## National Greenhouse and Energy Reporting[1] (NGER) Australia

The NGER Act, 2007, established the legislative framework for a National Greenhouse and Energy Reporting System. An electronic version of the Act is available at www.comlaw.gov.au

The reporting system established under the Act will underpin the Carbon Pollution Reduction (emissions trading) Scheme as well as meeting Australia's international reporting obligations.

Reporting is mandatory if a controlling corporation's[2] corporate group – i.e. the controlling corporation, subsidiary, joint venture or partnership – emits greenhouse gases or produces or consumes energy at or above the specified thresholds for a financial (reporting) year[3].

Corporations are required to report at two threshold levels: facility and corporate. That is, when a controlling corporation's group hits a facility or corporate threshold the controlling corporation must register and report to the Greenhouse and Energy Data Officer its ghg emissions and energy data.

**The facility reporting threshold is 25kt or 100TJ of energy consumed or produced.**

**The corporate group thresholds are 125kt or 500TJ in the first reporting year (2008-9); 87.5kt or 350TJ in the second reporting year (2009-10); and 50kt or 200TJ in the third reporting year.**

Registration and activity data are entered into the Online System for Comprehensive Activity Reporting (OSCAR) to create an organisation's Greenhouse Gas Report.

Reporting applies to Scope 1 and Scope 2 emissions only. Reporting of Scope 3 emissions is not mandatory.

[1] http://www.climatechange.gov.au/reporting/register/index.html (accessed 28/11/08)
[2] "A controlling corporation is a constitutional corporation that does not have a holding company in Australia; it is generally the corporation at the top of the corporate hierarchy in Australia. Foreign corporations may also be controlling corporations." http://www.climatechange.gov.au/reporting/guidelines/pubs/nger-reporting-guidelines-aug08.pdf (accessed 28/11/08) page 7
[3] http://www.climatechange.gov.au/reporting/guidelines/pubs/nger-reporting-guidelines-aug08.pdf (accessed 28/11/08) page 5

## Online System for Comprehensive Activity Reporting (OSCAR)

The Online System for Comprehensive Activity Reporting (OSCAR) creates an organisation's Greenhouse Gas Report from data entered by an organisation.

**"OSCAR** is a tool used for reporting greenhouse gas emissions and energy data under the [National Greenhouse and Energy Reporting] Act; it has the ability to calculate greenhouse gas emissions from activity data submitted in reports.

"OSCAR uses default emissions factors. Alternatively, reporters can elect to provide their own emissions factors or emissions estimates, although only the methods for calculating emissions and energy prescribed in the National Greenhouse Energy Reporting (Measurement) Determination 2008 can be used. …

"Reporters are given access to OSCAR, including logon and password details, once they are registered by the Greenhouse and Energy Data Officer. OSCAR is currently being reconfigured to meet the reporting requirements of the National Greenhouse and Energy Reporting System."[4]

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[4] http://www.climatechange.gov.au/reporting/guidelines/pubs/nger-reporting-guidelines-aug08.pdf (accessed 28/11/08)

## Primary data, secondary data

In life cycle analysis primary data refers to all observable data that can be accounted for first hand from on-the-ground analysis of the actual processes and products involved.

Secondary data refers to data from compiled data bases or sector averages used in input output tables. …

## Profit and Loss (P&L)

The profit and loss (P&L) statement is usually an internal report of revenue and expenses for use by managers. P&Ls are often prepared monthly or however frequently managers need them. They are a decision making tool and not intended to be used for reporting to stakeholders. The bottom line of the report (figuratively and literally) is the net profit or net loss.

When a P&L statement is prepared in accordance with financial standards for external reporting it is called a *statement of financial performance*. The P&L and the *statement of financial performance* are not identical. The P&L statement usually shows more detail than that for an external audience.

### References

Kimmel, P.D., Carlon, S., Loftus, J., Mladenovic, R., Kieso, D. E. & Weygandt, J.J. (2003). *Accounting; Building business skills*. John Wiley & Sons Australia, Ltd: Queensland.

## Publically available specification (PAS) 2050

The PAS 2050 is a UK specification released October 2008 to assist firms to measure the carbon footprint of goods and services. It is designed to help customers to know how much $CO_2$ has been emitted during production, use and disposal of a range of products.

The specification was developed by the British Standards Institute (BSI)[5] at the request of the Department of Environment, Food and Rural Affairs (Defra) and The Carbon Trust. Its aim is to address the need for a consistent and reliable tool to assess greenhouse gas emissions associated with goods and services. The PAS is not a British Standard, European Standard or International Standard, but could become the basis of such a standard. In that event the PAS would be withdrawn.

Development of the PAS 2050 began in June 2007 when The Carbon Trust and Defra approached BSI Standards Solutions to oversee the development of the standard. Research to support this process was commissioned from The Stockholm Environment Institute.

According to the Carbon Trust website[6] the new standard is expected to help businesses 'move beyond managing the emissions their own processes create and to look at the opportunities for reducing emissions in the design, making and supplying of products.' The PAS 2050 was piloted with 75 product ranges from a number of companies including Coca Cola and Cadbury.

Defra also carried out its own testing of the PAS on about 100 food products examining the production, manufacture and distribution.

According to The Carbon Trust website development of the PAS 2050 involved almost a 1000 industry experts. They say that the resulting framework is 'robust' and will provide businesses and the public sector with a tool for consistent assessment of embodied GHG emissions and the ability to compare products and services. It is also intended to give the consumer a better understanding of life cycle ghg emissions and an ability to compare products and services.

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[5] http://www.bsi-global.com/en/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050/ accessed 31/10/08
[6] http://www.carbontrust.co.uk/News/presscentre/PAS-2050.htm accessed 31/10/08

The PAS 2050 builds on existing LCA methods supported by BS[7] EN ISO 14040 and 14044. The BS EN ISO 14044 (2006) and the Intergovernmental Panel on Climate Change IPCC (2006) *Guidelines for National Greenhouse Gas Inventories*[8] are considered to be indispensible support documents for the application of the PAS.

