THE ONE-FOR-ALL TV REMOTE CONTROL

By how much can we reduce our carbon footprint?

Having multiple remote controls is not only extremely confusing, but also harms the environment. A standardised, one-for-all TV remote control would make your everyday life easier and reduce your carbon footprint massively, benefiting future generations.

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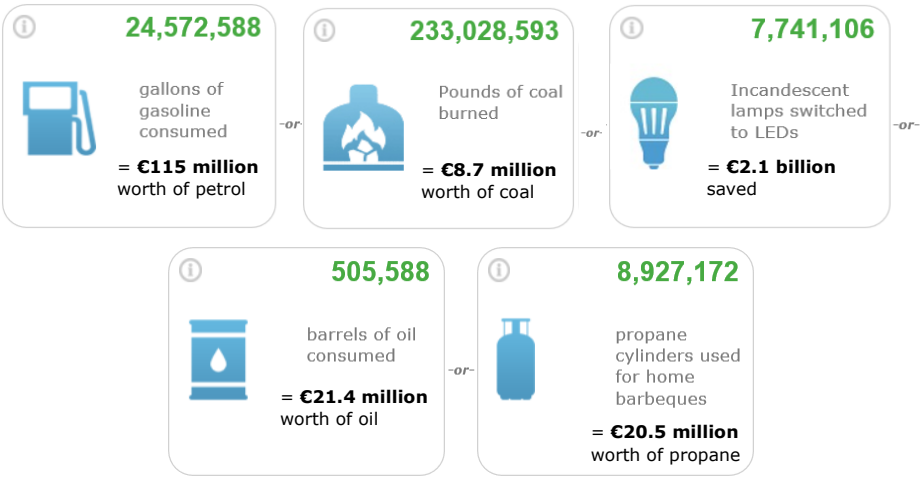
1. Introduction

Atlantic Digital Net is proposing a new initiative that will reduce CO_2 emissions. If there was one standardised remote control in the European Union, compatible with all brands of TVs and DVD players, every **7 years** we would save approximately

- **156,705 tonnes** of CO_2 emissions from ABS plastic production only
- **81,823.6 tonnes** of CO_2 emissions from AAA batteries from production to disposal
- **2,190 tonnes** of CO_2 emissions from fibreglass production only
- **50,550 tonnes** of ABS plastic
- **1.294 billion** (or **14,622.2 tonnes** of) AAA batteries

from electronic and plastic waste production of redundant remote controls.

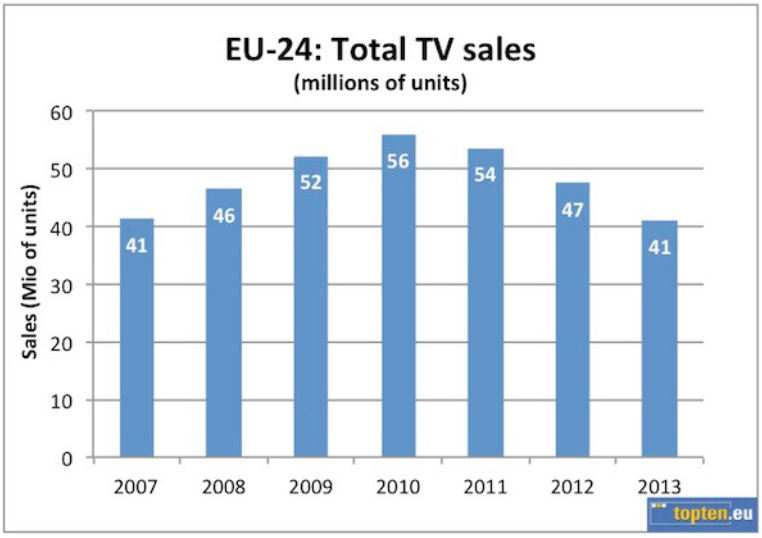
Therefore, we prevent approximately a total of **240,718.6 tonnes of CO_2 emissions every 7 years** from plastic, batteries and fibreglass production from harming the environment, which is the equivalent of CO_2 emissions from:



Not only households, but also offices, hotels and other such institutions use TV sets on a daily basis. On average, there are three remote controls per TV unit in the European Union (The Verge, 2015) and there are 337 million TV sets in use in the EU in 2013 (Michel, Attali and Bush, 2014 p.11). Therefore, 2013 saw around **1.011 billion** remote controls in use in the EU. Our goal is to prevent the production of **674 million** redundant remote controls.

