MAPPING THE ENVIRONMENTAL IMPACTS, INTERVENTIONS & EVIDENCE REQUIREMENTS FOR THE TV ROADMAP

A report completed for the Department for Environment, Food and Rural Affairs

December 2007

Global View Sustainability Services

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This research was conducted as an internal report for the Defra SCP Evidence Base by the consultant below while working on contract with the SCP Evidence Base. The views expressed reflect the research findings and the authors' interpretation; they do not necessarily reflect Defra policy or opinions.

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TABLE OF CONTENTS

Glossary

BAT	Best Available Technique
CPR	Collective Producer Responsibility
Defra	Department for Environment, Food and Rural Affairs
ECMA	ICT & CE industry standarisation association
EEE	Electrical and Electronic Equipment
EuP	Energy Using Product
ICER	Industry Council for Equipment Recycling
IPR	Individual Producer Responsibility
MTP	Market Transformation Programme
RoHS	Restriction of Hazardous Substances
WEEE	Waste Electrical and Electronic Equipment

Executive Summary

To inform the TVs Roadmap being developed by Defra Sustainable Products and Materials (SPM), a short review of existing evidence on the following was conducted:-

- Key environmental impacts of TVs;
- Key current and future expected interventions for improving environmental performance of TVs.

On the basis of this review, recommendations were made on where the TVs **roadmap** can add value beyond existing interventions as well as further evidence required.

The environmental impacts across the life cycle of TVs are well documented with a range of key evidence sources and studies available (see section 3). One of the most recent is the *Eco-design of EuP Products Preparatory Studies LOT 5: Consumer Electronics: TV* (hereafter called LOT5) study underpinning the Ecodesign of EuPs TV implementing measure. Based on this and other sources used in the review, the key environmental impacts of TVs to include associated consumables, batteries and packaging) are:-

- Energy consumption (on mode, passive stand-by, active standby)
- Waste generation to include hazardous and non hazardous waste
- Resource depletion (precious metals and increased resource consumption from new technologies)
- Use of hazardous substances to include flame retardants, heavy metals (e.g. Pd, Hg, Cd), POPs, PVC
- Emissions to air (GHG, particulates, VOCs, PAHs)
- Electromagnetic emissions (ionising and non ionising)
- Noise emissions.

Interventions relevant to improving the environmental performance of TVs include the forthcoming obligations under the Eco-design of EuP implementing measure for TVs (currently in development and expected for 2010), proposed mandatory A-G energy label for power in use, existing WEEE & RoHS legislation and a range of standards and voluntary initiatives. Debate is currently ongoing over the BAT performance criteria being defined for TVs in the Ecodesign of EuP TV implementing measure, in particular for power consumption. Subject to appropriate performance levels for this and other environmental criteria under the implementing measure being implemented in practice, the existing and forthcoming interventions aim to target most of the key environmental impacts of TVs. Their success in practice is another issue, in particular in light of increasing consumption patterns. In terms of adding value to existing and proposed interventions, there are some additional areas for investigation, in particular in a UK context, that it is recommended further evidence is gathered on. These include:-

- If and how UK consumption statistics (technology types, volumes and trends) are difference from the EU25 averages assessed in LOT5;
- Environmental impacts limitations posed by the EU25 average TV scope/definition vs. the UK;
- Current UK TV consumption trends, volumes and supply chain statistics;
- Energy impact of active standby (currently a gap in the evidence);
- UK WEEE end of life management (domestic and exported);
- Comparison of LOT5 proposed environmental performance criteria for TVs vs. UK MTP standards;
- WEEE IPR vs CPR approaches and the implications for driving ecodesign of TVs.

1 Introduction

Defra SPM is developing roadmaps for 10 products which are environmental priorities, one of which is TVs. In order to inform the baseline evidence gathering for the TVs roadmap this short desk top review was conducted to map the environmental impacts of TVs across their lifecycle and interventions to improve these. This report documents this review and outlines:-

- the key environmental impacts of TVs across their lifecycle and supply chain (section 3);
- the current and expected future interventions impacting environmental performance improvement for TVs (section 4);
- recommendations for where the roadmap can add value beyond existing and future interventions and for additional evidence required (section 5).

2 Method

A desk top review of key existing evidence sources was the method used to conduct this mapping. It was conducted as an internal study within Defra's SCP Evidence Base to inform the SPM policy clients working on the TVs roadmap. The review scope was defined in conjunction with the TVs roadmap lead and SPM policy clients (to include those within the Market Transformation Programme (MTP), draft report reviewed and final report disseminated to the TVs roadmap lead and other relevant SPM policy clients.

3 Key Evidence On Environmental Impacts of TVs

3.1 Key Evidence Sources

The environmental impacts across the life cycle of TVs are well documented. Key evidence sources and studies include the following:-

Evidence	Author	Date
Ecodesign of EuP Products Preparatory Studies LOT 5: Consumer Electronics: TV http://www.ecotelevision.org/finalised_documents.php http://www.ecotelevision.org/index.php[1]	Fraunhofer (Dr. Lutz Stobbe) Plus partners (Oko-Institut eV Bio Intelligence Service, Deutsche Umwelthilfe, PE Europe, CODDE)	2 Aug. 2007
MTP Consumer Electronics SPPBs & Indicative Performance Stds for TVs (UK)	MTP	May 2007
ECMA-370 2nd edition (harmonised with the ECO declaration label - TED) http://www.ecma-international.org/publications/files/ECMA-ST/ECMA-370.pdf	ECMA International (ICT & CE industry standarisation association)	Dec.2006
ECMA-341 Standard on environmental design considerations for electronic products http://www.ecma-international.org/publications/standards/Ecma-341.htm (Technical Report TR/70 Product related environmental attributes of ICT and CE is an evidence source for both these standards)	ECMA	Dec 2004

[1] Ecodesign of EuP Methodology Report (MEEuP), Product Case 9 TVs, Final, 28/11/2005, VHK for European Commission is the precursor to the LOT 5 study and includes useful TV impacts evidence, but most of this is captured in the later LOT 5.

