ESD – DEFINITIONS AND MEASUREMENT

WHAT IS ESD?

The words Ecologically Sustainable Development or Environmentally Sustainable Design (and other permutations) are abbreviated to ESD. ESD is the practice of designing property and infrastructure to achieve minimal impact on the environment both initially (in construction) and in the long term.

The Natural Step[i] provides one of the broadest and most elegant definitions of sustainable development:

"Sustainable development is a dynamic process which enables all people to realise their potential and to improve their quality of life in ways which simultaneously protect and enhance our Earth's life support systems."

The reality is that all human activity affects the environment, but, since the dawn of the Industrial Revolution, people have largely ignored the destructive impact industry we have had on our world. Dulux Protective Coatings' perspective on ESD is about measuring the ecological impact of what we do, developing best practice to achieve the lowest ecological impact, and monitoring and revising these to continuously improve ecological outcomes.

CURRENT SITUATION

Increased building activity in coastal areas near Australian capital cities, where population is increasing at a greater rate than the national average, is placing pressure on our environment. Construction material consumption was 5,226 kg per person per year in 2001, a staggeringly excessive figure, when you compare it with, say, paper consumption of 168 kg per person for the same period. [ii,iii]

Apart from the obvious land-fill problems associated with disposing of building material waste, there are other environmental costs to this building activity – high energy consumption, land degradation, water consumption and pollution, and emissions to the atmosphere.

Australia has a high per capita level of greenhouse gas emissions by world standards. Greenhouse gas emissions increased by 16.9% between 1990 and 1998.[iv] According to the Green Building Council of Australia, commercial buildings produce 8.8% of this country's greenhouse emissions. Good design can therefore contribute to meeting Australia's international greenhouse obligations.[v]

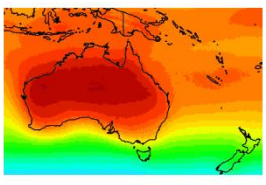
Australian ESD legislation and policies for Australian Government buildings[vi] provides direction for:

- Planning buildings for the long term while being feasible in the short term
- Using the precautionary principle in all decision making
- Taking a global approach to issues
- Input from users and communities on building projects
- Avoiding the use of materials that have a negative effect on biodiversity
- Ensuring healthy indoor environments
- Reporting on performance

Our oceans are becoming toxic. The Australian Fisheries and Wildlife Department advises pregnant women to limit consumption of fish to two serves per week to avoid exceeding maximum allowable levels of heavy metals that can retard foetal development

For over 25 years, The Natural Step International has maintained a vision of "a world in which human society thrives within nature's limits"

Australia's and New Zealand's cities and towns hug the coastline, which presents major challenges with regard to corrosion protection of both steel and reinforced concrete. The extremely high UV radiation endured by much of Australasia causes many building materials and coatings to photo degrade, causing surface chalking and erosion.



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HOW CAN I MEASURE ESD?

There are a number of bodies that have been established to advise on ESD:

AUSTRALIAN BUILDING GREENHOUSE RATING (AGBR)

The ABGR scheme allows office building owners and occupants to measure and reduce energy demands and hence greenhouse emissions. ABGR was developed and is managed by Australian Government and is endorsed by the Property Council of Australia.[vii] The ABGR tool has been adopted by both the Green Building Council in its Greenstar Environment Rating System and the National Australian Built Environment Rating System (NABERS) for their energy component.

GREEN BUILDING COUNCIL

The Green Building Council is a national, not-for-profit organisation bringing together industry and governments with the very practical mission to:

"...develop a sustainable property industry for Australia and drive the adoption of green building practices through market-based solutions."[viii]

The Greenstar Environment Rating System, developed by the Green Building Council, is a tool that enables the user to rate building practices, such as choice of building materials, with the intention of selecting those with lower environmental impact and lower embedded thermal demands.

NATIONAL AUSTRALIAN BUILT ENVIRONMENT RATING SYSTEM (NABERS)

NABERS is a method of measuring the environmental performance of existing buildings. It takes into account the building itself, as well as the activities of its occupants, which can have a profound impact on the total environmental rating of the building as a whole.[ix]

STANDARDS AUSTRALIA AS/NZ2312

Another important design tool is AS/NZS 2312:2002, "Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings." This Standard provides guidance for specifiers on coating systems for the protection of steel work against corrosion. From the easy to use Table 6.3 of that Guide, the specifier can select a coating system based on expected service life to first maintenance for various environments.[x]

This is an extremely important specification tool for ecologically sustainable design, as it offers a direct performance comparison of corrosion protection systems to allow the specifier to make an informed decision based not on immediate, short-term gains, but on sound long-term sustainable design.