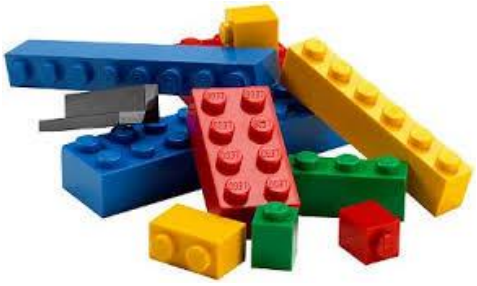
2. Time range

The time range we have used throughout our study is seven years and this section will explain why many of our results were for a seven-year period. The average life span of a television is approximately seven years (CCM, 2017), therefore the life span of a remote control is expected to be approximately seven years too. The graph below shows the total TV sales for the period 2007-2013: a seven-year period. Therefore, the majority of TVs brought in 2007 will work through until about **2013**. Thus, the number of TVs in use in the year **2013** would be the cumulative sum of TVs sold in the period 2007-2013 (see graph below): **337 million** (because the TV bought in 2007, 2008, 2009 and so on until 2013 will be in use in 2013). We have thus used this figure of 337 million to calculate the amount of CO_2 emitted from the production of ABS for the all the remote controls in use in 2013 (337 million × 3), and the amount of CO_2 that would **not** be emitted if the number of remote control is reduced from three to one per TV.



(see Michel, Attali and Bush, 2014 p.11)

3. ABS Plastic



Remote controls are mostly made of acrylonitrile-butadiene-styrene, or ABS, which is one of the most common plastic materials. There are countless applications for ABS. For example, it is used for the production of computer keyboards, power-tool housing, the plastic face-guard on wall sockets (oftentimes a PC/ABS blend), LEGO toys (Creative Mechanisms, n.d.), vacuum cleaners, kitchen appliances, telephones, toys and it is even used in the automotive industry (PlasticsEurope, n.d.). ABS is a popular choice for manufacturers because it is able to withstand physical and chemical damage and it is relatively inexpensive ($1.50 per lb) (Creative Mechanisms, n.d.).

However, ABS is not environmentally friendly. The petrochemical compounds acrylonitrile, butadiene and styrene undergo several chemical reactions and then form into a plastic polymer. ABS is essentially made from petroleum (Hyrule Foundry, 2013) and is neither a biodegradable nor a renewable resource. This leads to an unnecessary increase in CO_2 emissions, landfills and all-round harm to the environment.

3.1. Statistics and calculations

Average weight of a remote control	100g (for example, see Walmart, n.d.)
Amount of ABS in one remote control	~ 0.075kg
Time Range	7 years: 2007-2013 (see Michel, Attali and Bush, 2014 p.11)
Number of TVs in use in 2013 in the EU	337 million (see Michel, Attali and Bush, 2014 p.11)
CO_2 emissions for 1 kg ABS	3.1kg (Boustead, 2005 p.9)
Avg. life expectancy of a TV set	4-10 years → avg. 7 years (CCM, 2017)
Avg. life expectancy of a remote control	~ 7 years (CCM, 2017)

	7 years (2007-2013)
Number of remote controls in use in the EU	1.011 billion
Number of remote controls to be spared	674 million
Amount of ABS to be spared	50,550 tonnes
Amount of CO_2 to be spared	**156,705 tonnes**