MTP BNTV01 TVs Future Stock & Energy Trends Briefing Note V2	MTP	2006
Environmental, Technical and Market Analysis concerning the ecodesign of Television Devices, 22212 EN (used in EuP LOT 5 above) http://www.jrc.es/publications/pub.cfm?id=1388	IPTS (White et al)	4/2006
Range of LCAs & proprietary TV "lifecycle environmental impact studies" in the public domain from the TV OEMs who publish sustainability reports e.g. LG http://www.lge.com/about/sustainability/environmental_management.jsp Philips http://www.philips.com/about/sustainability/index.page Compiled in ecodesign guides for electronics there are several of these e.g. Environmentally Improved Product Design Case Studies of the European Electrical and Electronics Industry (Phillips green TV)	EU ECOLIFE Network	2006 July 2002
Development of EU Ecolabel Criteria for TVs, AEAT/ENV/R0937 http://ec.europa.eu/environment/ecolabel/pdf/televisions/finalreport_jan2002.pdf	AEAT (J. Poll, P. Dolley, N. Varey)	Jan 2002

All of the above are key TV specific evidence sources as well as more generic studies e.g. on Waste Electrical and Electronic Equipment (WEEE) that include TVs have informed this report. References are noted throughout the report for these. In particular under the Eco-design of EuP directive[2], TVs are one of the priority products being focused on. To support the development of implementing measure for TVs under this directive, the Eco-design of EuP Products Preparatory Studies LOT 5: Consumer Electronics: TV (hereafter called LOT5) was completed in 2007.

[2] Directive 2005/32/EC establishing a framework for setting ecodesign requirements for Energy Using Products (EuP) and amending Council Directives 92/42/EEC, 95/57/EC and 2000/32/EC

LOT5 analyses:-

- the environmental impacts of TVs in light of the market, consumption, technologies and consumer behaviour for the EU25;
- Best Available Techniques (BAT) for improving environmental performance ;
- lifecycle costing of improvement options.

On the basis of this analysis, it recommends environmental performance criteria for TVs for the Eco-design of EuP TVs implementing measure expected in 2010. It draws on existing evidence as well as data sets provided from 10 brand name manufacturers on 15 representative TV products[3]. For these reasons it is seen as the most comprehensive and current available evidence source for understanding the environment impacts of TVs. Even with the above comprehensive approach many data gaps were identified and assumptions made, as is normal in this level of assessment. However, the evidence it provides is deemed as reliable.

TV types LCD-TV, PDP-TV, CRT-TV, RP-TV were assessed and chosen for representativeness regarding:-

- Different display technologies
- Different screen sizes
- Strong market segment trends to 2010
- Products with expected environmental improvement potential.

For each product assessed this included: chassis, display module (plus back lighting etc.), power supply, remote control, electronic boards (PCBs etc.), packaging and other (e.g. internal cables).

The lifecycle stages covered were:-

- Production
- Distribution
- Use phase (product)
- Use phase (system)
- End of life.

[3] Manufacturer data provided specifically for the study was in a standardised format defined in MEEuP.

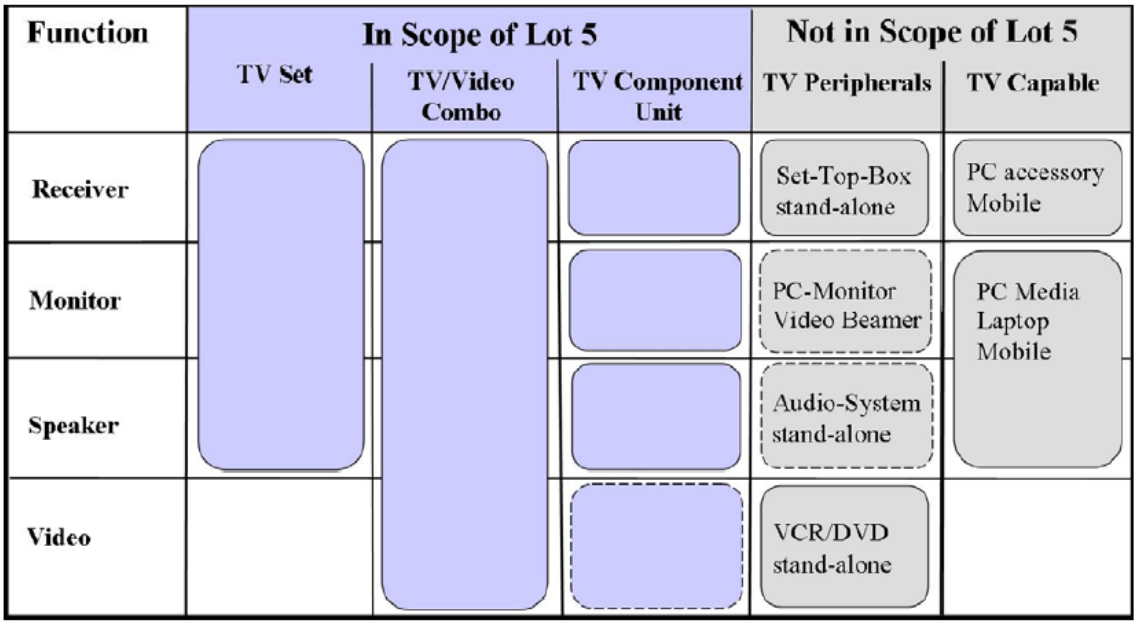
The rationale for a use phase (product) and (system) as separate was to look at the use phase impacts per “product” separately and with the full “system” it uses to operate (peripherals etc…) to enable impacts to be more accurately allocated.

For UK generated WEEE there are several studies, and some provide data for TVs. These are referenced in section 3.3 below.

3.2 Definition of TVs and why this is important

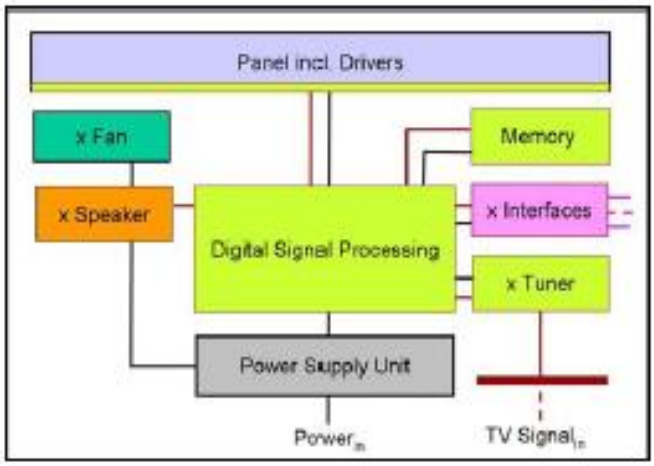
The definition of TVs varies in the existing market classifications (e.g. for trade), industry standards and environmental related initiatives (labels etc..). Lot 5 analyses this in detail to conclude that for EuP TVs should be defined in terms of the functions outlined in Table 1 below. The definitions of each of these functions is in Annex A.

