier 2	Compliance in 2011: ≤ 0,50 W ≤ 1,00 W if the TV is providing					< 0.3 W	0.45 W (screen) 3.4 W (Media	1 W	< 1 W < 0.1 W (Vision Eco)	0.3-0.45 W	0.8-1 W

	Implementing Measures	European Ecolabel ver. 4.0 and 5.0	Nordic Ecolabel	Energy Star	TCO'06	Samsung LCD and Plasma	Sony 40" and 46"	LG	Grundig	Panasonic	Bang & Olufsen
	information or status display						receiver)				
Passive standby	For TV sets which consist of a display, and one or more tuner(s)/receiver(s) and optional additional functions for data storage and/or display such as digital versatile disc (DVD), hard disk drive (HDD) or videocassette recorder (VCR) in one or more separate units, points (a) to (c) apply for the display and the separate unit(s) individually										

	Implementing Measures	European Ecolabel ver. 4.0 and 5.0	Nordic Ecolabel	Energy Star	TCO'06	Samsung LCD and Plasma	Sony 40" and 46"	LG	Grundig	Panasonic	Bang & Olufsen
Active standby low tier 1				Additional: 01.05.2010 ≤ 0.08 kWh/day		No information available	No information available	No information available	No information available	No information available	No information available
Active standby low tier 2				Additional: 01.05.2012 ≤ 0.02 kWh/day		No information available	No information available	No information available	No information available	No information available	No information available
Automatic power down	Compliance in 2011: After no more than 4 hours in on mode following the last user interaction and/or a channel change, the TVs shall be automatically switched from on mode to: — standby-mode, or, — off-mode, or, — another condition which does not exceed the applicable					No information available	No information available	No information available	No information available	No information available	No information available

	Implementing Measures	European Ecolabel ver. 4.0 and 5.0	Nordic Ecolabel	Energy Star	TCO'06	Samsung LCD and Plasma	Sony 40" and 46"	LG	Grundig	Panasonic	Bang & Olufsen
	power consumption requirements for off-mode and/or standby-mode										
	TVs shall display an alert message before the automatic switch from on mode to the applicable condition/modes. This function shall be set as default.					No information available	No information available	No information available	No information available	No information available	No information available
Home-Mode	TVs with forced menu on initial activation of the television shall provide a 'home-mode' in the forced menu, which shall be the default choice on initial activation of					No information available	No information available	No information available	No information available	No information available	No information available

	Implementing Measures	European Ecolabel ver. 4.0 and 5.0	Nordic Ecolabel	Energy Star	TCO'06	Samsung LCD and Plasma	Sony 40" and 46"	LG	Grundig	Panasonic	Bang & Olufsen
	the TV. If the user selects a mode other than 'home mode' on initial activation of the TV, a second selection process shall be prompted to confirm this choice.										

References: (LG Electronics, 2010), (Grundig, 2010a), (Grundig, 2010b), (Panasonic Europe Ltd, 2010), (Sony, 2010), (Samsung, 2010) and (Bang & Olufsen, 2010)

Summary

English

The focus of this report is the implementation of the EU Directive 2005/32/EC on ecodesign requirements for energy using products (the EuP Directive) with special attention to the ecodesign requirements for televisions (TV). The aim is to investigate the scope of the Implementing Measures (IM), how ambitious the requirements of the IM are, and to what degree they can promote eco-innovations of TVs.

It is concluded that the potential of the EuP Directive has not been fully realized, since only requirements related to energy efficiency in the use phase have been set up, while other improvement potentials based on an ecodesign rationale have been neglected.

Danish

Denne rapport omhandler implementeringen af EU Direktiv 2005/323/EF om rammerne om fastlæggelse af krav til miljøvenligt design af energiforbrugende produkter (EuP Direktivet), med særlig vægt på miljøkravene til fjernsyn. Målet er at undersøge gennemførelsesforanstaltningernes rækkevidde, hvor ambitiøse gennemførelsesforanstaltningerne (IM) er og i hvilken grad de vil promovere miljøvenlig innovation.

Det konkluderes bl.a., at potentialet i EuP direktivet ikke er blevet udfoldet fuldt ud, idet der kun er opstillet energieffektivitetskrav relateret til brugsfasen, mens andre forbedringspotentialer ud fra et eco-design rationale er blevet negligeret.

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