### Scope of the PAS 2050[9]

The PAS 2050 addresses:

- Requirements for specifying a system boundary
- Sources of ghg emissions within the boundary
- Data requirements
- Calculation of results

One of the intentions of the PAS 2050 is to facilitate comparisons of ghg emissions between products and assist in communicating this information. However it is not intended that it specify any requirements for communication.

### Principles of the PAS 2050 (adapted from BS ISO 14064: 2006, Clause 3)

- Relevance: appropriate ghg sources, carbon storage, data and methods have been selected
- Completeness: all ghg emissions and storage that provide a material contribution to the assessment have been included
- Consistency: meaningful comparisons can be made
- Accuracy: biases and uncertainties are minimised
- Transparency: all ghg emissions related information is provided to enable decisions based on the results of the LCA to be made with confidence.

### System boundary

Where a Product Category Rule (PCR) developed in accordance with BS ISO 14025 exists and where it does not conflict with the PAS 2050 system boundary rules then it should be used. Where a PCR does not exist the system boundary must be defined.

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[7] BSI implementation of international standard
[8] National Greenhouse Gas Inventories Programme, Intergovernmental Panel on Climate
[9] The following sections are adapted from: British Standards Institute (BSI) (2008). PAS 2050:2008 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services. BSI: UK

Emissions arising from the following products are counted as within the system boundary.

- Raw materials
- Energy
- Manufacturing and service provision
- Operation of premises (inc lighting, heating ventilation)
- Transport
- Storage
- Use phase (for business to business, cradle-to-gate, assessment downstream emissions are excluded)
- Final disposal (for business to business, cradle-to-gate, assessment final disposal emissions are not relevant)

Greenhouse gas emissions resulting from production of capital goods used in the life cycle of the product are excluded from the calculations.

**Comment**

It is difficult to see how this PAS provides any greater certainty around emissions calculations or how it enhances the ability to make comparisons. The principle of *Relevance* demands that all appropriate ghg sources have been selected however it would seem impossible to know this unless the whole of the supply chain has been examined. The principle of *Completeness* demands inclusion of all ghg emissions and storage that provide a material contribution to the assessment. Again this will be difficult to know unless a full upstream examination has taken place.

The principle of *Consistency* requires that meaningful comparisons can be made, however if boundaries have to be drawn by each reporting organisation then comparisons will continue to be difficult to make because boundaries may be drawn in different ways by different organisations. The principles of *Accuracy* and *Transparency* are compromised by the fact that Scope 3 emissions cannot be accurately accounted for using the PAS 2050.

## Renewable Energy Target[10] (Australia)

The Government's Mandatory Renewable Energy Target was instigated in April, 2001 and was reconfirmed in 2004. It aims to increase the uptake of renewable energy.

*The Renewable Energy (Electricity) Act 2000* required the generation of 9,500 gigawatt-hours of extra renewable electricity per year by 2010, enough power to meet the residential need of 4m people. This resolution was strengthened in 2007 when the incoming Labor Government committed to ensuring that 20% of Australia's electricity supply (or 45,000 gigawatt-hours) would come from renewable energy sources by 2020. The government also committed to bringing existing state-based targets into one single, national scheme.

The Act requires that electricity retailers and wholesale buyers on grids exceeding 100MW in all states and territories contribute proportionately to increase renewable energy sources

Renewable Energy Certificates (RECs) are an electronic form of currency initiated by the *Renewable Energy (Electricity) Act 2000.* RECs are created by registered persons, validated by the Office of the Renewable Energy Regulator, traded between registered persons, and eventually surrendered to demonstrate liability compliance against the requirements of the Australian Government's mandatory renewable energy target. Owners or operators of eligible renewable power stations are eligible for RECs provided the Renewable Energy Regulator accredits the renewable energy power station. Owners of eligible small generation unit installations are eligible for RECs. Small generation unit installations include: photovoltaic systems; wind systems; small hydro electric systems.

On 14 February each year, liable parties are required to surrender a number of registered RECs equal to their liability for the previous calendar year. Liable parties surrender RECs in the REC registry between 1 January and 14 February each year.

Each REC represents one megawatt hour of renewable energy form an eligible renewable energy source.

The new Renewable Energy Target (RET) scheme is being designed in cooperation with the Council of Australian Government (COAG) Working Group on Climate Change and Water.

The RET is seen as a transitional measure to assist in moving to a low emissions economy. It will be phased out between 2020 and 2030 as the emissions trading scheme matures.

[10] http://www.climatechange.gov.au/renewabletarget/index.html

## Responsibility

The issue of who should take responsibility, for example for damaging environmental impacts, or for laudable job creation, is a vexed one. Organisations often would like to claim the latter but shy away from the former. Not only that but how far up the supply chain should you go? In their sustainability report a multi-national organisation based in France claimed responsibility for job creation in the local area through their buy-local policy but failed to mention any responsibility they may have had for land disturbance or emissions caused by their increased use of primary resources as their business expanded.

They may argue that since the consumer demands the goods that the company manufactures then the consumer should be held responsible for the emissions and the land disturbance (they may not suggest this about job creation however). So who should be held responsible?

> *"While responsibility for the environmental impacts of production has been commonly assigned to producers, production is driven by consumer demand, and it is valid to question whether impacts should instead be assigned to consumers. However, in each of these approaches producers and consumers either bear the full burden of responsibility or none at all. An example of this is the Kyoto Protocol, where all greenhouse gas emissions are assigned to the producer and no consideration is given to where goods are finally consumed… A shared responsibility approach appears to distribute the burden of responsibility and associated liability between parties more fairly, and is likely to be more widely acceptable than pure producer or consumer perspectives." (Andrew, R. & Forgie, V. 2008).*

### Allocating responsibility

The question is: who *should* count, and therefore take responsibility for, the inputs and therefore the effects of doing business.

