Equipment Energy Efficiency

Product Profile: Battery Chargers

April 2013

A joint initiative of Australian, State and Territory and New Zealand Governments.

This Report is available at

www.energyrating.gov.au

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GLOSSARY

ABS	Australian Bureau of Statistics
AS/NZS	Australian Standards and New Zealand Standards
BAU	Business-as-usual
CEC	California Energy Commission
CO_2-e	Carbon dioxide equivalent units
COAG	Council of Australian Governments
DOE	The Department of Energy in the United States of America
DCCEE	Department of Climate Change and Energy Efficiency
DEWHA	Department of the Environment, Water, Heritage and the Arts
E3	Equipment Energy Efficiency Committee (formerly NAEEEC)
GHG	Greenhouse Gas
GWh	Giga Watt hour – 1,000 million Watt hours
kt	Kilo Tonnes – 1 thousand Tonnes
kWh	Kilo Watt hour – 1 thousand watt hours
MCE	Ministerial Council for Energy
MEPS	Minimum Energy Performance Standards
Mt	Mega Tonnes – 1 million Tonnes
NZ	New Zealand
PG&E	Pacific Gas and Electric, a Californian energy utility
RIS	Regulatory Impact Statement

Document Scope and Purpose

Introduction

This report is a product profile focusing on battery chargers, and products using or incorporating battery chargers, where a battery charger is a device with charge control circuitry for charging batteries for consumer products. It is distinct from an external power supply, which is an external electrical device that is used to convert household electric AC current in DC current or lower-voltage AC current to provide power to a consumer product which may or may not contain a battery. External power supplies are already regulated for MEPS and are not being considered in this profile. It is an initial document for consultation with industry and other stakeholders, and readers are asked for feedback on the data and assumptions used in preparing this profile. Comments and supporting documents should be lodged at either the Australian or New Zealand Email address provided below.

The report broadly describes different battery charger technologies and their end use products. The approach to policy development is likely to firstly categorise battery chargers based on their end use products, rather than the battery chargers themselves, as the majority are incorporated into end use products, or sold as a package, and their energy use profile is dependent on the product they are supplied with. The exception is standalone battery chargers for charging batteries with no specific end use and these would be given separate consideration. The description considers standby and operating energy requirements. It also surveys international methods of improving energy efficiency of these types of product. Modelling presented in the report shows that significant energy savings are achieved when assumed energy use and potential energy savings values derived from international programs are applied to the Australian and New Zealand market profile.

Based on the findings of this Product Profile the Equipment Energy Efficiency (E3) Committee may decide to proceed with the development of a Regulatory Impact Statement (RIS) for Consultation. Such a Consultation RIS will detail proposals for improving energy efficiency of these products, along with the cost/benefit analysis for proceeding with the proposals. Such a Consultation RIS will take into consideration any feedback received in relation to this product profile and will also seek further feedback from stakeholders.

Where to from here

Consultation on this product profile

Readers are asked to comment on a number of aspects in this document, particularly market data and modelling assumptions, to assist with the formulation of a preferred policy option in future. While we welcome comments on all aspects of the Product Profile, comments on the **Battery Chargers Product Profile – Key Questions** below would be of particular assistance.

Comments and any supporting documents should be Emailed to one of the addresses indicated below. The Email Subject should be clearly titled 'BATTERY CHARGERS PROFILE - Consultation'.

The closing date for comments is **COB 12 July 2013**.

Australia	New Zealand
e3.appliance@climatechange.gov.au	regs@eeca.govt.nz

After consultation on the product profile

The evidence in this Product Profile will be reviewed and supplemented in light of any written submissions made by stakeholders and/or issues raised at stakeholder meetings.

Decisions will then be made on whether to proceed with a proposal for battery chargers (to improve their energy efficiency) and what the preferred options should be.

If the preferred options involve regulation (e.g. MEPS and/or labelling) a RIS will be prepared to analyse the costs, benefits, and other impacts of the proposal. Consultation will be undertaken with stakeholders prior to any final decisions being made.

Final decisions on policy will be made by the relevant Council of Australian Governments (COAG) Ministerial Council in Australia and by the New Zealand Cabinet.

Battery Chargers Product Profile – Key Questions

- Do you agree with the market data presented for Australia and New Zealand? In particular, do you agree with the estimates of current and projected stock and sales of battery chargers? Are there any products that are only sold in New Zealand or Australia?
- Do you agree with the breakdown of sales between the various product types? Are there any major trends that are not specified in the product profile for Australia and New Zealand?
- Do you agree with the projected trends? Are the average efficiency, size and operating hours accurately estimated for Australian and New Zealand?
- Is there a source of sales weighted average efficiency of devices in Australia or New Zealand that can be used for further analysis?
- What do you think would be the best way for governments to facilitate an increase in the average energy efficiency of battery chargers sold?
- Do you think that there is a case for MEPS for battery chargers and implementing a government regulated trans-Tasman MEPS?
- Is there a preferred international standard/regulation or protocol that could be used as the basis of a government regulated MEPS and/or labelling program?
- What additional costs do you think this would place on industry compared to the current situation? What impact do you think it would have on competition and consumer choice?
- Are there any other issues that may impact on the potential regulation of battery chargers?

Executive Summary

A battery charger is a device that incorporates charge control circuitry to charge batteries for consumer products. Battery chargers are used by a wide variety of equipment in both the residential and the commercial/industrial sectors. Typical battery charging systems include:

- electronic devices with a battery that are normally charged from AC line voltage or DC input voltage through an internal or external power supply and a dedicated battery charger;
- the battery and battery charger components of devices that are designed to run on battery power during part or all of their operations;
- dedicated battery systems primarily designed for electrical or emergency backup;
- devices whose primary function is to charge batteries, along with the batteries they are designed to charge. These units include chargers for power tool batteries and chargers for automotive, AA, AAA, C, D, or 9 V rechargeable batteries, as well as chargers for batteries used in larger industrial motive equipment.
- The charging circuitry of battery charger systems may or may not be located within the housing of the end-use device itself. In many cases, the battery may be charged with a dedicated external charger and power supply combination that is separate from the device that runs on power from the battery.

General battery charger form factors are:

- Power supply and charge control circuitry, each in separate housings;
- Power supply and charge control circuitry in one housing, battery in separate housing;
- Charge control circuitry and battery in one housing, power supply in separate housing;
- Power supply, charge control circuitry, and battery all in the same housing.

Note – the housing may be the consumer product, such as a mobile phone, mobility scooter etc.

The energy used by battery chargers is significant and has been estimated by Ecos Consulting [1](Ecos 2006) to be approximately 2% of the USA electricity usage. It is also estimated that this energy use could be reduced by approximately 30% at reasonable cost using readily available technology.

The range of products which include or use battery chargers is extensive and quite diverse, but can be grouped into the following categories:

- Consumer electronics and ICT products
- Commercial and industrial equipment and instruments
- Electric vehicles
- Uninterruptable power supplies
- Emergency lighting and security systems.

Analysis of the Australian and New Zealand market indicates that around 15 million products involving battery chargers are sold annually in Australia, and 2.5 million in New Zealand (GfK2010). The majority of these are consumer electronic products with short product lives, so improvement in the efficiency of battery chargers would quickly affect many of the products in the market. Analysis in this report indicates an estimated 3,370 GWh in Australia and 640 GWh for New Zealand is being used on battery charging systems annually.

There is considerable technical potential for energy savings from battery charging products. Research indicates that a typical battery charger is only around 13% efficient when charging over a 24 hour period and there is wide variation in the efficiency of existing chargers (Ecos 2006). This suggests that existing technologies can support much greater efficiency than the current market average.

Preliminary estimates conducted for this profile of energy saving potential in Australia and New Zealand indicates that around 5,300 GWh of energy could be saved in Australia and 1,000 GWh in New Zealand over a ten year period from improvements of battery charger efficiency. This is equivalent to a greenhouse emission savings of approximately 4.4 million tonnes CO_2-e in Australia, and 0.4 million tonnes CO_2e in New Zealand. These energy

[1] Ecos is now known as Ecova

savings also translate into a significant energy cost savings for small and large consumers, estimated at around at $1,125m in Australia and $170m in New Zealand over ten years.

Internationally, Pacific Gas and Electric (PG&E), a Californian energy utility, has led analysis of battery charger energy use and scope for energy savings. The US EPA and DOE, Californian and Canadian government officials are engaged in the process. A US national MEPS for battery chargers is expected to come into effect in 2014 and Canada is expected to follow this policy. Korea already has MEPS on battery charger for mobile phones but the intention of other Asian nations regarding battery charger efficiency is unknown.