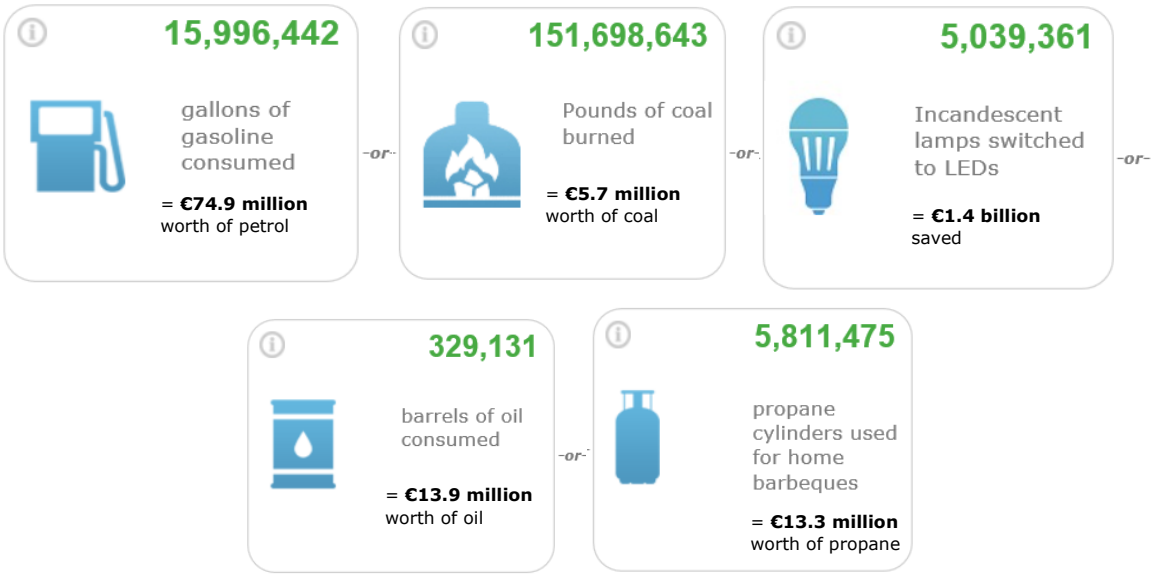
3.2. Methodology

Firstly, it must be taken into consideration that no remote control is the same, but they generally weigh between 80-140 grams, depending on their brand. Therefore, we took an average weight of 100 grams for a remote control, as this will be the best possible representation. The main component of any remote control is ABS plastic, which makes up approximately 75% of a remote control in terms of weight. Therefore, we are working with 75g (0.075kg) of ABS in one remote control. According to a report by the European Plastics Industry, the production of 1 kg of ABS plastic (table below, or see Boustead, 2005 p.9) emits 3,100,000 mg (3.1 kg) of CO_2. This includes the amount of CO_2 produced from fuel production, fuel use, transport, and production processes, therefore the 3.1 kg figure is reliable.

As we have already mentioned in the ***Time range*** section (page 3), European TV sales amount to a total of **337 million** TV units (see Michel, Attali and Bush, 2014 p.11). Assuming that on average 3 remote controls are being used, the result comes to just over **1 billion** remote control devices in the European Union for the entire seven-year period (2007-2013), or **144.4 million a year**. Thus, our aim is to decrease the average number of remote controls from three to one per TV, meaning subtracting 337 million from 1.011 billion. This is a reduction of **674 million** redundant remote controls, leaving us to calculate the amount of plastic and thus CO_2 emission to be spared from the environment. Going back to our 0.075kg ABS plastic assumption from before, we multiply this by 674 million and come up with **50,550 tonnes of waste ABS**. With our previous result of 3.1kg CO_2 that are emitted during the production of 1kg ABS, the final result of CO_2 that can be saved stands at almost **156,705 tonnes** of CO_2 for the seven-year (2007-2013) period.

With this result of **156,705 tonnes** of CO_2 emissions spared a year, we can go on to illustrate the environmental effects. The effects as shown below are extraordinary and would save the economy unnecessary costs across multiple sectors, while also preventing further damage to the environment.