Is it the producer?

*If a gadget is made in China by an American company and exported and used by consumers from Stockholm to Sao Paulo, Brazil, should the Chinese government be held responsible for the carbon released in manufacturing it? (Wall Street Journal. N.Y. Nov 12, 2007. pg. A.2)*

If the Chinese government were to take *full responsibility* (the blame-the-producer approach) this would mean that the *producer* takes responsibility for all the effects of its production.

Is it the consumer?

*As China's emissions rise, everyone is pointing the finger of blame at China … The real responsibility for rising emissions should lie with the final consumers in Europe, North America and the rest of the world. (Wall Street Journal. N.Y. Nov 12, 2007. pg. A.2)*

*Full consumer responsibility* (the blame-the-buyer approach) means that the final consumer calculates her or his full upstream footprint, accounting for all emissions, land use etc embodied in the goods and services purchased and takes full responsibility for it.

| | |
|---|---|
| Is it everyone's responsibility? | *… emissions are embedded in goods that move around the world through trade -- so if the U.S. imports iPods from China, Americans should share some responsibility for the pollution produced in making them* (*Wall Street Journal. N.Y. Nov 12, 2007. pg. A.2)* |

*Shared responsibility* means that we acknowledge that we're all in this together, we're an integrated system, and we must all take our share of the good and the bad effects of doing business. We're all responsible for creating employment along the supply chain just as we're all responsible for creating greenhouse gas emissions along the supply chain. If we are all responsible then the question now is: how can the responsibility of an individual or an organisation be calculated consistently and fairly.

**Apportioning the effects of doing business along the supply chain – sharing responsibility**

Apportioning emissions, or any other impact, along the supply chain has only recently been consistently and quantitatively conceptualised by ISA researchers. Allocating each impact – for example on a 50%-50% basis between the supplier and the recipient – removes double-counting and solves a decades-long problem in Life Cycle Analysis.

ISA's framework allocates a 50:50 split of all impacts, so that they cascade along the supply chain. This means that, for example, the portion of jobs (which could just as easily be greenhouse gas emissions) retained/accepted by your organisation is 50% of the on-site total[11] plus 50% of your allocation of the upstream impacts embodied in the goods and services that you purchase[12]. The other 50% gets passed on to your customers, pro-rata-ed according to the amount of goods that each customer purchases. This could just as easily be a negotiated split or responsibility could be allocated according to the amount of value added to the goods or services by an organisation.

The above methodology was used in 2009 by the Economic Analysis Team, Institute for Global Environmental Strategies, Japan, to account for embodied emissions in trade between developed and developing nations.

[11] In the case of emissions this is the equivalent to the Scope 1 emissions category of the Factors and Methods Workbook (Australian Bureau of Statistics (2006). 2003-04 Household Expenditure Survey - Detailed Expenditure Items. Canberra, Australia, Australian Bureau of Statistics.)

[12] In the case of embodied emissions these are proportionally allocated to producer and consumer at every intersection so that when the good or service is purchased by an entity it arrives with its own allocation of the emissions generated by every stage of its production and delivery. In the ISA framework *indirect emissions* covers the Scope 3 category of emissions identified in the Factors and Methods Workbook as well as the Scope 2 emissions caused by the consumption of purchased electricity, steam or heat produced elsewhere (Australian Greenhouse Office 2006). Furthermore, emissions occurring further upstream from Scope 3 are also accounted for.

Table 1 is an example from the NZ economy. In column two it shows, under a full producer responsibility model, the percentage of responsibility assigned to *producers*, aggregated into major groups of industries (Primary, Manufacturing and Services).

Table 1: Summaries of responsibilities for New Zealand's domestic greenhouse gas emissions using three perspectives: Producer responsibility, Consumer responsibility, and Shared responsibility. (Andrew, R. & Forgie, V. 2008).

| **Sector** | **Producer (%)** | **Consumer** | **Shared** |
|---|---|---|---|
| Primary | 37 | – | 14 |
| Manufacturing | 18 | – | 12 |
| Services | 30 | – | 17 |
| NZ households | 15 | 43 | 29 |
| RoW | – | 52 | 26 |
| Other FD | – | 5 | 2 |
| Total | 100 | 100 | 100 |

Note that NZ households must accept some producer responsibility. This is for their direct emissions, mainly from energy consumption. The third column illustrates the amount of responsibility allocated to *consumers*, split into NZ households, the Rest of the World (RoW) and ‘other’ final demand (FD) categories in a consumer responsibility model. The final column shows what the split would look like if consumers and producers were to share responsibility. This shared responsibility model shows percentages of responsibility assigned according to value added along the supply chain with the remaining responsibility being ‘passed on’ to downstream industries or final demand.

In the case of NZ most of the output from Agriculture is consumed overseas, however the emissions from the sector are assigned to the *producer* under the Kyoto Protocol accounting regime. This means that to reduce emissions NZ would need to reduce its exports and therefore its export earnings which is not something that it is prepared to do. You may think that the answer is to move to a consumer responsibility model, either NZ residents or consumers overseas. However if this were to result in higher prices for NZ goods overseas once again this may impact on the economy. Another disadvantage is that if goods are exported to countries not bound to reduce their ghg emissions then responsibility for the emissions is not taken by anyone thus losing an opportunity for motivation to reduce emissions. Sharing responsibility has the potential to be more politically acceptable all round. In addition it solves the issue of double counting.

### Further reading

Foran, B., M. Lenzen, et al. (2005). “Balancing Act: a triple bottom line analysis of the Australian economy.” Sydney, CSIRO and the University of Sydney.