Australia introduced MEPS regulations for EPS in December 2008 and New Zealand introduced regulations in June 2011. The impact of the EPS MEPS when used to power a battery charger is to reduce the energy used when there is no load on the battery charger, such as when the charger is in standby/no battery mode. The EPS MEPS also provides small efficiency gains when the battery charger is in charge mode. However, this does not imply that battery chargers connected to EPS will be operating efficiently. There will still be considerable potential to improve the battery charging circuitry and management of charging modes. Also EPS regulations do not affect large power supplies, greater than 250W, or devices with internal power supplies.

It is recommended that the battery charger situation be reviewed in 6 months, especially the developments of international standards. This review may then require the undertaking of a RIS to explore potential voluntary and regulatory options for improving battery charger efficiency.

Product Description

A battery charger is a device that charges batteries for consumer products, including internal chargers, (battery chargers embedded in the product and the product is connected to the power source during charging), external chargers (the battery must be removed from the product during charging), external chargers (the battery charger is connected to the product) and standalone chargers for batteries unrelated to a specific product. It is distinct from an external power supply, which is an external electrical device that is used to convert household AC electric current into DC current or lower-voltage AC current to provide power to a consumer product. External power supplies are already regulated for MEPS and are not being considered in this review.

A battery charger provides electrical energy to a battery, within which the electrical energy is converted to chemical energy. During use (discharge) of the battery, this chemical energy is converted into electrical energy. The type of battery charger depends on the type of battery chemistry, while the type of battery depends on the end use product. Therefore the type of battery charger ultimately also depends on the end use product.

Chargers perform two main functions: converting electrical energy to a current that can be safely supplied to the battery, and monitoring the battery to determine the suitable rate of charge. There are four broad types of chargers depending on the battery chemistry (Horowitz, 2003). Current commercially available battery technologies/chemistries are Lead acid, Nickel Cadmium (NiCd), , Nickel metal hydride (NiMH) or Lithium ion based.

The simplest type of charger supplies a constant current to the battery at a slow rate, and requires manual removal of the battery. There is no automatic cut off from the charger when the battery is full, thus it continues to provide current at the same rate overheating the battery. This type of charger can only be used with NiCd batteries, as the other types will become dangerous if overheated.

The next step up from this is a charger with an automatic timer. This will provide current at a constant rate for a set period of time; that is determined based on the time it typically takes to fully charge a battery that has been completely drained. Again this type of charger is only suitable with NiCd batteries due to the risk of overheating.

A more sophisticated charger can monitor voltage across the battery terminals. When it detects the battery voltage reaches a maximum, the charger will respond by reducing or terminating the current flow. This type of charger can be used with all battery chemistries.

The most sophisticated charger on the market contains a computer chip that can adapt to the number of cycles the battery has experienced and the battery's depth of discharge. It monitors the batteries voltage, impedance, and temperature and regulates the current flow accordingly. These are also suitable for use with all battery chemistries.

This profile group's battery charger by products they are used in, rather than the chargers themselves, as battery chargers are nearly always incorporated into, sold in a package with or in some other way intended for use with a specific application. Thus the usage profiles, energy use, and power requirements are driven by the product associated with the charger. The exception to this is standalone chargers for charging batteries that can be used in a variety of products, which will be given separate consideration.

Battery chargers are now found in a wide variety of equipment in both the residential and the commercial/industrial sectors. The cumulative energy used by battery chargers in the USA has been estimated by Ecos Consulting (Ecos 2006a) to be approximately 2% of total USA electricity consumption. In the residential sector, examples of products that use battery chargers are:

- video camcorders
- digital cameras
- mobile telephones
- cordless phones
- wireless home phones
- laptop and notebook computers

- electronic portable games
- rechargeable electric toys
- rechargeable toothbrushes
- rechargeable personal grooming products
- portable stereos
- portable DVD players
- cordless tools
- standalone battery chargers
- personal electric vehicles (mobility scooters)

Battery chargers are also found in the commercial and industrial sector, as well as other products such as:

- bar code scanners
- 2-way radios
- monitoring devices
- data recorders and information appliances
- commercial power tools
- emergency lighting
- uninterruptable power supplies
- security systems
- electric fork lifts and plant equipment (e.g. scissor lift)
- golf carts
- electric vehicles (not covered by this profile)[2]

These products are quite diverse but can be grouped into three broad categories:

- Small Consumer;
- Small Non-consumer; and
- Large Non-consumer.

As the use of portable electronics increases, the use of rechargeable batteries for power will continue to increase. The performance of batteries is also improving such that more energy intensive products can operate on a battery such as tools, equipment and vehicles. "Battery charger systems" defined in the scope of this product profile refers to battery chargers coupled with their batteries, such as:

- electronic devices with a battery that are normally charged from AC - internal or external power supply and a dedicated battery charger;
- battery and battery charger components of devices that are designed to run on battery power during part or all of their duty cycle including portable appliances and commercial material handling equipment;
- dedicated battery systems designed for electrical or emergency backup e.g. emergency lighting and uninterruptible power supply (UPS) systems
- devices whose primary function is to charge batteries including:
  - power tool batteries and chargers for automotive, AA, AAA, C, D, or 9 volt rechargeable batteries
  - motive equipment (including golf carts, forklifts, scooters)

Power Modes of Battery Chargers

Battery chargers available in Australia and New Zealand generally can be considered to have four operational modes: Active mode, Standby mode, Maintenance mode and Off mode. The definitions shown in Table 1 are consistent with the USA DOE's definitions used in their Energy Conservation Program: Test Procedures for Battery Chargers and External Power Supplies; Final Rule.

[2] Will be addressed in future E3 publications

Table 1: Definition of Power Modes

Mode	Definition
Off	Battery charger is connected to supply but switched off using a switch in the battery charger
Standby/No Battery	Charge is connected to supply but batteries not connected to charger
Idle/Maintenance*	Charger is connected to supply but not charging as the battery is fully charged
Active/Charge	Charger is connected to supply, is delivering current and the battery is being charged

*The battery charger may be delivering some current in the idle or maintenance mode in order to compensate for the self-discharge of the battery.

Sources of Product

The sources of battery chargers vary with type of product being powered but the overwhelming majority of battery chargers are manufactured outside of Australia and New Zealand, and are produced for the global electronics market. This market is dominated by companies based in Japan, Korea and China with manufacturing taking place in a diverse range of countries, mainly throughout Asia. However companies from Europe and the United States make up a significant share of the market especially for high quality consumer products and for commercial/industrial equipment and instruments.

Some products for the commercial and industrial sector, such as uninterruptable power supplies, emergency lighting and security systems, are manufactured or assembled in Australia and New Zealand.

Energy Consumption of Products

Based on the Ecos Consulting research (Ecos 2006b, Ecos 2010), the average energy consumption and potential energy savings of a variety of products has been estimated and shown Table 2. As many of these products are internationally traded, it is assumed that the potential energy savings would be applicable to Australia and New Zealand.

Table 2 provides an indication of potential savings per device if they were being recharged efficiently. This preliminary estimate clearly indicates the huge potential for energy savings if battery chargers were more efficient. The total energy savings are dependent on the sales and stock of these products, which is explained in the section Energy and Greenhouse Gas Reduction Potential on page 24.

Table 2: Estimated Energy Consumption and Potential Savings from Efficient Battery Charger Systems

Market Segment	Product Category	Baseline Unit Energy Consumption (kWh pa)	Potential Unit Energy Consumption (kWh pa)	Energy Savings Per Unit (kWh pa)
Small Consumer	Auto/Marine/RV	343	29	314
	Mobile Phones	3	3	0.5
	Cordless Phones	19	6	13
	Personal Audio Electronics	2	2	0.5
	Emergency Systems	25	9	16
	Laptops	34	17	17
	Personal Care	4	2	1.8
	Personal Electric Vehicles	931	394	537
	Portable Electronics	3	1	1.7
	Portable Lighting	14	5	9
	Power Tools	23	8	15
	Universal Battery Charger	8	4	4
	Golf Carts/Electric Carts	2,440	1,753	687
Small Non-consumer	Emergency Backup Lighting	14	5	9
	Handheld Barcode Scanners	27	7	20
	Two-Way Radios	18	9	9
Large Non-consumer	Single Phase - Fork lifts	8,169	7,137	1,033

	Three Phase - Fork lifts	22,509	20,418	2,091

Several assumptions regarding the power and usage of battery charger systems were used to develop the unit energy consumption and savings potential. The baseline power consumption and potential efficient product power consumption (shown in brackets) by mode of operation is shown in Table 3. The proportion of time that each product is used in each power mode is shown in Table 4. The data is based on the Ecos research (Ecos 2010) and would be similar in Australia and New Zealand, as they have similar market characteristics to the U.S. The product of the power use and time of use per mode provides the estimated energy consumption for each device.