Table 1 TV definition and scope proposed for Ecodesign of EuP



Based upon “TV sets” being the most significant consumption & monetary expenditure category for the EU and TV sets, TV/Video (includes DVD)/component units being the most common equipment category for the EU, the above table shows the “TV” scope proposed for EuP. Some of the consumption figures and equipment trends for the UK may be different (albeit UK figures to include Market Transformation Programme (MTP) data is included in the study) and should be considered further in evidence gathering for the UK roadmap. The environmental impacts assessment of TVs is done for the technologies LCD-TV, PDP-TV, CRT-TV and RP-TV of varying screen sizes. The TV system LOT 5 is illustrated in Figure 1

Figure 1 LOT 5 TV System assessed



For consistency , using the same TV definition and scope as EuP uses would be important for industry consistency for the TVs roadmap.

Note: the different definitions of TVs in the existing evidence studies will impact the comparability of existing evidence, so for this reason (as well as the currency and comprehensiveness of the study) it is recommended that the EuP Lot 5 study should be used as the primary source of evidence informing the roadmap on the environmental impacts of TVs.

3.3 Consumption Statistics

Lot 5 provides averaged EU25 statistics for the following:-

- Economic and market analysis
  - Television production, imports and exports (except this does not clarify the supply chain geographically)
  - Consumption (TV types, volumes etc.)
  - Consumer expenditure data
  - Market and stock data
  - Market trends (technologies, digital TV broadcasting, high definition, optical storage systems)

- Consumer Behaviour (buying decisions, frequency & characteristics of use, end of life) and local infrastructure.

These averaged statistics include UK statistics, much which are from MTP, but for the TVs roadmap more UK specific analysis is required.

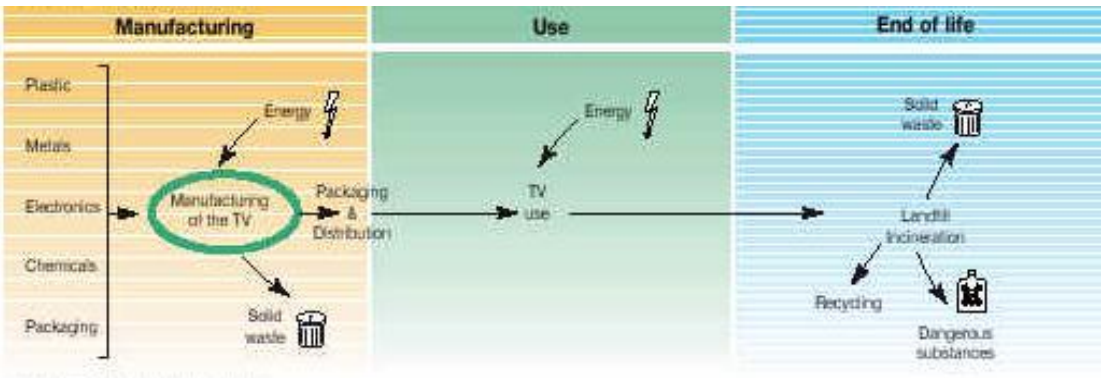
3.4 Environmental Impacts

On analysis of key evidence sources e.g. LOT4 and others listed in section 3.1, a summary of the key environmental impacts of TVs (to include associated consumables, batteries and packaging) are:-

- Energy consumption (on mode, passive stand-by, active standby)
- Waste generation to include hazardous and non hazardous waste
- Resource depletion (precious metals and increased resource consumption from new technologies)
- Use of hazardous substances to include flame retardants, heavy metals (e.g. Pd, Hg, Cd), POPs, PVC
- Emissions to air (GHG, particulates, VOCs, PAHs)
- Electromagnetic emissions (ionising and non ionising)
- Noise emissions.

Figure 2 (from the EU Ecolabel for TVs) shows where these impacts occur across the lifecycle (excluding raw material extraction & processing)

Figure 2 Key environmental Impacts of TVs (Source: EU Ecolabel TVs (2002 and retained as of March 2007))



A summary of environmental impacts of EU stock 2005 TVs from LOT 5 is below.

Summary Environmental Impacts EU-Stock 2005, Televisions

main life cycle indicators	value	unit
Total Energy (GER)	538	PJ
of which, electricity	45,0	TWh
Water (process)*	54	mln.m3
Waste, non-haz./ landfill*	1772	kton
Waste, hazardous/ incinerated*	162	kton
Emissions (Air)		
Greenhouse Gases (GWP100)	25	mt CO2eq.
Acidifying agents (AP)	154	kt SO2eq.
Volatile Org. Compounds (VOC)	4	kt
Persistent Org. Pollutants (POP)	10	g I-Teq.
Heavy Metals (HM)	25	ton Ni eq.
PAHs	8	ton Ni eq.
Particulate Matter (PM, dust)	75	kt
Emissions (Water)		
Heavy Metals (HM)	20	ton Hg/20
Eutrophication (EP)	0	kt PO4

*=caution: low accuracy for production phase

Annex B has the LOT 5 summary tables for :-

- Impacts per unit of TVs
- Impacts of new TVs produced in 2005 over their lifetime.

3.4.1 Key Impact Descriptions

- *Energy - On Mode Power Consumption* -The primary environmental impact of TVs is the on-mode energy consumption in the use phase. The standby power consumption used to be focused on as the main impact, but more recent studies show the in use power consumption being more significant. Based on an average EU household consumption of 2 TVs /household[4], energy from on more power consumption is expected to increase over future years. The increasing trend towards better new display technologies, bigger screen sizes, better picture quality and full HD (incl. HDTV content) is expected to increase power consumption of TVs further.