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CURRENT ESD CRITERION TO RATE COATINGS

At the moment, most ESD ratings tools generally rate paint and coatings only in terms of their VOC content. It is hoped that other important ecological effects will be taken into account, such as HAP (hazardous air pollutant) emissions, solid and liquid waste emissions, thermal energy demands in manufacturing and application and distribution, and durability and performance of the finished material. All the above should be impartially compared with alternatives. All building materials should be assessed for embedded energy and CO_2 emission; for example, whilst concrete emits only water whilst curing, cement production is estimated to produce about 5% of all CO_2 emissions from human sources worldwide.[xi]

The plumes of this chimney are likely to include nitrous oxides, carbon dioxide, carbon monoxide, sulphur compounds and ash. Smoke is airborne particles of ash. Fires burning in the absence of oxygen can produce a mixture of toxic and non toxic products.

WHAT IS VOC?

VOC stands for Volatile Organic Component, or Compound. The term includes both naturally occurring and synthetic compounds. VOC's exist in a very broad range of products including but not limited to food, household cleaning agents, glues, fabrics and linings, joint sealants, carpet backing, adhesives for carpet, tiles, vinyl, laminate and joinery, coatings and plastics. In paint and coatings, VOC is also known as solvent or thinner.

The release of VOC's can affect the coating applicator, the occupant, and the environment. For more information, please refer to Dulux Protective Coatings Tech Note 2.3.2, ESD – Coatings and VOC.

IS VOC THE BEST CRITERION FOR ESD?

No. VOC's are only a subset of all gaseous emissions to the atmosphere. We really need to consider hazardous air pollutants (HAPS), which include lead compounds, sulphur dioxide, nitrous oxides, hydrochloric acid, sulphuric acid, and many other toxic chemicals that are not organic.

Furthermore, VOCs have widely differing chemical behaviours in our atmosphere. Many organic compounds break down into carbon dioxide and water, much the way ethanol does in our bodies. Other organic compounds (either benign or toxic to begin with), can break down into toxic and/or photochemically harmful byproducts. To treat all volatile organic compounds as if they were the same is simplistic and unnecessary and ignores the much larger picture.

We also need to consider liquid and solid waste emissions to our already stressed environment. Energy consumption also needs to be taken into account, as do performance and longevity. So we urgently need to adopt a holistic approach – all significant ecological impacts, not just atmospheric emissions, (and certainly not just VOCs) need to be given informed consideration when designing buildings.

Wines contain around 12% VOC in the form of ethanol, and a good scotch whiskey is around the 40% mark! Obviously some VOCs are not so bad after all.

TOTAL ECOLOGICAL IMPACT CRITERIA NEEDED

We, as an organization, recognize that sustainable design is high priority. The functions of coatings are to protect and beautify, both of which are integral to sustainable design. To choose the right coatings to achieve the best environmental outcome for a project requires a rating system that takes into account all significant ecological impacts.

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TOTAL EMISSIONS AND THEIR IMPACT:

- Obviously not all VOC's are equally harmful – many are benign and occur naturally[xii] (eg monoterpenes from pine trees, isoprene from deciduous trees, citrus oil from citrus, eucalyptus oil – the blue haze over the Blue Mountains, and ethanol from fermentation of fruit), some break down in the upper atmosphere to CO_2), whilst others are harmful . For example, chlorofluorocarbons (CFCs) break down the ozone layer that protects us from UV radiation (and are now banned). A ratings tool must be able to distinguish the bad from the neutral.
- Some processes consume and release significant quantities of mineral **acids**, **chromates** and **heavy metal vapour** into the **atmosphere** – none of these **HAP's** (Hazardous Air Pollutants) are classified as **VOC's**, yet have **serious adverse effects** on the environment.
- **Total emission** of greenhouse contributors should be considered – **not just within buildings**, but also in spray shops and in the open, as all emissions end up in our upper atmosphere.
- Some processes produce large amounts of **solid waste**, including dust, which can become airborne and thus present inhalation hazards.
- Some processes produce large amounts of **hazardous aqueous waste**, such as contaminated acids, which present major disposal problems.