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Lenzen, M., J. Murray, et al. (2007). "Shared producer and consumer responsibility - theory and practice." Ecological Economics **61**(1): 27-42

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## Scopes 1, 2 and 3

Organisations may cause the emission of greenhouse gases either directly - for example, by on-site fossil fuel combustion - or indirectly through their consumption of electricity or other products which resulted in GHG emissions during their production. The accurate accounting and reporting of organisational *carbon footprints* is an increasingly important requirement to guide effective climate change policy, organisational management and investment. For greenhouse gas accounting and reporting purposes three ‘scopes’ were defined by the World Resources Institute (WRI) in their 2004 Greenhouse Gas Protocol.

Scope 1 accounts for direct GHG emissions from sources owned or controlled by the company. This does not include direct emissions from the combustion of biomass, neither does it cover those not covered by the Kyoto Protocol.

Scope 2 accounts for GHG emissions associated with the generation of electricity, heating/ cooling, or steam purchased for the reporting entity’s own consumption.
Scope 2 emissions occur at the facility where the generation of electricity, heating/ cooling, or steam takes place.

Scope 3 accounts for all other indirect GHG emissions. These are emissions that occur as a result of the activities of the company – the company’s demand for goods and services – but are from sources not owned or controlled by the company.

**Issues**
Whilst the boundaries of scope 1 and 2 emissions are quite clearly defined, scope 3 accounting is more problematic – it requires an analysis that extends back through many stages of the upstream supply chain. Consequently, methodological and practical difficulties have inhibited consistent reporting of scope 3 emissions and raised concerns over double counting; examples are given below.

*Inter-company comparisons*: the GHG Protocol states that “[S]ince companies have discretion over which categories they choose to report, scope 3 may not lend itself well to comparisons across companies.” (p.29). Companies must determine which scope 3 emissions to include and how many levels up the supply chain they want to investigate. Whatever the decision it is likely that other companies will have made different decisions.

*Data availability and accuracy*: the GHG Protocol says that “[W]hile data availability and reliability may influence which scope 3 activities are included in the inventory, it is accepted that data accuracy may be lower. (p. 31). The Protocol says that verification will often be difficult, something that is confirmed by the Carbon Disclosure Project's 2007 report on the results of their FT500 questionnaire (p. 18)[13].

*Double counting*: the GHG Protocol states that "[S]copes 1 and 2 are carefully defined in this standard to ensure that two or more companies will not account for emissions in the same scope. This makes the scopes amenable for use in GHG programs where double counting matters." (p.25). However if scope 3 is to be reported on it is likely that at least some of the emissions have already been captured in someone else's reporting as scope 1 or 2 emissions. The Protocol points out that for participation in GHG trading two organisations cannot claim ownership of the same emissions and that it is necessary therefore to be able to differentiate ownership.

**Current Position**

*Although scope 3 is an optional reporting category its importance is rapidly increasing with the need to close loopholes for purposes of carbon trading; to manage the financial impacts of carbon pricing in the supply chain; and the need to maintain consumer confidence and avoid accusations of 'greenwash'.*

The Global Reporting Initiative's advice is that a sustainability report should include "entities over which the reporting organization exercises control or significant influence both in and through its relationships with various entities upstream (e.g., supply chain) and downstream (e.g., distribution and customers)." (Sustainability Reporting Guidelines, GRI 2000-2006, p. 17). Further it states that an organisation "should include in its boundary all entities that generate significant sustainability impacts (actual and potential)" (p. 18).

The Carbon Disclosure Program's questionnaire asks respondents to provide, where feasible, estimates of their supply chain emissions as well as estimates of external distribution/logistics and employee business travel.

**Stress free Scope 3**

Reporting scope 3 emissions would normally require organisations to survey their entire supply chains – and the supply chains of their suppliers; an administratively complex, expensive and methodologically problematic approach for most organisations. The Centre for Integrated Sustainability Analysis at the University of Sydney has developed a solution to this problem by modeling supply chain emissions throughout the economy. The ISA methodology based on Input-Output Analysis automatically carries out a complete upstream life-cycle assessment of your organisation's impacts.

In order to do this it requires **only one** set of information – your organisation's financial accounts.

[13] http://www.cdproject.net/cdp5reports.asp

Of course the more detailed your financial accounts are the more accurate the assessment of your scope 3 greenhouse gas emissions will be. If you, for example, sort *packaging* expenditure into *paper* expenditure and *plastics* expenditure, which will have different GHG implications, then you will get more accurate results than if you lumped them together. However you can get useful and meaningful results with as few as 20 expenditure items.

**What's the big deal about scope 3? Who cares?**
The big deal is that unless you examine your supply chain you won't know what's hidden there. And unless you examine it using Input/Output analysis you will never be able to uncover more than an arbitrary scattering of potential risks.

Who cares? Well you might if you've made an important strategic decision – based on the wrong information.

**How does the ISA methodology evaluate scope 3 emissions?**
Your indirect (supply chain) emissions, such as emissions from air travel, are calculated by allocating your organisation's expenditure across a breakdown of 344 sectors of the national economy, based on Australian Bureau of Statistics data. The total emissions for each sector of the economy are known and a portion commensurate with your expenditure in each sector is calculated. So, for example, you provide your expenditure on airline tickets and the software calculates your share of the average emissions of an airline.

The ISA methodology takes all your expenditure data and converts it into your chosen indicators. For example, say you chose *$CO_2$ emissions* as an indicator, and you provided a value of, say, *100$* for paper purchased. Then the ISA methodology calculates how many kilograms of $CO_2$ are 'embodied' in this 100$ worth of paper. This will be added to the *$CO_2$ emissions* embodied in all of your other expenditure items.

The methodology traces every one of your purchases through your supplier, the supplier of your supplier, the supplier of your supplier's supplier and so on in an infinite chain of interactions. The thoroughness of the ISA analysis can be appreciated when you consider that in the ISA model of the Australian economy

- supply chain layer above you – your suppliers – has 344 members, who each have 344 suppliers, so that
- the next supply chain layer has 118,336 "suppliers of suppliers",
- the one above that has over 4 million "suppliers of suppliers of suppliers",

and so on throughout the whole of the economy. To assess all these suppliers' impacts manually is impossible. The ISA methodology and software account for the impacts of *all* suppliers.