156,705 tonnes of CO_2 are equivalent to…



(see United States Environmental Protection Agency, n.d.)

Below is a detailed overview of the harm ABS causes the environment:

Gross air emissions associated with the production of 1 kg of ABS. (Totals may not agree because of rounding)

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	From biomass (mg)	From fugitive (mg)	Totals (mg)
dust (PM10)	1000	190	4	490	-	-	1700
CO	1300	1200	50	2500	-	-	5100
CO2	550000	2100000	12000	380000	-670	-	3100000
SOX as SO2	2100	4500	160	1100	-	-	8000
H2S	<1	-	<1	<1	-	-	<1
mercaptan	<1	<1	<1	<1	-	-	<1
NOX as NO2	1800	2900	92	760	-	-	5500
NH3	<1	-	<1	2	-	-	2
Cl2	<1	<1	<1	<1	-	-	1
HCl	51	26	<1	2	-	-	79
F2	<1	<1	<1	1	-	-	1
HF	2	1	<1	<1	-	-	3
hydrocarbons not specified	880	280	27	3200	-	2	4400
aldehyde (-CHO)	<1	-	<1	<1	-	-	<1
organics	<1	<1	<1	340	-	-	340
Pb+compounds as Pb	<1	<1	<1	<1	-	-	<1
Hg+compounds as Hg	<1	-	<1	<1	-	-	<1
metals not specified elsewhere	<1	2	<1	<1	-	-	3
H2SO4	<1	-	<1	<1	-	-	<1
N2O	<1	<1	<1	<1	-	-	<1
H2	36	<1	<1	16	-	-	52
dichloroethane (DCE) C2H4Cl2	<1	-	<1	<1	-	<1	<1
vinyl chloride monomer (VCM)	<1	-	<1	<1	-	<1	<1
CFC/HCFC/HFC not specified	<1	-	<1	<1	-	-	<1
organo-chlorine not specified	<1	-	<1	1	-	-	1
HCN	<1	-	<1	<1	-	-	<1
CH4	27000	450	<1	2400	-	<1	30000
aromatic HC not specified elsewhere	<1	-	<1	420	-	2	430
polycyclic hydrocarbons (PAH)	<1	2	<1	<1	-	-	2
NMVOC	<1	-	<1	28	-	-	28
CS2	<1	-	<1	<1	-	-	<1
methylene chloride CH2Cl2	<1	-	<1	<1	-	-	<1
Cu+compounds as Cu	<1	<1	<1	<1	-	-	<1
As+compounds as As	-	-	-	<1	-	-	<1
Cd+compounds as Cd	<1	-	<1	<1	-	-	<1
Ag+compounds as Ag	-	-	-	<1	-	-	<1
Zn+compounds as Zn	<1	-	<1	<1	-	-	<1
Cr+compounds as Cr	<1	1	<1	<1	-	-	1
Se+compounds as Se	-	-	-	<1	-	-	<1
Ni+compounds as Ni	<1	2	<1	<1	-	-	2
Sb+compounds as Sb	-	-	<1	<1	-	-	<1
ethylene C2H4	-	-	<1	5	-	-	5
oxygen	-	-	-	<1	-	-	<1
asbestos	-	-	-	<1	-	-	<1
dioxin/furan as Teq	-	-	-	<1	-	-	<1
benzene C6H6	-	-	-	3	-	7	10
toluene C7H8	-	-	-	<1	-	1	1
xylenes C8H10	-	-	-	<1	-	<1	<1
ethylbenzene C8H10	-	-	-	1	-	2	2
styrene	-	-	-	<1	-	1	2
propylene	-	-	-	4	-	-	4

(see Boustead, 2005 p.9)

4. Other main components

4.1. Fibreglass

Fibreglass is a reinforced plastic material composed of glass fibres embedded in a resin matrix. It usually makes up around 10% of the weight of a standard TV remote control. Having a total of 1.011 billion remote controls operating in the EU in the 2007-2013 period, we can go on to calculate their combined weight:

1,011,000,000 devices x 100g = 101,100,000,000g

⇨ weight of all remote controls 101,100,000kg

Now considering that 10% of the material is fibreglass, the calculation goes on as follows:

10% of the 101,100,000kg = 10,110,000kg of fibreglass

⇨ 10,110 tonnes of fibreglass

The carbon footprint of producing 1 tonne of fibreglass results in 325 kg of CO_2 emissions.