Many industrial processes produce relatively large quantities of solid and liquid waste, as well as HAPs.

LONG TERM PERFORMANCE:

- The overall performance of a coating over the entire design life of the building, including maintenance requirements, is an essential ESD indicator. For example, if a two-pack solvent-borne protective coating can out-perform enamel paint with the same VOC level by decades, then it demonstrates a clear advantage in ESD. Conversely, if a waterborne paint fails to prevent deterioration of the substrate and requires frequent maintenance, then it demonstrates a very poor choice.
- Currently Green Star points are awarded for specifying no coatings at all, even if the substrate may be subject to degradation without a protective coating. Many common building materials rapidly degrade in coastal, industrial and CBD areas, creating needless and excessive rectification costs[xiii]. The merit of using coatings that significantly extend the life of the building should be recognized[xiv]. By their very nature, protective coatings add to the sustainability of the material. If we take steel as an example, the presence of a well-specified primer coating may add decades to the durability of the steel in a given environment.

A sacrificial method of corrosion protection was selected based on its claim of low VOC emission, without regard for suitability in a corrosive coastal environment. Extensive rectification work will now be necessary to fix this four year old steel canopy in a Queensland school.

Total embedded energy:

- The total energy required in raw material mining, processing, transportation, manufacturing, packaging and final application is another essential ESD indicator. It makes ecological sense to ensure that these essential raw materials are used in high-performance coating formulations that maximise their longevity. The longer a coating lasts, the less pressure placed on our natural resources.
- Some processes, used as alternatives to zinc-rich coatings, have been favourably compared to zinc-rich coatings as they do not involve the use of VOC's, but mechanical handling during surface preparation, and application of material require high thermal energy inputs the form of electricity, gas or coal, to apply. Simply put, while they do not emit VOC's, they are responsible for emitting volumes of CO_2.
- Maintenance of a building over its entire life cycle by the use of coatings not only requires the application of additional coats, but also additional energy in the erection of scaffolding and use of mechanical tools for removing degraded coatings and corroded substrates. Therefore, the specification and use of high performance coatings is vital in significantly reducing the frequency of maintenance and therefore lowering total energy input – "do it once, do it right".

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GREEN SPECIFICATIONS

When it comes to specifying coating systems for projects being designed within Green Star guidelines or you simply wish to minimise impact on the environment, call your Dulux Consultant. Many of our Consultants actively and regularly attend environmental conferences, seminars and training sessions, and can help you to specify the most environmentally responsible coating systems for your project.

For more information, please contact the Dulux Protective Coatings Technical Consultant in your state.

Dulux is a member of the Green Building Council of Australia.

green building council australia
MEMBER

[i] The Natural Step (TNS) founded in Sweden in 1989 by Dr. Karl-Henrik Robèrt. 64.207.158.76/au.naturalstep.org
[ii] SoE 2006 Report (Australian Government)
[iii] SoE 2001 Report (Australian Government)
[iv] SoE 2001 Report (Australian Government)
[v] Green Building Council Australia www.gbcaus.org
[vi] ESD Design Guide For Australian Government Buildings – Australian Government Department of The Environment and Heritage
[vii] The Australian Building Greenhouse Rating scheme www.abgr.com.au
[viii] The Green Building Council Australia www.gbcaus.org
[ix] www.nabers.com.au
[x] Australian/New Zealand Standard™ AS/NZS 2312:2002, Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.
[xi] Environmental Literacy Council Article, Cement: www.enviroliteracy.org/article.php/1257.html
[xii] More than a change of color: Autumn foliage may affect air quality, climate. www.ucar.edu/communications/staffnotes/0110/foliage.html
[xiii] Srikanth Venkatesan, "Evaluation of distress mechanisms in bridges exposed to aggressive environments" http://www.2006conference.crcci.info/docs/CDProceedings/Proceedings/P101_Venkatesan_R.pdf
[xiv] Dulux Protective Coatings Tech Note 2.3.3 ESD And Coating Specifications.