[4] LOT 5

- *Resource Use* **-** Resource use was highlighted as a key impact of increasing significance. Key resource issues are use of precious metals, fossil fuels for plastics and rapid technology shifts plus increasing consumption driving increased resource use. LOT 5 identified display manufacturing and electronic components of growing environmental significance because technological developments focused on the improvement of the displays quality in combination with larger, high definition screens is resulting in increasingly resource intensive manufacturing processes and the increased utilization of precious material.

- *Passive and Active Stand by* - Reducing standby power consumption, while no longer seen as the biggest energy impact, is still important. Passive standby power has been reduced by many manufacturers over the past years. LOT5 concludes that ≤1 Watt is a feasible target which can be achieved on a broad scale by applying existing technologies and gives significant environmental improvement. Further reduction of passive standby is possible and recommended, however, the improvement potential is less significant in comparison to other issues.

  Power consumption related to active standby is a source of potentially increasing power consumption due to the increasing trend of including this feature in TVs. LOT 5 identifies that the actual extent of related power consumption from active standby is difficult to assess at this point of time due to the few existing examples and is an evidence gap. Based on limited examples it concludes that BAT for active standby low is currently 1.8 Watt.

- *Waste* - WEEE is the fastest growing waste stream in the EU constituting 4% of the municipal waste today, increasing by 16-28% every five years - three times as fast as the growth of average municipal waste[5]. The UK estimates between 1-2 million tonnes WEEE per annum. WEEE incorporates both hazardous (one of the largest known sources of heavy metals and organic pollutants in municipal waste) and non hazardous waste. For TVs, components of key concern include, CRTs, LCDs, circuit boards and large electrolytic capacitors. Because of the WEEE and RoHS directives (see section 3

[5] EU Directives 2002/96/EC on waste electrical and electronic equipment (WEEE) and 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

below) much evidence is available on WEEE. For the UK, a key evidence source that collates this is the Defra funded AEAT WEEE and Hazardous Waste study[6]. Table 3 gives estimates for annual household waste arisings published by the Industry Council for Equipment Recycling (ICER) to include TVs.

Table 3

ICER Waste Arisings Estimates (2000)[3]

Category	Annual Arisings		
	Units (millions)	(tonnes)	%
Large Household Appliances	10	392,000	43
Small Household Appliances	15	30,000	3
IT	22	357,000	39
Telecomms	7	8,000	1
Radio TV & audio	12	72,000	8
Lamps	77	12,000	1
Medical		No data	
Monitoring & control	8	8,000	1
Toys	8	8,000	1
Electrical and electronic tools	6	28,000	3
Automatic dispensers		No data	
TOTAL	**165**	**915,000**	**100**

A 2004 ICER/EA study[7] on WEEE exports from the UK estimated that 160,000 tonnes of WEEE was exported in 2003. This included an estimated 11,00 tonnes of TVs (500,000 units). Ultimate UK WEEE destinations of equipment include Eastern Europe, the Far East, the Indian, subcontinent, Africa and China. For domestic WEEE like TVs Eastern Europe and Africa were the main destinations especially Nigeria, Uganda, Ghana and Kenya. An estimated 130 WEEE dismantlers, asset management and refurbishing companies were deemed to be part of the UK WEEE network at the time and the ultimate fate of the WEEE was unclear but involved reuse and some recycling. With WEEE now in place in the UK an updated study could show a clearer picture.

On WEEE, LOT 5 recommends improvement options focusing on WEEE prevention/minimisation to include miniaturisation, light-weighting and increased use of recycled materials, as well as compliance with WEEE and RoHS. It highlights the

[6] WEEE & Hazardous Waste Par 1 AEAT/ENV/R/1688, March 2004

WEEE & Hazardous Waste Part 2, AEAT/ENV/R/2233, June 2006

[7] WEEE – Green List Waste Study, Report prepared by ICER and EA , April 2004, http://www.icer.org.uk/ExportsReportFinal.pdf

importance of eco-design for minimising resource and waste impacts at source, but also notes that existing WEEE implementation schemes with their focus on Collective Producer Responsibility vs. Individual Producer Responsibility (CPR vs. IPR) do not provide feasible incentives for manufacturers to improve product design. This is an ongoing debate.

4 TV Related Environmental Interventions

Current and expected future policy, legal and market interventions impacting the environmental impacts of UK consumed TVs are outlined below.

4.1 Current Obligations

4.1.1 Legal

WEEE & RoHS – TVs are one of the 10 categories of Electrical and Electronic Equipment (EEE) covered by the WEEE & RoHS Directives which have been in effect in most EU Member States since August 2005 and in the UK since August 2007.

The WEEE directive aims to divert WEEE from landfill and increase separate collection and end of life management in line with specified treatment standards and recovery/recycling targets. Key obligations include producer responsibility for EEE producers, development of a separate WEEE collection infrastructure and retailers taking back household EEE from consumers.

The RoHS directive tackles the hazardous substances used in EEE by banning, other than in permitted trace levels[8], lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and Polybrominated Diphenyl Ethers (PBDE). When designing and manufacturing EEE, producers are obliged to meet ROHS requirements subject to certain exceptions. For TVs the key RoHS issues are mercury containing LCD backlights, lead content in displays and choice of flame retardants. Mercury in LCD backlights is currently exempted from the RoHS substance ban because the mercury content in LCD backlights provides long-term efficient light generation. RoHS currently exempts Plasma Displays from the lead ban, although recently lead free panels have been introduced so this is likely to change.

[8] RoHS directive sets the permitted trace levels as a maximum concentration value of 0.1% by weight in homogenous materials for lead, mercury, hexavalent chromium, PBB and PBDE and of 0.01% for cadmium.

There are also non environmental directives on *Low Voltage* and *Electromagnetic Compatability* that are relevant to power consumption.

4.1.2 Standards and Voluntary Instruments

ECMA341 and ECMA 370 2nd edition (harmonised with the ECO declaration label - TED) are the ICT and Consumer Electronics (CE) industry standards on environmental design considerations for electronic products. They cover ICT and Consumer Electronics (CE) products with a rated voltage not exceeding 1000 V) and specify requirements for:-

- Energy efficiency
- Material efficiency
- Consumables and batteries
- Chemical and noise emissions
- Extension of product lifetime and end of life considerations
- Substances and preparations needing special attention
- Product packaging
- Documentation.