Table 3: Estimated Baseline and Potential Power Use by Mode for Battery Charger Systems

Market Segment	Product Category	Charge Mode (W)	Maintenance Mode (W)	No Battery Mode (W)
Small Consumer	Auto/Marine/RV	214 (118.1)	41.9 (1.82)	49.3 (0.3)
	Mobile Phones	3.9 (2.8)	0.5 (0.5)	0.3 (0.3)
	Cordless Phones	2.7 (1.1)	2.2 (0.6)	1.7 (0.3)
	Personal Audio Electronics	2.1 (1.2)	0.5 (0.5)	0.1 (0.1)
	Emergency Systems	7 (4)	2.9 (1.08)	2.5 (0.3)
	Laptops	27.1 (24.6)	3 (0.69)	1.9 (0.3)
	Personal Care	1.2 (0.6)	1 (0.6)	0.9 (0.3)
	Personal Electric Vehicles	230 (120)	34.1 (2.22)	33.9 (0.3)
	Portable Electronics	9.2 (8.4)	2.5 (0.65)	0.9 (0.3)
	Portable Lighting	1.8 (0.7)	1.6 (0.61)	0.4 (0.3)
	Power Tools	17.5 (14.7)	3.5 (0.66)	1.8 (0.3)
	Universal Battery Charger	7.1 (3.9)	1.1 (0.61)	0.9 (0.3)
	Golf Carts/Electric Carts	620 (523)	103 (13.2)	1.6 (0.3)
Small Non-consumer	Emergency Backup Lighting	2.2 (1)	1.6 (0.62)	1.6 (0.3)
	Handheld Barcode Scanners	11.2 (3.2)	3 (0.61)	0.2 (0.2)
	Two-Way Radios	5.3 (3.8)	2 (0.61)	0.9 (0.3)
Large Non-consumer	Single Phase - Fork lifts	2000 (1770)	50 (36.4)	50 (10)
	Three Phase - Fork lifts	5600 (5111)	88.5 (50.8)	33.5 (10)

Table 4: Estimated Proportion of Use by Mode for Battery Charger Systems

Market Segment	Product Category	Charge Mode	Maintenance Mode	No Battery Mode	Unplugged Mode
Small Consumer	Auto/Marine/RV	2%	78%	6%	15%
	Mobile Phones	5%	30%	19%	46%
	Cordless Phones	31%	56%	9%	4%
	Personal Audio Electronics	6%	25%	35%	33%
	Emergency Systems	0%	99%	0%	0%
	Laptops	6%	56%	30%	8%
	Personal Care	5%	36%	6%	53%
	Personal Electric Vehicles	37%	28%	35%	0%
	Portable Electronics	1%	10%	1%	88%
	Portable Lighting	1%	99%	0%	0%
	Power Tools	4%	48%	15%	32%
	Universal Battery Charger	1%	66%	17%	17%
	Golf Carts/Electric Carts	37%	47%	16%	0%
Small Non-consumer	Emergency Backup Lighting	0.8%	99.2%	0%	0%
	Handheld Barcode Scanners	13%	52%	35%	0%
	Two-Way Radios	19%	31%	50%	0%
Large Non-consumer	Single Phase - Fork lifts	45%	32%	24%	0%
	Three Phase - Fork lifts	45%	32%	24%	0%

Market Profile

Several forms of battery chargers are present in almost every Australian and New Zealand home. Most homes will own multiple products; for example cordless phones, mobile phones, notebook/laptop computers and battery chargers for the batteries of digital cameras, torches etc. Likewise in the commercial and industrial sectors, the use of battery chargers is wide spread for portable office equipment, scanners and data recorders, portable tools, security systems and electric forklift trucks and equipment.

The ever increasing penetration of portable products and equipment powered by batteries, driven by increasing use of electronics and improved battery technologies, means there is a growing use of battery chargers. Table 5 gives the estimated stock numbers and annual sales of the various main devices using battery chargers. The stock and annual sales are estimated from various sources, including GfK Australia (who collect sales data from retailers for both Australia and New Zealand), published reports and industry sources. Where data is not available, for a small number of product categories, the Australian and New Zealand markets were estimated based on California data and scaled according to households.

The estimated total sales of battery charger systems in Australia are 15M pa and in New Zealand are 2.5M pa in 2010. The total stock is almost 75M in Australia and 10M in New Zealand (GfK 2010).

Table 5: Estimated penetration and sales of products with battery charging: Australia and New Zealand 2010

Market Segment	Product Category	Annual Sales Australia (000's)	Existing Stock Australia (millions)	Annual Sales New Zealand (000's)	Existing Stock New Zealand (millions)
Small Consumer	Auto/Marine/RV	30	0.30	6	0.06
	Mobile Phones	3,800	22.0	729	1.46
	Cordless Phones	1,250	5.95	320	1.60
	Personal Audio Electronics	2,450	10.0	350	1.05
	Emergency Systems	870	3.55	167	0.68
	Laptops	1,700	4.51	220	0.88
	Personal Care	240	1.20	40	0.20
	Personal Electric Vehicles	27	0.07	5	0.01
	Portable Electronics	1,860	9.67	200	1.04
	Portable Lighting	74	0.80	14	0.15
	Power Tools	402	2.62	77	0.50
	Universal Battery Charger	967	7.74	185	1.48
	Golf Carts/Electric Carts	13	0.12	3	0.02
Small Non-consumer	Emergency Backup Lighting	1,339	5.29	257	1.01
	Handheld Barcode Scanners	51	0.32	10	0.06
	Two-Way Radios	47	0.06	9	0.01
Large Non-consumer	Single Phase - Fork lifts	3	0.04	1	0.01
	Three Phase - Fork lifts	6	0.08	1	0.02
	Totals	**15,128**	**74.3**	**2,593**	**10.2**

This table was derived from multiple sources of data (for Australia and New Zealand) including GfK 2010, ACS 2010, ABS 2011, E3 2009, Ecos 2010 and Industrial Trucking Association.

The consumer products requiring battery charging are characterised by large annual sales volumes, often in the millions p.a., and by relatively rapid turnover. The majority of these products are relatively low cost items and have a product life of a few years or less. This means that any improvements to the efficiency of battery chargers of these products will quickly flow through to stock in the market and create energy savings.

In comparison, the products directed at the commercial and industrial market often have much longer operating lives and are sold in smaller volumes. This means it will take a longer time to make improvements in the efficiency of stock in the market for these products, which may be relevant when determining the priorities for improving different types of battery chargers.

Estimated Product Energy Consumption in Australia and New Zealand

Energy consumption by battery charging systems is estimated to be 3,370 GWh p.a. in Australia and 640 GWh p.a. in New Zealand[3] in 2010. The Australian and New Zealand energy consumption has been determined from a detailed model of the stock, estimated power consumption and usage of various battery charger systems by product category. The Australian energy consumption estimated in this study compares relatively closely with the estimated 2% of the national USA electricity consumption by Ecos Consulting (Ecos 2006). If the same was true for Australia, then in 2010 the national estimated electricity consumption is 230,000 GWh, which would imply 4,600 GWh may be being used by battery charging systems.

The contribution of the different products to the total energy use is shown in Table 6 for Australia and New Zealand, along with the estimated per unit energy consumption.

Table 6: Annual Energy Use of Battery Charging Systems- Australia and New Zealand

Market Segment	Product Category	Annual per Unit Energy Consumption (kWh pa)	Australian Energy Consumption (GWh pa)	New Zealand Energy Consumption (GWh pa)
Small Consumer	Auto/Marine/RV	343	103	20
	Mobile Phones	3	77	5
	Cordless Phones	19	116	31
	Personal Audio Electronics	2	25	3
	Emergency Systems	25	90	17
	Laptops	34	151	29
	Personal Care	4	5	1
	Personal Electric Vehicles	931	62	12
	Portable Electronics	3	28	3
	Portable Lighting	14	11	2
	Power Tools	23	61	12
	Universal Battery Charger	8	63	12
	Golf Carts/Electric Carts	2,440	286	55
Small Non-consumer	Emergency Backup Lighting	14	74	14
	Handheld Barcode Scanners	27	9	2
	Two-Way Radios	18	1	0
Large Non-consumer	Single Phase - Fork lifts	8,169	339	65
	Three Phase - Fork lifts	22,509	1,868	358
Totals			**3,370**	**641**

[3] Total electricity consumption was 230,000 GWh in Australia and 38,244 GWh in New Zealand in 2010.