The ISA model provides consistency of reporting because there is no cut-off point or imposed boundary. **Thus results between organisations are more comparable**.

## Shadow price of carbon (SPC)

In 2008 the UK Department for Environment, Food and Rural Affairs (Defra) published guidelines on how to value greenhouse gas emissions in policy and project appraisals. The Shadow Price of Carbon (SPC)[14] was adopted in the guidelines as the basis for incorporating ghg emissions in cost-benefit analyses and impact assessments across government.

The SPC is used to value the increase or decrease in emissions that will result from a proposed policy. According to an article in the Guardian (Sat. Dec. 22, 2007) Ministers must factor a carbon cost into their policy decisions covering transport, construction, housing, planning and energy. The shadow price for carbon, representing the cost of environmental damage, has been set by the UK government for each year up to 2050. This cost must be factored into, for example, the building of a new power station. This will show up the relative real costs (i.e. including emissions costs) of building a nuclear power plant and a coal fired power plant. It will show up the real cost of building a new road. It will make 'zero-carbon' building regulations appear more economic.

[14] http://www.defra.gov.uk/Environment/climatechange/research/carboncost/index.htm (accessed 20/11/08)

## Social sustainability

From: Murray J, Dey C, and Lenzen M, Systems for Social Sustainability: Global Connectedness and the Tuvalu Test, *Journal of Sociocybernetics*, 5(1-2), 34-56, 2007

*Alan Black (2004) in his address to the Effective Sustainability Education Conference in Sydney, Australia, defined social sustainability as the extent to which social values, social identities, social relationships and social institutions can continue into the future. This raises the question of time scales: how long do social systems need to continue into the future to be called sustained? Or are they always sustained for x number of years (in which case who's counting?). There are social organisations that last a lifetime and those that are sustained over the rise and fall of many lifetimes; rituals, arts and stories that carry a culture and bind a social group can continue over generations. Membership may change, wax and wane, but, like my old broom that's had four new handles and six new heads, the social system goes on. (This would bear out Luhmann's argument that the social system cannot be the actors, they come and go, they are part of the environment, it is communication that is sustained, that goes on manufacturing and transforming itself, and is therefore the social system.) But how can we call any social system a sustainable system when it is disappearing into an unknown future (and how do we know the future will want a system that seems like a good idea now?).*

*Furthermore, although in some respects Black's definition echoes the oft-quoted sustainability definition of "development that meets the needs of the present world without compromising the ability of future generations to meet their own needs" (UNWCED, 1987) it makes no judgments about the type of social system that is sustained or its impact on future generations. It leaves room for social upheaval: if current social norms are not sustainable over the long term, because say, they are unjust, they will be overturned (e.g. if social relationships are based on a class system and at some time it is overthrown then it wasn't socially sustainable in the long term). This implies a striving for social balance, a kind of social equilibrium maybe, and the notion of equity where no one group is living at the expense of another (the lifestyle of that particular group wouldn't be socially sustainable, because at some time there would be a reshuffle of power, bloody or otherwise, and a realignment of resources). Someone would have overstepped the mark living at the expense of others. As a recent UK government report points out, "A world disfigured by poverty and inequality is unsustainable"[15] (HM Government, 2005:13), implying that 'someone' should do something about it. However, in practice, Córdoba and Midgley (2003) suggest that there are always implicit or explicit boundaries to the extension of human concern for others. Also we cannot escape our history and what one group may see as overstepping the mark another may see as their inalienable right. One group can, and history has shown that they will, cause the complete annihilation of another if they do not find*

[15] "over a billion people live on less than a dollar a day, more than 800 million are malnourished, and over two and a half billion lack access to adequate sanitation." (HM Government, 2005:13)

*ways to 'fit' (Wright, 2005). As Maturana and Varela (1987) suggest, if they cannot find ways to fit they will 'separate' or 'disintegrate'. But bringing about the 'disintegration' of one group, as Wright (2005) points out, can be about the survival of another. Social sustainability is not an innocent concept. Gray and Milne (2004:77) discuss the political minefield of social sustainability, suggesting that it "rests on nothing less than interpretations and explanations of the relationships between modern capitalist activity and social justice – the probability of a consensus on this area" they say, "seems slim, indeed". Others who may or may not operate in a modern capitalist society may say that social sustainability rests on ethics, human relationships and survival of kin, local, and ultimately global community. Which looks as though we, who are lucky enough to have communication systems that allow us to live to some extent in a global community, cannot escape an obligation to act to find ways for social systems to fit together. However, as in many other political dilemmas throughout history the danger lies in creating insiders and outsiders (Córdoba & Midgley, 2003; Ulrich, 1983; Midgley, 2000).*

*Thus social sustainability is a restless concept, it cannot escape the messiness of human life on earth. It implies interrelationships and interdependencies built on communication over time; local or global communities in constant struggle towards living together without exploitation in an ever-changing world. On a small scale this could be about sharing services and paying for those services (where those more able may pay for services enjoyed equally by those less able to pay, such as through taxes to pay for social infrastructure) or in providing different but essential services according to our abilities, to maintain the functioning of, say, a sport or social club. On a larger scale however since all communities are interdependent and ultimately form one global social system the sustainability of one community (of geography or interest) ultimately affects and is affected by that of others. To achieve social sustainability, it seems, would be to achieve lasting global harmony, and not just between social systems but also between social systems and their environments. Striving for a new utopia! Something that Luhmann (1997) cautions us about looking for because, he says, it can only lead to new disappointments.*