IEC 62430 Standard on environmentally conscious design for electrical and electronic products and systems (TC111/WG2) is expected to be published soon and to be consistent with the ECMA standards.

Figure 3 outlines some of the current TV energy use voluntary and mandatory industry initiatives. Figure 4 plots the minimum energy performance requirements for these. Summaries of some of the key initiatives follow this.

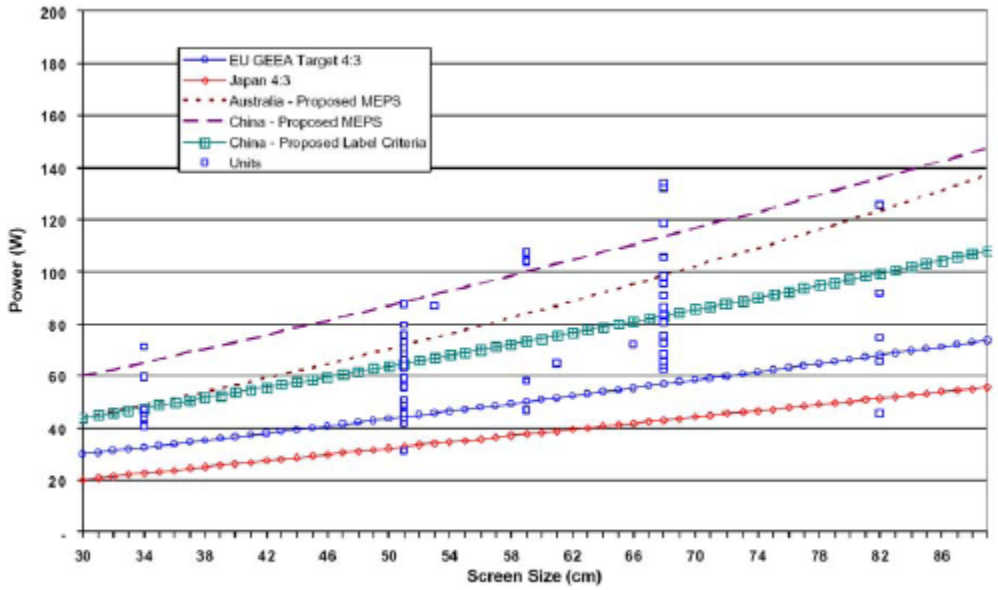
Figure 3 (Source LOT 5)

Overview legislation and voluntary programs for television energy use worldwide

Voluntary Programs				
Televisions	USA & Australia	ENERGY STAR	Standby only	Analog: Standby ≤3W, on 1/7/04 ≤1W Digital: Standby ≤3W, on 1/7/05 ≤1W
Televisions	Europe	GEEA Energy tick	All	Meet index value of 0.75 *
Televisions	Europe	Eco-label	All	Meet index value of 0.65
Televisions (CRT type)	Europe	EICTA agreement	All	Achieve sales weighted average of 3W in passive standby Improve sales weighted energy efficiency index by 10%
Televisions (Non-CRT type)	Europe	EICTA agreement under development	All	Achieve sales weighted average of 3W in passive standby Improve sales weighted energy efficiency index
All	International	IEA "One Watt Initiative"	Standby only	Standby ≤1W
Mandatory Programs				
Televisions – CRT	China(2005)	Endorsement label	All	EEI ≤1.1, standby ≤3W
Televisions – CRT	China(2005)	MEPS	All	EEI ≤1.5, standby ≤9W
Televisions – CRT	Japan	Top Runner	All	Sales weighted MEPS levels based on formula.

*= GEEA requirements 2005 and 2006: passive standby ≤ 1W; active standby (digital TV with IRD only) lower than 7, 8, 9W for resp. Cable, terrestrial, satellite

Figure 4 Minimum energy performance requirements (Source LOT 5)



Limits posed by worldwide mandatory and voluntary labelling programs [^{61}]

Voluntary industry initiatives include:-

- EICTA Industry TV Self-Commitment to improve the energy performance of CRT and flat LCD televisions and stand by mode for DVD players (2003)
- EICTA Code of conduct for Digital TV Services (2001) *http://re.jrc.ec.europa.eu/energyefficiency/pdf/COP_IRDv10_march2001.pdf*
- Japanese Top Runner Initiative

- UK Consumer Retail Voluntary Initiative – Red / Green Calculator (in development) http://www.mtprog.com/

Eco Labels covering TVs include:-

- EU Eco-label for TVs (2002 & retained as of 31 March 2007 to enable new criteria to be developed, but not available at the time of publication.)
- Energy Star Programme *http://www.eu-energystar.org/*
- TCO'06 Media Displays
- Nordic Swan.

There are also a range of relevant non environmental standards e.g.:-

- for measurement of power consumption e.g. IEC 62087 and Standards for Electromagnetic emissions and fire safety.
- ECMA-74 Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment (ISO 7779)
- ECMA-109 Declared Noise Emission Values of Information Technology and Telecommunications Equipment (ISO 9296)
- ECMA-328 Detection and Measurement of Chemical Emissions from Electronic Equipment

4.2 Future Obligations

The Eco-design of EuP implementing measure on TVs is expected by 2010. Based on the requirements of the Eco-design of EuP directive this will, in the main, define environmental criteria that TV producers must meet. Demonstrating this will be a requirement for CE marking pre entry of new TVs onto the EU market. One of the functions of the Lot 5 study is to identify what environmental criteria and performance standards should be recommended for TVs under EuP. The study suggests the following:-

- Compliance with ECMA 341 (and IEC 62430 when available). As this uses a holistic environmental impact lifecycle approach that is good from the roadmaps perspective.

- Suggested LOT 5 Energy Efficiency Improvement options for TVs are outlined in the table below.