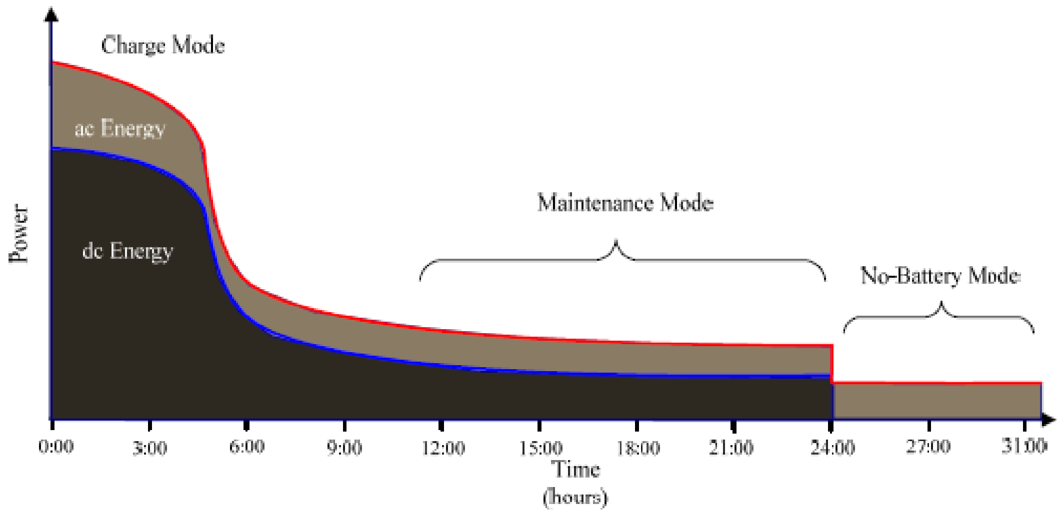
Scope for Technological Improvement

Recent studies have concluded that energy savings from battery chargers range from 20% to 60%. Ecos Consulting (Ecos 2006) investigated the potential for energy savings from battery chargers and concluded that energy savings can be roughly half of the total energy use of battery chargers. Energy saving strategies identified includes the following:

- Improving the efficiency of the power supply circuitry (but these are not always included in the charger and can be partially covered by EPS);
- Improving charge mode efficiency through better battery charging circuitry;
- Improving the battery control strategy to cut off unnecessary maintenance charge and no-battery power.

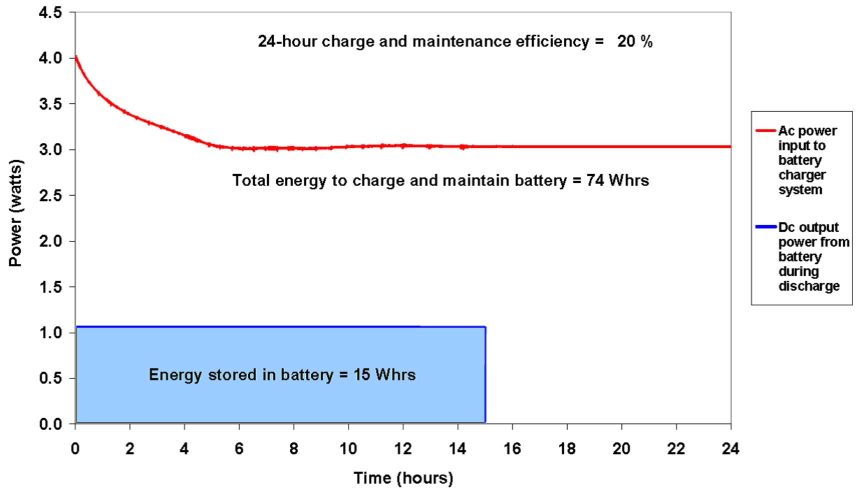
Figure 1 illustrates the potential power usage of a battery charger that would move from charge mode to maintenance mode when the battery was fully charged. The power requirement would decline even further when the battery was removed from the charger or no battery maintenance charge was required.

Figure 1: Typical Power Requirements of a Battery Charger System



In comparison, Figure 2 shows an example of the more typical power consumption of existing battery chargers over a 24 hour period versus the energy stored by the battery. Over five times as much energy is used to charge the battery as is stored in the battery.

Figure 2: Comparison of Battery Energy Storage and Energy Used by Charger over 24 Hours



There is a wide variation in the efficiency of battery charging in each mode, showing that there is the technical potential to improve the average efficiency rates across chargers in the market. Figure 3 shows the results of measurements made by Ecos Consulting on the wide range of variations in battery charger power usage for different battery capacities.

Figure 3: Measured Efficiency of Battery Charges (Ecos 2010)

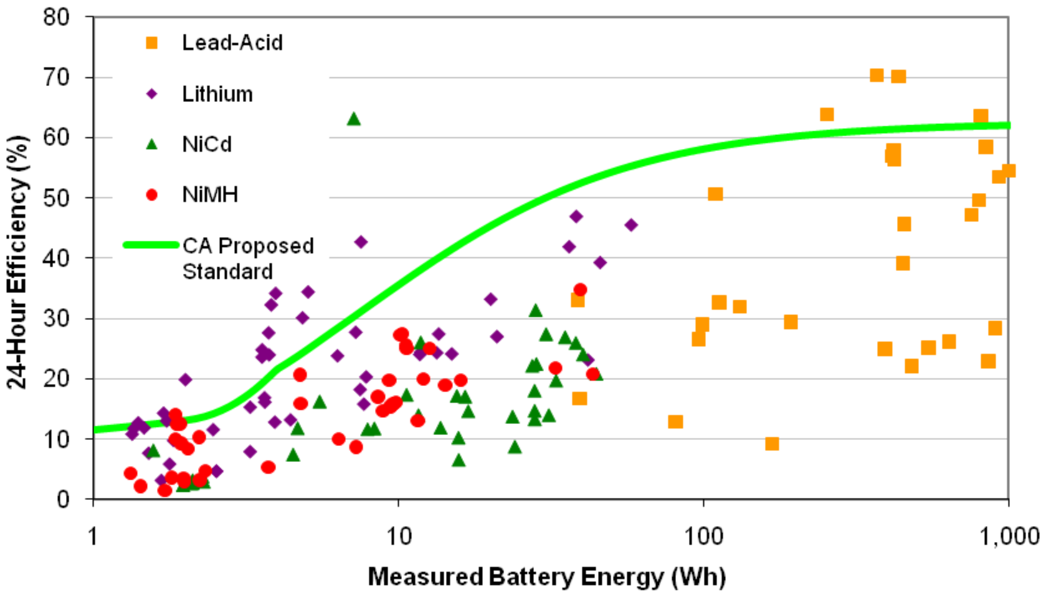


Figure 3 also shows that the efficiency of battery chargers, in terms of energy stored in the batteries charged versus energy used by the chargers over 24 hours, can vary from 10% to 70%. Typically the efficiency varies from around 10% to 30% across all the different battery capacities, so the technical potential to improve the efficiency of battery chargers in the market exists for all sizes of battery chargers.

The United States ENERGY STAR program has battery chargers as one of its products and also provides evidence that there is existing technical potential to improve the efficiency of battery chargers. The ENERGY STAR program requires qualified products to use at least 30% less energy than standard equipment. Some battery chargers are ENERGY STAR certified, so the technical feasibility of battery chargers to be significantly more efficient than the existent standard charger is evident.

In California, the California Energy Commission (CEC) has implemented regulations that will not allow products that do not meet certain levels of efficiency to be sold. The standards set a requirement that allows product to be sold if they are above the line illustrated as "CA Proposed Standard" in Figure 3 (although this line is slightly different due to changes made in the final rule making).

These findings suggest that to assume a 30% energy savings from the elimination of inefficient battery chargers is realistic.

Small efficiency gains will also be made as MEPS for External Power Supplies (EPS) applies to many of the EPS that supply battery chargers. However these EPS efficiency gains will only affect the charging of smaller appliances and products, and there will still be considerable potential to improve the battery charging circuitry and management of charging modes.

Review of International Actions

Pacific Gas and Electric (PG&E), a Californian energy utility, has led analysis of battery charger energy use and scope for energy savings. They engaged Ecos Consulting to assist in the analysis and help identify possibilities for government intervention to improve the take up of energy efficiency opportunities across the battery charger product sector. The US EPA and DOE, Californian and Canadian government officials were engaged in the process.

Ecos Consulting has determined that in California (population 36 million) battery charger energy use is around 7,700GWh/year and rising (Ecos 2010). The introduction of MEPS by the CEC should reduce this by 35%, saving 2,700GWh a year. These savings would occur by improving the efficiency of the battery chargers measured over a 24 hour period. It would involve moving chargers to more efficient switch mode power supplies, reducing maintenance power and reducing no-battery power. Due to the high penetration of mass market products like mobile phones, the technology required to move to more efficient battery chargers is available and could be introduced at a low cost. The CEC approved regulation to impose MEPS on battery charges on January 12, 2012. The USA Department of Energy (DOE) published a Notice of Proposed Rulemaking in the Federal Register on March 27th 2012. Canada is also considering the introduction of regulations following the notification of the USA regulations.