*Perhaps then, rather than a meaningless quest for a utopian social sustainability grounded in say, well-being, it is better to settle for the struggle itself and the constant learning that this implies. Perhaps our focus should be on the "sustainable quest for systems of inquiry" (Bawden, 1997:3); sustainability-as-process, learning to manage in a shifting world (Cox, MacLeod & Shulman, 1997) as we living systems in communication with ourselves in reflection (Schön, 1979, 1983) and others in discussion find novel ways to deal with the tensions created by ethical dilemmas and competing demands. Perhaps it is sufficient to strive towards social sustainability which implies a framework in which to consider the likely issues embedded in our actions.*

*Summary*
*This section of the discussion has suggested some problems inherent in the definition of social sustainability. A god's eye view is implied in the idea that someone is counting and judging, we cannot know for example:*

- *how long something must persist for it to be called 'sustainable';*
- *if social sustainability connotes an ethical position based on principles of equity, whose notion of 'equity' should prevail and be sustained; or*
- *whether an identified social system, pronounced 'sustainable' today will 'fit' in a future world.*

*We are of the system and cannot take an outside point of view. Instead we can ask from the messiness of our relationships:*

- *if social sustainability is something utopian and unattainable like lasting global harmony should we shift the focus of our debate to something attainable like a sustainable process of learning as we communicate as living systems in our environment over time[16]; and*
- *how long can this (process, activity etc) be sustained; what are the likely issues to arise from this activity/behaviour – locally, globally, now, and in the future?*

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[16] This may, of course, be more akin to the Little Prince commanding the sun to rise in the morning since living systems have always learned –that's how they/we go on living (Maturana et al, 1987).

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## Social system

Excerpt from: Murray J, Dey C, and Lenzen M, (2007). Systems for Social Sustainability: Global Connectedness and the Tuvalu Test, *Cybernetics and Human Knowing*, volume 14, no. 1, pp. 87-105.

*Biologists Maturana and Varela (1987) claim that we, like all living systems, are structurally determined systems. By this they mean that the way in which we respond to perturbations (or irritations) in our environment is determined by our structure. But the environment is also a structurally determined system. Recurrent interactions of both living system and environment will result in structural changes in both system and environment. Who we, as living systems, are at this instant and the environment we find ourselves in mutually specify each other so that each contributes to creating the world of the next instant, and so on, creating the world by living in it. This process Maturana and Varela call co-ontogenic structural drift. In co-ontogenic structural drift, they say, the system does not adapt to the environment as in the classical system-environment model (Krohn, Kuppers, Novotny, 1990) but both change over time as they become structurally coupled (Maturana, 2002); either they 'fit' together or separate or disintegrate (Maturana et al, 1987; Maturana, 2002). Luhmann (1995, 1997) uses this concept in his work on human social systems. In a social context, he says, communication is the social system and everything else including living systems, is the environment in which communication operates (i.e. living systems – in this case human actors - are part of the environment of social systems rather than composing them). However, he says, "[T]he concept of the environment should not be misunderstood as a kind of residual category. Instead, relationship to the environment is constitutive in system formation" (Luhmann, 1995:176, italics in the original). Communication, he says, becomes structurally coupled with the consciousness of individuals (1997) and, "[O]nly consciousness can produce the noise necessary for the emergence and evolution of social order" (1997:4). A particular social system arises out of the difference between system (communication) and environment as they bump up against each other and (because of their differences) change over time as they find ways to 'fit'.*

*Viewed through Luhmann's social frame communication and its environment, which is the consciousness of individuals, change over time as they become coupled in a never-ending reciprocal relationship. Viewed through Maturana and Varela's biological frame all living systems and their environments (which include other living systems as well as all communication) become coupled so that they grow and change together, each influencing the possibilities of the other. In both cases we are structurally changed in the process of living and communicating over time. This means, as Fell and Russell (1993:35) say, "that everything we have ever done together in this world could be a part of who we are and what we do today" and "[w]e cannot know what the future holds, but we can know that everything we do (or say) contributes significantly to it . . . This awesome responsibility is what we regard as the biological basis of our human ethics." (Fell & Russell, 1993:35; see also von Foerster, 1992 on cybernetics and ethics).*

*Thus the social impact of doing business is part of the web of interactions that are life on this planet. Socially sustainable activities, like all of our activities, become part of who we are and what we do. They are activities that, because they become part of who we are and what we do (and the 'we' referred to includes all of humanity including ourselves, carrying with us our histories, and future generations) must, for us if we accept this position, be bound by human ethics. Moreover if human ethics have a biological basis, as suggested by Fell and Russell above, it is probably reasonable to suggest, as Maturana (1988) argues, that they play a role in human survival.*

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## Structural coupling

Maturana and Varela (1987:75) describe structural coupling as a process of engagement – a "history of recurrent interactions leading to the structural congruence between two (or more) systems". This means that systems reciprocally change and are changed by their interactions. They have a co-history of structural transformation, mutually specifying their trajectories.