Option	Specification of improvement	Improvement potential	Cost factor / availability
High Efficient PSU (η 85% - 90%)	Optimized power supply architecture (dimension) with specific electronic components choice and board design.	Very good (+ +)	Cost increase or neutral Possible utilization of proprietary technology
Fewer Voltage conversion stages	Multiple power conversion increases losses. A reduction of power conversion steps has a very good potential to reduce power consumption.	Very good (+ +)	Cost neutral or down (difficult to achieve)
Reduced power consumption of tuner and DSP, non-volatile memory	Utilization of low power components and improved power management. Non-volatile memory is mainly used already. Signal and picture processing power increases with full HD.	Very good (+ +)	Cost increase or neutral (Possible utilization of proprietary technology)
Passive Standby reduction under 1W	Related to PSU design. State of the art is ≤1W, lowest standby down to 0.3W is BAT. In standby all unnecessary components (functions) should be disabled (processor)	Good (+)	Cost increase or neutral
Active (network) Standby reduction	Active standby for downloading programs and information should be time limited. Tuner /DSP function is critical point of improvement (use of timer)	Good (+)	Cost increase or neutral
Alternative power supply for remote control	e.g. solar powered	Marginal	Cost increase

- For energy consumption, further improvement of power supply is recommended and power consumption improvement options for LCD and PDP are defined (see summary in Annex 3).
- A proposed mandatory A-G energy label for power in use is proposed. Much debate is already ongoing about the maximum energy performance levels which can be met economically and technologically. LOT 5 recommends proposed power consumption criteria and a potential label criteria based on the following recent specifications which are be discussed in the EuP TV implementing measure discussions.

    - U.S. EPA draft 1 version 3.0 Energy Star for TV product specification from 29 June 2007
    - AEAT 3rd discussion paper on revised Ecolabel Criteria for Televisions from 28 June 2007
    - Hans-Paul Siderius & Bob Harrison “Energy Efficiency Index for TVs from 12 Feb. 2007.
- Compliance with WEEE and RoHS ;

- Suggested options for material, waste and design related improvement options for TVs include miniaturization of electronic boards, general material and weight reduction and the utilization of environmentally benign materials for housing. The full list is outlined in the table below.

Option	Specification of improvement	Improvement potential	Cost factor / availability
Miniaturization of electronic boards	Higher system integration aiming on a reduction of board surface area and number of electronic components	Good (+)	Unknown (cost trade-off possible)
Reduction of the number of parts	Amount of screws, cable, metal or plastic parts, etc.	Good (+)	Cost down
Reduction of product weight	Physical design of frames, chassis, thermal management elements (heat sinks, fans), etc.	Good (+)	Cost down
Reduction of parts or materials that need special treatment at product end-of-life	Reduction of Hg containing LCD-BLU. Reduction of lead in display panels. Reduction of PVC in cables. Use of bromine and chlorine -free flame retardants (today mostly phosphor based).	Good (+)	Cost increase or neutral
Utilization of hybrid or full bio-plastics	Modified Poly Lactic Acid (PLA), corn starch based polymers, etc. Only eco-friendly when energy efficient material supply (e.g. transport and processing) is realized.	Good (+)	Cost increase (long-term cost trade-off possible)
Utilization of recycled materials	Recycled polymers (e.g. PC/ABS) for housing.	Marginal	Unknown (cost trade-off possible)
Avoidance of color layered (painted) or sandwiched plastics	Composite materials and surface finished (painted) plastics increases the treatment efforts during recycling. Homogenously dyed plastics are the better option.	Marginal	Unknown
Component lifetime improvement and repair friendliness	Quality of power supply unit and main components such as the display. However be aware that continuous power efficiency improvement could make faster exchange of product feasible	Marginal	Cost increase However, advantage could be generated trough life cycle cost reduction
Design for Recycling	Easy disassembly of main components: Display (if applicable mercury containing BLU), electronic boards, steel frames and chassis, large heat sinks, etc.	Marginal Depending on actual recycling schemes	Cost increase Optimized recycling scheme could provide cost incentive
Reduction of packaging material and volume	Optimum utilization of space, use of recycled materials or materials that is easy to recycle.	Marginal / Good (+)	Cost neutral

- A range of consumer focused information requirements for user manuals or on the product are also proposed in addition to the proposed energy label to include:-
  - Mode-specific power consumption data
  - Rated power consumption
  - Explanations of power modes (particularly standby options) and energy saving options (eco-modes)
  - Warning of mercury content in backlights (information to recycling industry on the back of the BLU).

Whether all these recommendations from LOT5, go into the Eco-design for EuP TVs implementing measure is still to be determined.

5 Conclusions

5.1 How the TV "Roadmap" can add up value ?

Given the forthcoming potential obligations under Eco-design of EuP, existing WEEE & RoHS and standards / voluntary initiatives most of the environmental impacts of TVs could be well catered for, subject to the appropriate performance levels being agreed. Hence, just a mapping of all of this and filling evidence gaps may be the a suitable way forward for the TV roadmap.

5.2 Recommendations for additional evidence requirements

Some suggestions to consider for further evidence to inform the TVs roadmap includes the following. They are very specific issues and could be combined into one study.

- An investigation of if and how UK TV consumption statistics (technology types, volumes and trends) are different from the EU25 average assessed in LOT5. As LOT5 includes UK data (and MTP data) the UK specific consumption should be sufficiently covered to enable the impacts assessment to be the same. However, any irregularities on the UK case would be picked up in this and useful for UK Ecodesign of EuP work also.

- Consider whether there are any impacts related limitations posed by the TV definition and scope eco-design of EuP is using especially regarding UK specific consumption. For example should the scope go beyond the " TV unit " to include the multifunctional service provided (e.g. digital TV supply etc.) and does this sufficiently effect the environmental impacts given the UK has a big market in this area?

- Determine current UK TV consumption & supply chain statistics to enable an understanding of the current and likely future consumption volumes and trends. This should include:-
  - UK market trends, patterns and value,
  - UK production and consumption volumes per TV type (service and technologies),
  - Public and private consumption expenditure per product type

- UK Imports and exports
- Supply chain (cradle to grave) geographically for UK consumed TVs

The MTP will be one important source for this data.

- Technology innovations emerging for TVs and related systems and their associated environmental improvement potentials beyond 2010 (the timescale Lot 5 caters for).
- Impact of active standby is a gap LOT5 identifies requiring further study to understand the energy impact and improvement options further. However, follow on Ecodesign of EuP work at EU level may pick this up.
- Determine the UK WEEE end of life management both domestic and exported. Waste Strategy evidence includes WEEE studies and this could be built into the scope.
- Determine how the proposed performance criteria in LOT5 for energy compare with UK MTP energy performance targets in the MTP industry stds currently out for consultation. At a broader level, for all EEE, the issue of WEEE IPR vs. CPR and the implications in driving eco-design warrants further investigation.