There is considerable technical scope for improvement in the efficiency of battery chargers. Products tested by the CEC show that Battery Charger efficiency ranges from 0.4% to 70% over a 24 hour duty cycle. The weighted average is around 10%. There is no apparent technical reason for such low efficiency, so the potential energy efficiency improvements are considerable.

Programs addressing the efficiency of battery chargers implemented to date are limited. The USA EPA has covered a small range of battery charging devices under the Energy Star program since 2006 and is seeking to expand and update their specification in Version 2.0 (EPA 2010). The development of the new specification for battery chargers is currently delayed pending the outcome of the 'national standard for battery chargers for consumer devices' being developed by the USA DOE.

Many regulatory actions are still under development and decisions are expected to take place in 2012 in the USA, while the European and Asian intentions are unknown. Further details of these programs are discussed in the following section.

Energy Efficiency Performance Standards

There are no energy performance standards for battery chargers in Australia or New Zealand. At present governments in Canada and the USA are in the process of regulating the energy efficiency of battery chargers. As a step towards this, the battery testing procedures in the USA were revised. The CEC, the PG&E and Ecos Consulting have been strong proponents of revisions to the USA testing procedures. In May 2010 the USA Department of Energy (DOE) held a public meeting seeking input on a variety of amendments to the current battery charger test procedures. Changes to the test procedure were finalised in June 2011 (DOE 2011) and the new test procedures are expected to be used in the formation of MEPS for battery chargers. A Notice of Proposed Rulemaking (NOPR) outlining DOE's intended MEPS for battery chargers was published on March 27, 2012 (DOE 2012). These MEPS cover only products distributed in commerce for personal use or consumption by individuals.

The State of California adopted MEPS for battery chargers on January 12, 2012 (CEC 2012). The MEPS will apply to small consumer battery charger systems from 1 January 2013, non-consumer from 1 January 2017 and large battery charger systems from 1 January 2014.

Other relevant regulations concern the introduction of MEPS for external power supplies (EPS). For many consumer products and smaller commercial/industrial products an EPS is used to supply power to a battery charger. Following recognition throughout the world that the average efficiency of these EPS could be significantly improved, there has been a series of regulations introduced to improve the minimum efficiency of these devices. The CEC introduced MEPS for EPS in 2007, and the USA DOE also introduced MEPS in 2008. DOE has revised their EPS MEPS and published the intended new regulations in the same NOPR as the battery chargers. The EU issued a directive specifying MEPS for EPS in April 2009. Australia introduced MEPS regulations for EPS in December 2008 and New Zealand introduced regulations in June 2011.

The impact of the EPS MEPS when used for battery charging is to reduce the energy used when there is no load on the battery charger, such as when the charger is in standby/no battery mode. EPS MEPS also provides small efficiency gains when the battery charger is in charge mode. However, this does not imply that battery chargers connected to EPS will be operating efficiently. There will still be considerable potential to improve the battery charging circuitry and management of charging modes. Also EPS regulations do not affect large power supplies, greater than 250W, or devices with internal power supplies.

Voluntary Programs

Battery chargers are covered by voluntary schemes in Europe and the USA. In Europe voluntary information activities concerning the energy efficiency of home electronics, office equipment and IT-equipment are provided by the Group for Energy Efficient Appliances (GEEA)[4], a forum of representatives from European national energy agencies and government departments. The GEEA label is an endorsement program and applies to office equipment, and a variety of consumer electronic equipment. Manufacturers are invited to nominate eligible equipment and the efficiency of a product is judged by its energy consumption in standby mode, with only the top 20% to 30% of the market usually qualifying in a given year. Individual national bodies are responsible for promotion of the scheme.

Energy Star

Battery chargers are covered by the voluntary ENERGY STAR program in the USA and some other countries supporting the ENERGY STAR program (EPA 2011), but not in Australia and New Zealand. Again the program is a voluntary endorsement program. The program specification requires participants to supply battery chargers that use at least 30% less energy than standard equipment. The ENERGY STAR program also covers cordless phones, where battery charging constitutes a significant energy requirement. The requirements for battery chargers are defined in terms of maximum Non-Active Energy Ratio for specific battery voltage ratings, as shown in Table 7 (EPA 2011).

[4] From Clasp Online http://www.clasponline.org/clasp.online.worldwide.php?productsumm=323&product=107

Table 7: Non-Active Energy Ratio (ER) Criteria for Specific Battery Voltage Ratings

Rated battery voltage, V_B	**1.2**	**2.4**	**3.6**	**4.8**	**6.0**	**7.2**	**8.4**	**9.6**	**10.8**	**12.0**
Maximum non-active energy ratio requirement (ER_{MAX})	20.0	16.9	13.7	11.6	9.6	7.5	7.0	6.5	6.1	5.6
Rated battery voltage, V_B	**13.2**	**14.4**	**15.6**	**16.8**	**18.0**	**19.2**	**20.4**	**21.6**	**22.8**	**≥ 24.0**
Maximum non-active energy ratio requirement (ER_{MAX})	5.1	4.5	4.3	4.2	3.8	3.6	3.5	3.3	3.2	3.0

The Non-Active(ER) is defined by the following equation:

$$ER=Ea/Eb$$

Where:

Ea is the accumulated non-active energy in watt-hours (Wh) consumed by the battery charger in maintenance and standby mode over a 48 hour period. ENERGY STAR assumes a battery charger spends 36 hours in maintenance and 12 hours in standby mode.

Eb is the energy in watt-hours (Wh) that may be delivered by the battery under specified discharge conditions. ENERGY STAR assumes battery energy is measured at a constant current discharge rate of 0.2 C, beginning with a fully charged battery and ending at the manufacturer specified cut-off voltage.

Thus the ENERGY STAR program currently specifies limits for battery chargers in standby and maintenance mode only. In the recently published NOPR DOE intends to limit energy use in active mode, as well as standby and maintenance. When DOE's final rule is published, ENERGY STAR will revise their requirements accordingly to ensure their products continue to be more efficient than the market average in all modes.

Mandatory Programs

Korea

In Korea mobile phone battery chargers are covered by the Korean Energy Efficiency Label and Standards Program, which forms their core energy efficiency standards[5]. This program has formed a successful component of their energy conservation strategy. The program requires manufacturers and importers to produce and sell energy efficient products, so products must meet a MEPS level. Battery chargers were included in this program from July 2009 and use the ENERGY STAR requirements, discussed in the previous section, for the standard.

USA – Department of Energy (DOE)

The USA has regulatory provisions, via amendments of the Energy Policy and Conservation Act (EPCA), to include battery chargers in their household appliance energy conservation program. In 2009, the USA DOE begun proceedings to establish MEPS for battery chargers, through the establishment of appropriate testing procedures and then with the introduction of a MEPS. The rule making had so far established a new test procedure for the measurement of energy consumption and efficiency of battery charger systems (DOE 2010a). The DOE is currently reviewing the potential MEPS for battery chargers and published a Notice of Proposed Rulemaking (NOPR) in March 2012(DOE, 2012). DOE is scheduled to publish a final rule in 2013, and will allow 2 year lead time for compliance. The DOE rulemaking covers External Power Supplies as well as battery chargers, but only applies to products distributed in commerce for personal use or consumption by individuals.

In the NOPR 10 categories of battery chargers were assessed. The intended MEPS level for each category is shown in **Table *8***. DOE MEPS are required to be based on a single metric, for battery chargers an annual energy use calculation, which required assumptions about product duty cycle was used. This creates a wide range of categories for suppliers to consider when this approach is adopted in the final regulation.