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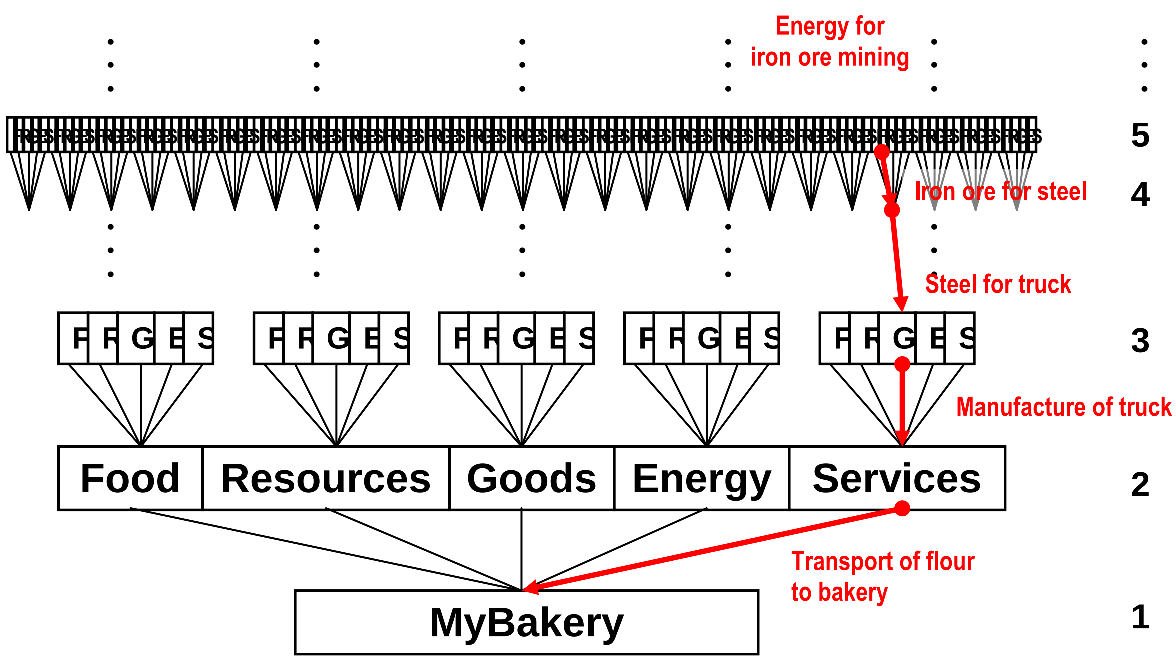
## Supply Chain

### What does it mean?

A supply chain is a network of suppliers, transporters, manufacturers, storage facilities, distributors, and any other process or entity that participates in the production, delivery and sale of goods and services.

Imagine MyBakery at the foot of a tree that represents MyBakery's supply chain. The first "canopy" up from the foot is MyBakery's suppliers. The next canopy up is the suppliers of MyBakery's suppliers, and so on. This tree is an infinite tree of suppliers. The foot is called *production layer 1*, the first canopy is labelled '2', the second '3', and so on.

**Figure 1: Example of a MyBakery supply chain**




### Accounting for supply chain impacts

Impacts occur in every production layer. Take the indicator 'energy' for example. MyBakery is connected to town gas to fire its ovens. The gas used on-site belongs into production layer 1. My Bakery buys flour. This flour needs to be produced by a flour mill. The energy used in the flour mill belongs into production layer 2, since the flour mill is a direct supplier of MyBakery. The flour also needs to be delivered to MyBakery by a transport firm. The diesel used by the truck also belongs into production layer 2, since the truck company supplies the transport service to MyBakery. The truck that the transport firm uses needs to be assembled by a vehicle manufacturer. The energy used during this assembly process belongs into production layer 3, since the vehicle manufacturer is a supplier of the transport firm which in turn supplies MyBakery. And so on.

The chain of red arrows in the supply chain tree is called a *structural path*. There are millions and millions of structural paths in a typical supply chain tree. This is because the economy is so complex. The complexity of the calculations can be appreciated when you consider that in the ISA model of the Australian economy

- production layer number 2 has 344 members, who each have 344 suppliers, so that
- production layer number 3 has 118,336 "suppliers of suppliers",
- production layer number 4 has over 4 million "suppliers of suppliers of suppliers",

and so on. ISA methodology accounts for the effects of *all* suppliers.

**Greening the supply chain**

*Greening the supply chain* refers to an organisation working with (or putting pressure on) parts of its supply chain in order to improve environmental or social outcomes. For example in October, 2008 Wal-Mart[17] announced that it wanted its suppliers to meet tighter environmental and social standards. It said that it wanted to work closely with a smaller group of suppliers so that it could monitor their practices and at the same time keep prices low. This included a large number of suppliers based in China where Wal-Mart was demanding environmentally friendly manufacturing practices and product-safety guidelines. Wal-Mart not only made demands on its direct suppliers but it also demanded that they in turn put pressure on their own suppliers. The avowed aim was to 'build a more environmentally and socially responsible global supply chain'.

One of the issues identified in this plan[18] was the vast network of suppliers of suppliers, and suppliers of suppliers of suppliers, and so on along the chain. Apparently Wal-Mart's suppliers in China are fed by a network of smaller and smaller organisations spread out across China, Vietnam and Thailand.

**Carbon Disclosure Program Corporate Supply Chain Programme[19]**

According to their website the CDP Corporate Supply Chain Programme is designed to assist companies in identifying risks and opportunities in the supply chain. It will, they say, help to 'anticipate and manage new pressures from climate change which are not directly within their organisational control.' To this end the CDP has produced a questionnaire for member organisations to distribute to their immediate suppliers. The questionnaire, they hope, will assist in calculating the upstream supply chain emissions, using GHG emissions data obtained directly from the suppliers. In turn this will help member organizations to extend their carbon disclosure to include 'related activities', reported under

[17] http://www.environmentalmanagementnews.net/StoryView.asp?StoryID=447523 & http://www.itworld.com/green-it/56771/wal-mart-aims-go-green-global-supply-chain-makeover (accessed 28/10/08)

[18] http://www.itworld.com/green-it/56771/wal-mart-aims-go-green-global-supply-chain-makeover (accessed 28/10/08)

[19] http://www.cdproject.net/corporate-supply-chain.asp (accessed 28/10/08)

Scope 3 of the GHG Protocol, and to take 'the first step towards calculating their carbon footprint'[20]

In September 2007 Wal-Mart provided the CDP with a case study piloting use of its supply chain questionnaire[21] with seven of its major suppliers. The seven suppliers were encouraged to fill in the questionnaire and provide information on greenhouse gas emissions. This provided Wal-Mart with insights into emissions embodied in their products. The questionnaire revealed the major source of emissions to be refrigerants used in grocery stores rather than the expected fuel used in its truck fleet.

In October 2007 the CDP created the Supply Chain Leadership Collaboration (SCLC) with 12 participating companies undertaking the pilot collaboration. The SCLC's aim was to standardise a process for supply chain reporting of carbon emissions, risks, opportunities and strategies. These 12 companies distributed the CDP questionnaire, including additional supply chain-related questions, to 328 suppliers asking for information on climate change initiatives. One hundred and forty-four suppliers responded. The challenges for CDP are now to improve the quality of responses and to include more organisations in the project.