Regarding Ecodesign of EuP, there is ongoing debate about whether the environmental performance criteria for TVs recommended in LOT5 are environmentally good enough. As this will be widely debated and consulted on as part of the development of the Ecodesign of EuP TVs implementing measure, this should be closely followed in establishing further evidence requirements for the TVs roadmap.

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Annex A: TV Definitions and Scope

LOT 5

- **Television (TV-Set)**
- A commercially available product that is specifically designed to receive and decode a television transmission (broadcast from cable, terrestrial or satellite), whether analogue or digital (integrated tuner), and displays the resulting image on an integrated screen while reproducing the accompanying sound (main function). The tuner/receiver and monitor are encased in a single housing. The product should be mains powered.
- **TV/Video Combination Unit**
- A commercially available product in which the TV and a Video Recording/Storage/Replay System (e.g. videocassette, standard or high definition DVD, hard disk dive, memory chips, or combinations of them) are combined into a single housing. The product should be mains powered.
- **TV Component Unit**
- A commercially available system, which is market and sold as a TV, consisting of a receiver and monitor in separate casing. Video is a further optional unit or could be integrated in one of the other units. The system should be mains powered and may have more than one power cord.
- **TV Peripherals**
- A commercially available stand alone device such as a Set-Top-Box (STB), Videocassette Recorder/Player, and DVD Recorder/Player, which is mains powered.
- **TV Capable**
- A commercially available TV receiver component as PC or Laptop accessory (e.g. TV tuner card), receiver integrated in mobiles (e.g. TV capable Mobile Phone), as well as Beamer/Video Projectors that are not specifically designed TVs but capable of displaying a TV/video signal form an STB or PC.

PRODCOM Trade Classifications

PRODCOM classification applicable to televisions [4]

PRODCOM #	Description
32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
32.30.20.20	Colour television projection equipment and videoprojectors
32.30.20.30	Colour televisions with a video recorder or player
32.30.20.50	Colour television receivers with integral tube (excl. television projection equipment, apparatus with a video recorder or player, video monitors)
32.30.20.60	Flat panel colour tv receiver, lcd/plasma, etc. excl. television projection equipment., apparatus with video recorder/player, video monitors, television receivers with integral tube
32.30.20.85	Black and white or other monochrome television receivers (excl. video monitors)
Related but not included in the current meaning of the product group:	
32.30.20.45	Colour video monitors with cathode-ray tube
32.30.20.49	Flat panel video monitor, LCD or plasma, etc., without tuner (colour video monitors) (excl. with cathode-ray tube)
32.30.20.75	Tuner blocks for CTV/VCR and cable TV receiver units (colour video tuners) (excl. those which isolate high-frequency television signals)
32.30.20.79	Satellite TV Receiver/Decoder (colour television receivers) (excl. with a screen, video tuners, video monitors, television projection equipment, with integral tube)
32.30.20.83	Black and white or other monochrome video monitors

Annex B: LOT 5 Environmental Impacts of TVs for the EU Television

Impacts per unit of TVs

Life Cycle Impact (per unit) of Televisions

Nr	Life cycle Impact per product: Televisions							Date: 0	Author: vhk		
	Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	Total			Disp.	Recycl.	Total	
	Materials	unit									
1	Bulk Plastics	g			2046			1841	205	2046	0
2	TecPlastics	g			2261			2035	226	2261	0
3	Ferro	g			6564			328	6236	6564	0
4	Non-ferro	g			1064			53	1010	1064	0
5	Coating	g			0			0	0	0	0
6	Electronics	g			1299			1299	0	1299	0
7	Misc.	g			16604			830	15774	16604	0
	Total weight	g			29837			6387	23451	29837	0
	Other Resources & Waste							see note! debet	see note! credit		
8	Total Energy (GER)	MJ	2246	295	2542	438	16702	367	207	160	19842
9	of which, electricity (primary MJ)	MJ	1055	174	1229	1	16569	0	2	-2	17797
10	Water (process)	ltr	769	2	771	0	1111	0	1	-1	1882
11	Water (cooling)	ltr	741	78	819	0	44159	0	9	-9	44968
12	Waste, non-haz./ landfill	g	35558	1160	36718	238	19563	1848	6	1842	58361
13	Waste, hazardous/ incinerated	g	785	0	785	5	389	3876	1	3875	5054
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	132	17	149	27	733	27	14	13	923
15	Ozone Depletion, emissions	mg R-11 eq.	negligible								
16	Acidification, emissions	g SO2 eq.	1120	72	1192	82	4284	55	19	36	5595
17	Volatile Org. Compounds (VOC)	g	111	0	111	6	9	1	0	1	127
18	Persistent Org. Pollutants (POP)	ng I-Teq	190	18	208	1	111	13	0	13	332
19	Heavy Metals	mg Ni eq.	365	42	406	12	314	101	0	101	833
20	PAHs	mg Ni eq.	167	0	167	15	60	0	0	0	243
21	Particulate Matter (PM, dust)	g	430	11	441	975	536	475	0	475	2427
	Emissions (Water)										
22	Heavy Metals	mg Hg/20	501	0	501	0	112	31	0	31	644
23	Eutrophication	g PO4	10	0	10	0	1	2	0	2	12
24	Persistent Org. Pollutants (POP)	ng I-Teq	negligible								

*=Note: Recycling credits only relate to recycling of plastics and electronics (excl. LCD/CRT). Recycling credits for metals and other fractions are already taken into account in the production phase.