Therefore, 10 110 tonnes × 0.325 (tonnes of CO_2 emissions) = 3,286 tonnes of carbon dioxide

If we reduce the amount of TV remotes controls from 3 to 1 per TV as intended, we need to calculate two thirds of the total amount of CO_2 we would be able to save

= **2 190 tonnes** of CO_2 emissions for 7 years (2007-2013)

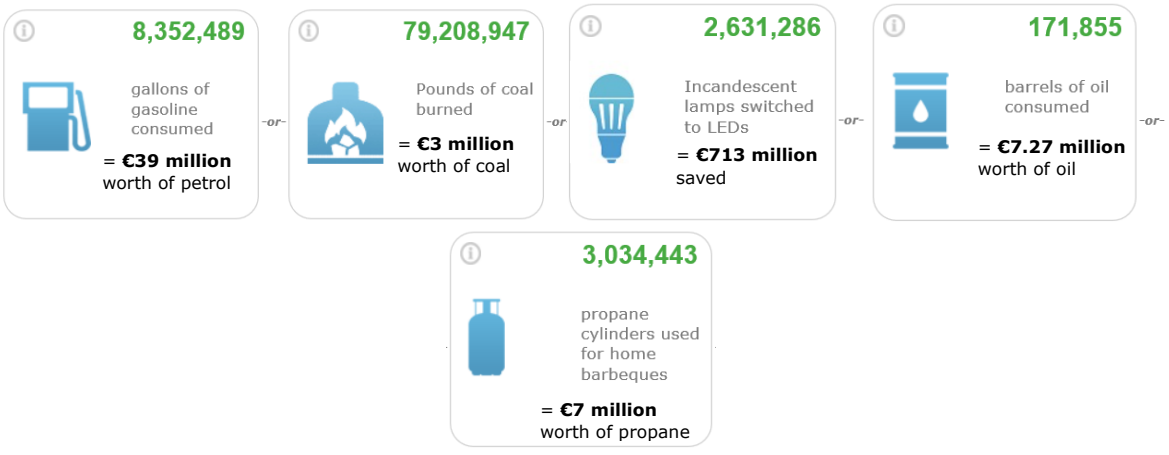
4.2. Batteries

Our current remote controls hold 2 AAA batteries on average and the production of 674 million remote controls is to be prevented every 7 years, therefore we can state that 60.7g of CO_2 are emitted during the production and consumption of 1 AAA battery (Muthu, 2015). This leads to a total of 121.4g for each remote control.

Calculating the total CO_2 emissions that can be saved, we arrive at:

674,000,000 × 0.0001214 tonnes = **81,823.6 tonnes** of CO_2 emissions for 7 years (2007-2013)

81,800 tonnes of CO_2 are equivalent to



5. Project limitations

Time range

The research data ranges from 2007 to 2013 and is therefore not the most recent information that can be acquired. Any other already operating TV sets and their remote controls are hereby not accounted for. Furthermore, the graph for 2007-2013 shows a visible decline in TV sales, therefore it cannot be ruled out that less CO_2 is being emitted in the production of TV remote controls in 2017.

EU-24

The graph used in this publication by Top Ten Services, which illustrates the EU TV Sales Market, is limited to only 24 out of the 28 member-states. The excluded markets are Cyprus, Croatia, Malta and Luxembourg. The reason for their exclusion is unknown.

Data accuracy

Most of the used data are assumed averages as no exact data is available or can be acquired. However, the estimates are within a reasonable and workable range.

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