[5] www.clasponline.org/clasp.online.worldwide.php?country=253

Table 8: DOE proposed battery charger MEPS (DOE, 2012)

Product Class	Product Class Description	Proposed Standard as a Function of Battery Energy (kWh/yr)
1	Low-Energy, Inductive	3.04
2	Low-Energy, Low-Voltage	$0.2095 * E_{batt} + 5.87$
3	Low-Energy, Medium-Voltage	For $E_{batt} < 9.74$ Wh, =4.68 For $E_{batt} \geq 9.74$ Wh = $0.0933 * E_{batt} + 3.77$
4	Low-Energy, High-Voltage	For $E_{batt} < 9.71$Wh = 9.03 For $E_{batt} \geq 9.71$Wh = $0.2411 * E_{batt} + 6.69$
5	Medium-Energy, Low-Voltage	For $E_{batt} < 355.18$ Wh = 20.06 For $E_{batt} \geq 355.18$Wh = $0.0219 * E_{batt} + 12.28$
6	Medium-Energy, Hgih-Voltage	For $E_{batt} < 239.48$Wh = 30.37 For $E_{batt} \geq 239.48$Wh = $0.0495 * E_{batt} + 18.51$
7	High-Energy	$0.502 * E_{batt} + 4.53$
8	Low-Voltage DC Input	0.66
9	High-Voltage DC Input	No Standard
10a	AC Output, Basic (i.e. no Automatic Voltage Regulation)	For $E_{batt} < 37.2$Wh = 2.54 For $E_{batt} \geq 37.2$Wh = $0.0733 * E_{batt} - 0.18$
10b	AC Output, Contains Automatic Voltage Regulation	For $E_{batt} < 37.2$Wh = 6.18 For $E_{batt} \geq 37.2$Wh = $0.0733 * E_{batt} + 3.45$

USA – California Energy Commission (CEC)

The CEC began progressing with a rule making for battery charger systems since the publication of the Codes and Standards Enhancement (CASE) Initiative (also called CASE study) in 2010. The final rule on MEPS was adopted on January 12, 2012 (CEC, 2012).

The MEPS are shown in Table 9 and address several modes of operation. For large battery charger systems (greater than 2kW peak input power), the “Charge Return Factor” measures the amount of energy applied to the battery versus the amount of energy extracted from that battery. The “Power Conversion Efficiency” is the systems’ efficiency in converting high voltage alternating current into lower voltage direct current and measures the losses occurring in the circuitry during charging. “Power Factor” is a measure of how well the system is able to utilise real power. “Maintenance power” is the amount of power the system draws to keep a battery at full charge as energy losses in maintenance mode are in both the charger circuitry and the battery. Finally the “No battery power” mode is the amount of power the system draws when no battery is attached at all and the charger is in standby mode.

For small battery charger systems (less than or equal to 2kW peak input power), the charge and maintenance modes are measured together over a 24-hour period rather than separately. Also the combined maintenance and no-battery mode power limits allow manufacturers some flexibility to improve energy savings and costs when implementing improvements to no-battery and maintenance modes. These combined metrics address the efficiency of the battery charge system regardless of the usage characteristics.

Table 9: California Energy Commission MEPS for Battery Charger Systems

Large Charger System Regulations		
Performance Parameter		**Standard**
Charge Return Factor (CRF)	100 percent, 80 percent depth of discharge	CRF ≤ 1.10
	40 percent depth of discharge	CRF ≤ 1.15
Power Conversion Efficiency		Greater than or equal to: 89 percent
Power Factor		Greater than or equal to: 0.90
Maintenance Power (E_b = battery capacity of tested battery as Wh)		Less than or equal to: 10 + 0.0012 E_b W
No Battery Power		Less than or equal to: 10 W
Small Charger System Regulations		
Performance Parameter		**Standard**
Maximum 24-hour charge and maintenance energy (Wh) (E_b = capacity of all batteries in ports as Wh and N = number of charger ports)		For E_b of 2.5 Wh or less: 16 x N
		For E_b greater than 2.5 Wh and less than or equal to 100 Wh: 12 x N + 1.6 E_b
		For E_b greater than 100 Wh and less than or equal to 1000 Wh: 22 x N + 1.5 E_b
		For E_b greater than 1000 Wh: 36.4 x N + 1.486 E_b
Maintenance Mode Power and No-Battery Mode Power (W) (E_b = capacity of all batteries in ports as Wh and N = number of charger ports)		The sum of maintenance mode power and no battery mode power must be less than or equal to: 1x N+0.0021x E_b Watts
Battery Backup and Uninterruptable Power Supplies Regulations		
Maintenance Power (E_b = battery capacity of tested battery as Wh)		0.8 + 0.0021 E_b
Inductive Charger Regulations		
		Either the applicable performance standards for small battery charger systems or shall use less than 1 watt in maintenance mode, less than 1 watt in no battery mode, and an average of 1 watt or less over the duration of the charge and maintenance mode test.

Test Standards

Energy Efficiency Battery Charger System Test Procedure

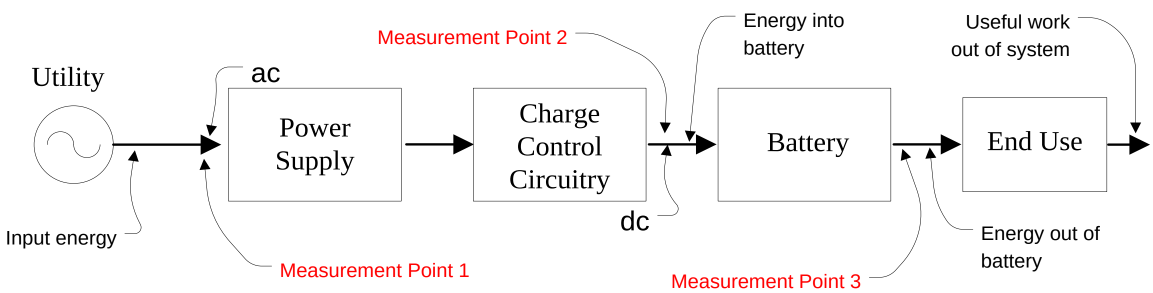
The CEC in December 2008 adopted a voluntary test procedure for battery charger systems. This test procedure was developed by PG&E and its technical consultant, Ecos Consulting, in collaboration with Southern California Edison, the CEC, and industry stakeholders. This test procedure (Porter et al, 2009) covers energy consumption of battery chargers in active, maintenance, and no-battery mode.

The CEC battery charger system test procedure enables testing of all types of battery charger systems regardless of end use and has two parts. Part 1 applies primarily to battery charger systems for smaller, consumer-oriented products and Part 2 applies to battery charger systems for larger, non-road vehicle chargers.

Part 1 specifies that the battery charger undergoes a 24-hour charge cycle, and 5-hour discharge cycle. The energy delivered from the battery during discharge can be compared to the energy consumed by the charger during charge, the result of which can be defined as the battery charger system efficiency. This is equivalent to the ratio of energy measured at point 3 to the energy measured at point 1; as illustrated in Figure 4. This efficiency measurement captures both energy used in the charging process and energy lost as heat in the battery discharge process. The 24-hour period is used to provide a common basis for comparison, whether or not a charger gives a “charging complete” indication. Maintenance mode energy consumption is measured by integrating the energy usage over the last 4 hours of the testing period. Similarly, no battery and off mode power are measured for 10 minutes.

Part 2 of the procedure begins by subjecting the charger to three discharge/charge cycles using three different depths of discharge. The measurements taken distinguish between energy lost in the charger and energy lost in the battery. The charge return ratio is one metric used to quantify battery charger performance and is defined as the ratio of ampere-hours into the battery over ampere-hours out, it represents a quantity related to how well the battery charger charges the battery. The power conversion efficiency is the ratio of dc output power of the charger (watts) and the ac input of the charger (watts), and is illustrated in Figure 4 as the ratio of energy measured at point 2 to the energy measured at point 1. This measure of efficiency and the power factor are recorded for three key points during recharge, maximum, median and minimum power levels. Energy consumption is measured for 72 hours of maintenance mode and one hour of no battery mode.

Figure 4: Battery Charger Efficiency Profile



USA DOE Test Method

The USA DOE have developed test standards in order to support the proposed MEPS. The DOE finalised a federal testing standard in 2011 after public consultation in 2010 (DOE 2011). In this final rule, the DOE:

- Inserted a new test procedure to measure the energy consumption of BCs in active mode in support of potential standards;
- Amended the battery charger standby and off mode test procedure by decreasing testing time;
- Amended the single-voltage EPS test procedure to accommodate EPSs that communicate with their loads, and may therefore require a specialized fixture to enable testing;
- And inserted a new test procedure for multiple-voltage EPSs, also in support of potential standards.

The DOE test standard is very similar to the CEC sponsored method, but only covers the smaller battery charger systems. It varies from the CEC method by terminology and dividing more complex procedures into simpler, discrete steps for testing technicians to follow.

Policy Options for Efficient Battery Charger Systems

There are a number of potential policy options that could be implemented to improve the efficiency of battery charger systems. Internationally, there are voluntary and mandatory programs implemented or under development. These include the voluntary ENERGY STAR labelling program in the USA and the mandatory Minimum Energy Performance Standards (MEPS) adopted by the CEC and under consideration by the USA DOE It should be noted that the ENERGY STAR program extends to other countries, including Australia and New Zealand, however, the range of products covered by the label varies in different countries. The ENERGY STAR program in New Zealand and Australia does not currently cover battery chargers. Considering the wide range of products and international programs already under development, the most likely policy options for consideration in Australia and New Zealand would be voluntary ENERGY STAR and/or mandatory MEPS. Other policy options such as subsidies are also discussed.