Impacts of new TVs produced in 2005 over their lifetime

EU Total Impact of NEW Televisions produced in 2005 (over their lifetime)

	EU Impact of New Models sold 2005 over their lifetime:	Date Author
Nr	Televisions	0 vhk

	Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	Total			Disp.	Recycl.	Total	
	Materials	unit									
1	Bulk Plastics	kt			66			60	7	66	0
2	TecPlastics	kt			73			66	7	73	0
3	Ferro	kt			213			11	203	213	0
4	Non-ferro	kt			35			2	33	35	0
5	Coating	kt			0			0	0	0	0
6	Electronics	kt			42			42	0	42	0
7	Misc.	kt			540			27	513	540	0
	Total weight	kt			970			208	762	970	0
	Other Resources & Waste							see note! debet	credit		
8	Total Energy (GER)	PJ	73	10	83	14	543	12	7	5	645
9	of which, electricity(primary PJ)	PJ	34	6	40	0	538	0	0	0	578
10	Water (process)	mln. m3	25	0	25	0	36	0	0	0	61
11	Water (cooling)	mln. m3	24	3	27	0	1435	0	0	0	1461
12	Waste, non-haz./ landfill	kt	1156	38	1193	8	636	60	0	60	1897
13	Waste, hazardous/ incinerated	kt	25	0	26	0	13	126	0	126	164
	Emissions (Air)										
14	Greenhouse Gases in GWP100	mt CO2 eq	4	1	5	1	24	1	0	0	30
15	Ozone Depletion, emissions	t R-11 eq.	negligible								
16	Acidification, emissions	kt SO2 eq.	36	2	39	3	139	2	1	1	182
17	Volatile Org. Compounds (VOC)	kt	4	0	4	0	0	0	0	0	4
18	Persistent Org. Pollutants (POP)	g I-Teq	6	1	7	0	4	0	0	0	11
19	Heavy Metals	ton Ni eq.	12	1	13	0	10	3	0	3	27
	PAHs	ton Ni eq.	5	0	5	0	2	0	0	0	8
20	Particulate Matter (PM, dust)	kt	14	0	14	32	17	15	0	15	79
	Emissions (Water)										
21	Heavy Metals	ton Hg/20	16	0	16	0	4	1	0	1	21
22	Eutrophication	kt PO4	0	0	0	0	0	0	0	0	0
23	Persistent Org. Pollutants (POP)	g I-Teq	negligible								

*=Note: Recycling credits only relate to recycling of plastics and electronics (excl. LCD/CRT). Recycling credits for metals and other fractions are already taken into account in the production phase.

*=Note: mt= megatonnes (metric)= 10^9 kg; kt= kilotonnes (metric)= 10^6g; ton(metric)= 10^6g; g=gram= 10^9 ng ; mln. M3 = million cubic metres= 10^9 litres; PJ= petaJoules= 10^9 MJ (megajoules) = 10^{15} Joules.

Annex C: LOT 5 TVs recommended power consumption improvement options

PDP

Option	Specification of improvement	Improvement potential	Cost factor / availability
PDP design for 3 lm/W luminescence efficiency	Technology specific improvement of the cell structure, material composition, electrical and optical design, and integrated energy recovery circuitry resulting in higher luminescence efficiency. (full HD need attention)	Excellent (+ + +)	Cost neutral or decrease Decrease in power consumption makes costs for circuitry and heat sinks decrease (proprietary technology)
PDP driving scheme improvement	Active brightness / power control Driving scheme improvement is achieved by improved signal processing algorithm (chip design and software)	Good (+)	Cost neutral (proprietary technology)
Thermal management without fans	Improved luminance and power supply efficiency could make cooling fans obsolete.	Good (+)	Cost decrease
Efficient switched power supply unit	The improvement of the electrical efficiency of the main PSU up to 85% or 90%	Very good (+ +) potential 10% to 20% decrease in power	Unknown electronic components and board design, (cost trade-off possible)
Lead-free PDP design	Substitution of Lead in glass frits etc.	Good (+)	Unknown (proprietary technology)

LCD

Option	Specification of improvement	Improvement potential	Cost factor / availability
BLU driver / inverter circuitry improvement	Advanced BLU driver / inverter circuitry with electrical efficiency of η 80 to 85%.	Good (+)	Cost neutral electronic components and board design (cost trade-off possible)
Complete dimming of BLU	Scaling of the complete backlight is state of the art and results in an increase of the energy efficiency of the LCD. The effective reduction in power consumption depends on the whites point (APL) of the shown video image.	Good (+)	Cost neutral electronic components and board design (cost trade-off possible)
Partial dimming of BLU	Advanced BLU dimming reduces power consumption of single lamps selectively (e.g. the black strips on top and bottom of a picture that occur when displaying wide screen movies).	Very Good (+ +)	Cost increase electronic components and board design (cost trade-off possible)
Ambient brightness related dimming of BLU	Advanced BLU dimming (complete and partial) in relation to the ambient brightness conditions. Light-sensor with controller board necessary. Further improvement of energy efficiency possible if consumer utilizes this feature.	Good (+)	Cost increase sensor integration and controller board
EEFL-BLU	New - commercially available - BLU type with lower rated power consumption and simpler circuitry design. In combination with BLU dimming technology very good energy saving potential. Lower mercury content (<4 mg) than CCFL.	Very Good (+ +)	Cost neutral or down limited availability for larger size LCD-BLU (cost trade-off possible)
LED-BLU	Very new – not yet mature – BLU type allegedly very high power saving potential due to low power requirements and capability of image controlled selective dimming. No known hazardous substances (however, material composition diverse, manufacturing and electronic packaging unknown).	Excellent (+ + +)	Cost increase (+ +) currently very limited availability, could improve with mass application within next five years, IP issues unknown
LCD panel design	General improvement of optical properties of functional layers, color filter and pixel design (e.g. RGB + White pixel), electrical driving scheme resulting in higher light utilization. This in turn can reduce the number of necessary lamps and power consumption accordingly.	Unknown	Unknown proprietary technology
Efficient polarizer / fewer lamps	Reflective polarizer (e.g. marketed by 3M) or prismatic film achieves a higher utilization of the lamp's randomly emitted light. This in turn can reduce the number of necessary lamps and power consumption accordingly.	Excellent (+ + +)	Cost increase (+ +) proprietary technology
Efficient switched power supply unit	The improvement of the electrical efficiency of the main PSU up to 85% or 90%	Very good (+ +)	Unknown electronic components and board design, (cost trade-off possible)
Direct power supply for BLU	Direct power conversion from mains input to BLU. Avoid lower voltage intermediate steps. Very good potential for electrical efficiency improvement.	Very Good (+ +)	Unknown BLU supplier relation issues, power board design

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