Voluntary Policy Options

Labelling

A voluntary electrical performance certification program involves suppliers submitting their products for objective testing and, if the products perform satisfactorily, then the products can be labelled as 'certified' to fulfil the required energy efficiency performance requirements or listed as certified products on a relevant website etc. The intention is that this provides information and encouragement for consumers to purchase more efficient products and motivates suppliers to improve the efficiency of their products.

As with other voluntary information-type programs, there is a tendency for only the better performing products to participate in an attempt to gain a marketing advantage over cheaper, and poorer performing products. This type of program can work in a market where consumers are actively looking for efficient products, but the energy efficiency of a battery charger incorporated with a product is unlikely to be the primary driver of the purchase decision for the vast majority of consumers. For a voluntary certification program for these products to be effective in Australia or New Zealand the certification would need to become highly recognised in the market, which would require considerable government support to occur. In addition, a significant proportion of consumers would need to regard such certification as an important or very important part of their purchase decision-making. Given the nature of the products, it is unlikely that consumers will do so, even if the certification program was well publicised.

Participation in a voluntary certification program is often a marketing strategy for product suppliers rather than a community service. Participation in a voluntary certification program can be a low cost marketing strategy for suppliers which they can use to focus on some specific market segments, e.g. environmentalists, as often the certification entity is well known within such target segments. Participation in voluntary certification programs largely depends on overall market size and the size of target segments as the market and sub-segment size must be sufficient to justify the expense and effort involved in certifying products.

As an example of the results of a voluntary certification program, the voluntary ENERGY STAR certification program currently covers most home entertainment products, such as DVDs, VCRs, audio systems and home theatres. Only 154 models out of 2200 models surveyed since 2001 have displayed an Energy Star Label in Australia (source EnergyConsult 2002-06). This represents 7% of the market, which greatly reduces the relevance of the ENERGY STAR Label to the Australian market. The ENERGY STAR program is currently under revision in the USA, and will be further developed following the decisions relating to MEPS for battery chargers in the USA. The outcome of the MEPS will influence the potential requirements for meeting the ENERGY STAR levels. In addition, the scope of the ENERGY STAR program is currently limited so only a portion of the products are considered in this product profile.

Consumers do not always purchase a product for its energy efficiency; functions, design and ease of operation are the primary consideration. Also consumers do not have the option to choose the installed or included battery charger whether it is energy efficient or not.

Mandatory Policy Options

Mandatory label

Three different types of mandatory labels exist. The first is a dis-endorsement label, which is the opposite of the endorsement label described above. It requires a label to be placed on the worst performing products on the market, making them easily identifiable to consumers. This type of label is used in South Korea to highlight products that use more than 1W in standby mode.

More common mandatory labels display the energy use of a product allowing consumers an easy way to compare. The energy use can either be provided on a continuous scale, for example the annual energy consumption or cost of operating the product for a year; or else it can be divided into categories, usually presented in different colours or a system of stars. This is a faster way for consumers to distinguish between the best and worst performing products, although it doesn't allow consumers to compare products with each category, which could be significant depending on the range of efficiency levels covered in each category.

However, all the labelling options will face the same problems as those described in voluntary labelling section: consumers are not necessarily looking for the most efficient product on the market. This is particularly difficult for battery chargers, as it covers such a diverse range of products, and consumers are more likely to be base their decision on the either the products themselves or the life of the battery, rather than the efficiency of the accompanying charger. Taking mobile phones, the biggest selling battery charger product in Australian and New Zealand (Table 5) as an example, a recent study the Australian Communications Consumer Action Network (Deakin University and ACCAN, 2011) found that consumers are already overwhelmed by the number of factors to consider when purchasing a mobile phone especially in relation to different pricing options, and functionality. It is unlikely that adding an energy label would do anything but increase customer confusion.

MEPS

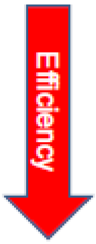
MEPS aim to prevent poorly performing products from entering the marketplace, rather than promoting the best. By doing this, MEPS aims to create a level playing field for suppliers and protect consumers from higher running costs associated with poor performing products. MEPS have the effect of increasing the overall sales weighted, average energy efficiency of products installed and hence decreases the energy use compared to the Business as Usual (BAU). In Australia and New Zealand this is achieved by including the energy performance criteria within an Australian/New Zealand Standard which is mandated through legislation.

MEPS for products covered by this product profile could be based on the CEC MEPS requirements. Any proposal for MEPS for these products could be considered by the Australia and New Zealand government after detailed consultation. Many of the products considered in this study include an external power supply (EPS), which is already required to meet the EPS MEPS. The EPS MEPS only addresses the efficiency of the power supply to the battery charger system and not overall system efficiency. Large energy savings are possible by managing the battery charger system more efficiently and hence the EPS MEPS will assist those product suppliers along the path to minimising wasted energy consumption. Products would be required to meet either the EPS MEPS and/or any potential requirements for battery chargers depending on the type of EPS used. Decisions on the application of the EPS MEPS and any potential battery charger MEPS would be guided by international MEPS developments, particularly the USA MEPS developments.

As the USA market moves towards MEPS for battery chargers, there is potential for the movement of inefficient products to other countries that have not aligned with their requirements. Products that do not meet the USA MEPS could be potentially sold in countries without these MEPS and hence become susceptible to “dumping” of inefficient products. Therefore it would be sensible to examine the potential for similar MEPS in Australia and New Zealand.

In addition, to assist with the identification of more efficient battery charger systems, an identification system is being considered by the USA CEC with potential for international harmonisation similar to EPS marking system. Figure 5 shows a diagram of a potential marking system under consideration by the CEC.

Figure 5: Potential Efficiency Marking Label for Battery Charger Systems



Level	Description	Standard
BC I	Least efficient	Less than BC II
BC II	Efficient	CEC and DOE standards
BC III	Most efficient	For Energy Star and utility incentives
BC IV	Future use	Future Energy Star and utility incentives

- Anchor protocol with California proposed standard at level II
- Leave one level below California to allow other jurisdictions to mandate labeling without minimum requirement

Regardless of the choice of policy option, this marking system would assist with the implementation. A product would be identified by a small mark, similar in the current safety and certification marks that already appear on the power supplies. International cooperation in this marking system would assist Australian and New Zealand with the implementation of policy options for battery chargers.

Other Options

Consumer Rebates and tax credits

In this case consumers would receive money back from the government for purchasing a more efficient product. This can either be a direct reimbursement after purchase, or a refund on income tax. Given the diverse range of products covered, this is unlikely to be a cost effective method of improving energy efficiency. Due to the fact that the most common battery charger product is a mobile phone, consumers would be more likely to consider the functionality, the network choice, etc., rather than energy use during charging. The cost to the government of setting up such a scheme would be wasted if consumers did not participate at a high level.

Negotiated Agreement

A negotiated agreement involves a committee of manufacturers signing onto a commitment to achieve an agreed efficiency standard by a given date. This gives manufacturers the flexibility to improve efficiency at their own pace. Failure to comply would result in removal of the signatory from the agreement. In order for negotiated agreements to be an effective means of saving energy it is necessary for at least 80% of the market to be a part of the agreement. This may make it unsuitable for battery chargers due to the large number of manufacturers.

Energy and Greenhouse Gas Reduction Potential

Based on the research conducted for the CEC (Ecos 2010), the potential energy savings can be determined from policies that aim to improve the efficiency of battery chargers in Australia and New Zealand. Assuming these policy options would affect the energy consumption of battery chargers sold, estimated energy savings can be determined based on future sales of the range of items which require battery chargers. Hence over time the stock of battery chargers would be replaced with more efficient battery chargers.

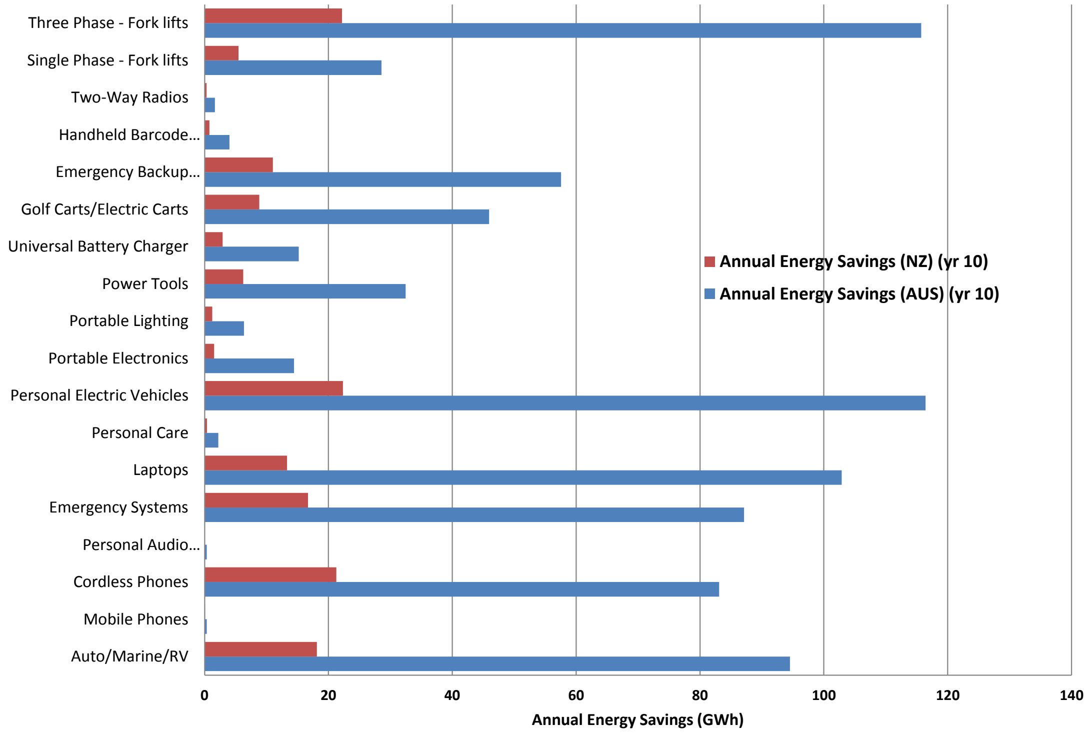
Assuming no increase in sales numbers, preliminary estimates of the annual energy savings that are possible in Australia and New Zealand after 10 years were developed. These estimates are shown in Table 10. Products with N/A means there is zero incremental cost of improving their designs to achieve their estimated energy savings..

Table 10: Preliminary Estimate of Potential Annual Energy Savings – Australia & New Zealand

Market Segment	Product Category	Lifecycle Benefit Cost Ratio (Ecos 2010)	Australian Energy Savings (GWh pa)	New Zealand Energy Savings (GWh pa)
Small Consumer	Auto/Marine/RV	45	94.5	18.1
	Mobile Phones	N/A	0.4	0.1
	Cordless Phones	19.8	83.1	21.3
	Personal Audio Electronics	N/A	0.3	0.0
	Emergency Systems	5.9	87.1	16.7
	Laptops	N/A	102.9	13.3
	Personal Care	5.39	2.2	0.4
	Personal Electric Vehicles	284	116.4	22.3
	Portable Electronics	N/A	14.4	1.6
	Portable Lighting	27	6.4	1.2
	Power Tools	22	32.5	6.2
	Universal Battery Charger	N/A	15.2	2.9
	Golf Carts/Electric Carts	4.5	46.0	8.8
Small Non-consumer	Emergency Backup Lighting	57.3	57.6	11.0
	Handheld Barcode Scanners	43.6	4.0	0.8
	Two-Way Radios	136.9	1.7	0.3
Large Non-consumer	Single Phase - Fork lifts	8.2	28.6	5.5
	Three Phase - Fork lifts	15.5	115.7	22.2
Totals			**808.9**	**152.8**

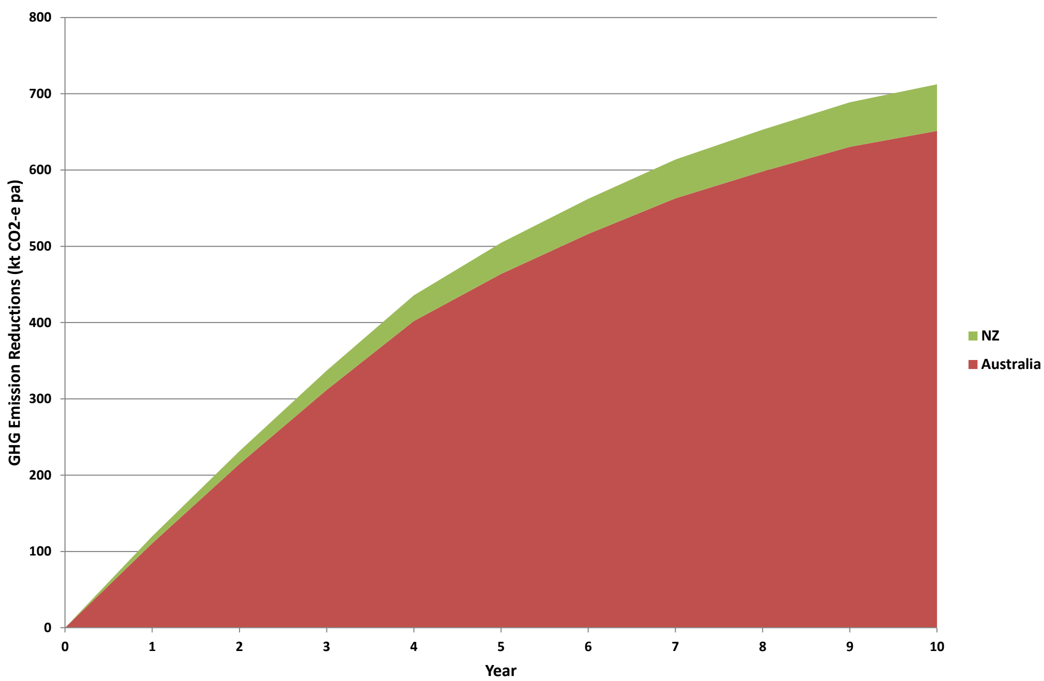
The size of the energy savings occurring in year 10 if Australia and New Zealand adopted similar policies to the CEC are shown in Figure 6. In Australia, the largest potential energy savings are from the Electric Forklifts product category, followed by Personal Electric Vehicles, Laptops, Auto/Marine/RV, Emergency Systems and Cordless Phones. In New Zealand, the largest potential energy savings are also from the Electric Forklifts product category, followed by Personal Electric Vehicles, Cordless Phones, Emergency Systems and Laptops.

Figure 6: Estimated Annual Energy Savings in Year 10



The results also show that around 5,300 GWh of energy could be saved in Australia and 1,000 GWh in New Zealand over a ten year period. This is an equivalent greenhouse emission savings of approximately 4.4 million tonnes CO_2-e in Australia and in New Zealand 0.4 million tonnes CO_2-e at the end of the ten year period, based on the current mix of fuels used to supply electricity. The annual GHG emission reductions are illustrated in Figure 7.

Figure 7: Preliminary Estimated Annual Greenhouse Gas Emission Reductions



These energy savings also translate into a significant energy cost savings for consumers. The cumulative 10 year energy costs savings to consumers are around M$1,125 (7% discount rate) in Australia and M$170 (5% discount rate) in New Zealand.

Conclusion

This product profile establishes:

- Battery chargers use significant energy each year in Australia and New Zealand.
- International research suggests almost a third of this battery charger power is wasted through inefficiency.
- The Australian and New Zealand marketplace continues to market inefficient battery chargers so government intervention appears warranted.
- An analysis of potential energy savings suggests significant energy and greenhouse savings could be made (if the market was transformed to use only the most efficient battery chargers already available on the market today):
  - 5,300 GWh of energy in Australia and 1,000 GWh in New Zealand over a ten year period;
  - 4.4 million tonnes CO2-e in Australia, and in New Zealand 0.4 million tonnes CO2-e of greenhouse emissions over the same period.
  - M$1,125 (7% discount rate) in Australia and M$170 (5% discount rate) in New Zealand of savings to users.
- The US DOE have recently published a Notice of Proposed Rulemaking outlining their intention to implement MEPS at the federal level in the near future (2014 or 2015) while California and Korea already have regulatory schemes for many types of battery chargers.

Reducing the inefficiency of battery chargers in our market is more than possible especially through partnering with the US Government to utilise their proposed standards system. Given the large potential energy, greenhouse and cost savings, the E3 committee is proposing to recommend battery chargers become subject to a program to improve efficiency as quickly as possible. This product profile demonstrates the value of considering using international testing protocols and established performance levels standard developments. The E3 committee proposes to explore the potential for a regulatory option aligned with the US scheme while still exploring voluntary alternatives. That work may then progress to the development of a RIS to explore partnering with the US Government as well as measuring all other viable options to improve battery charger efficiency.

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