Many of the suppliers of participating companies are new to GHG reporting. The CDP has therefore suggested that these suppliers should first become familiar with understanding their Scope 1 (direct or onsite) and Scope 2 (indirect from electricity, heat and steam purchases) emissions before moving to Scope 3 (other indirect or supply chain) emissions.

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[21] http://www.cdproject.net/wal-mart-case-study.asp (accessed 28/10/08)

**Supply Chain Thinking**

Supply Chain Thinking refers to the embedding of supply chain considerations in 'the way we do business'. This requires tools and frameworks to ensure that everyone in the organisation is aware of 'the supply chain' – what it means and what benefits an examination of the full supply chain can provide.

Examination of the full supply chain can reveal hidden costs and vulnerabilities but it can also reveal hidden opportunities for change.

For example in the case of land disturbance analysis of the supply chain for a fictitious Bank shows that the greatest effect on the Bank's land disturbance is from beef cattle supplied to the fresh meat industry supplied to hotels, clubs, restaurants and cafes that are used by the Bank (21.6%). Being able to identify this supply chain input would enable the bank to change its catering strategy to include less meat and more vegetarian options in all of the organisation's catering.

| Rank | Path Description | Path Value | Path Order | Percentage in total impact |
|---|---|---|---|---|
| 1 | Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > BigBank | 434 ha | 4 | 21.6 % |
| 2 | Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > BigBank | 92.7 ha | 4 | 4.60 % |
| 3 | Shorn wool > Computer and technical services > BigBank | 64.4 ha | 3 | 3.19 % |
| 4 | Computer and technical services > BigBank | 57.7 ha | 2 | 2.87 % |
| 5 | Services to finance and investment > BigBank | 51.9 ha | 2 | 2.58 % |
| 6 | Sheep and lambs > Fresh meat > Hotels, clubs, restaurants and cafes > BigBank | 51.1 ha | 4 | 2.54 % |
| 7 | Business services > BigBank | 44.4 ha | 2 | 2.20 % |
| 8 | Beef cattle > Meat products > Computer and technical services > BigBank | 39.0 ha | 4 | 1.94 % |
| 9 | Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Services to finance and investment > BigBank | 35.0 ha | 5 | 1.74 % |
| 10 | Electronic equipment > BigBank | 32.4 ha | 2 | 1.61 % |
| 11 | Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Computer and technical services > BigBank | 31.1 ha | 5 | 1.54 % |
| 12 | BigBank | 26.5 ha | 1 | 1.32 % |
| 13 | Wholesale trade > BigBank | 18.9 ha | 2 | 0.94 % |
| 14 | Market research and other business management services > BigBank | 17.4 ha | 2 | 0.86 % |
| 15 | Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Market research and other business management services > BigBank | 16.9 ha | 5 | 0.84 % |
| 16 | Horses > Property operator and developer services > BigBank | 13.9 ha | 3 | 0.69 % |
| 17 | Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Legal services > BigBank | 13.0 ha | 5 | 0.65 % |
| 18 | Market research and other business management services > Services to finance and investment > BigBank | 12.5 ha | 3 | 0.62 % |
| 19 | Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Market research and other business management services > Services to finance and investment > BigBank | 12.2 ha | 6 | 0.61 % |
| 20 | Beef cattle > Meat products > Property operator and developer services > BigBank | 11.8 ha | 4 | 0.59 % |

## Sustainability

*“development that meets the needs of the present world without compromising the ability of future generations to meet their own needs”* (UNWCED, 1987)

.

## sustainable development

*“Sustainable development or sustainability means finding a way to improve quality of life for people today and in the future by breaking the link between economic growth and environmental damage and social exclusion. It means developing our economy in ways that minimise pollution, protect natural habitats, use resources efficiently and tackle social inequalities to ensure that people, in this region and elsewhere, do not suffer as a consequence of our economic growth and are able to enjoy the benefits of it.*

*“In a sustainable region we would have thriving cities, towns and villages with strong economies, good access to services, attractive and safe surroundings and a healthy community. Resources would be used more productively with much less waste. To make sustainable development happen needs integrated economic, social and environmental objectives and consideration of the longer term impacts of decisions.”* (Yorkshire and Humber Assembly, 2003:4)

### Weak and strong sustainability

“Weak and strong sustainability are two concurrent concepts that are very frequently used to classify empirical approaches to durable development (e.g. Dietz and Neumayer, 2004).

The term of *weak sustainability* has been coined to characterize economic approaches to sustainability that emerged during the 1970s. These approaches were extensions of standard neo-classical growth theories. Standard growth models generally consider that output is only determined by technology and the available quantities of two production factors, labor and capital. The main innovation of this literature has been to introduce natural resources as an additional production factor in these models, and to specify the laws for the evolution of this natural factor, for instance a modeling of extraction behavior in the case of an exhaustible mineral resource - this literature developed after the first oil shock.

These models generally assumed large substitution possibilities between natural resources, capital and labor. Combined with exogenous technical progress, this offered one solution to the finiteness of resources, at least from a theoretical point of view: as oil resources decline, production is expected to use less and less of them but without any decline in standard of living, either thanks to pure technological progress, or by replacing oil by some alternative fossil energy or any other man-made production factor.

Promoters of *strong sustainability* rather consider that substitution possibilities necessarily face physical limits. Critical levels must be maintained for most of natural resources. These critical levels must be at least equal to those necessary for basic-life support functions, and more probably higher if we want to keep reasonable levels of environmental *resilience*, i.e. the capacity of eco-systems to regenerate and return to equilibrium after shocks. The concept of strong sustainability is often considered as irreducible to monetary approaches. All environmental variables of interest have to be followed in physical terms."

p. 236. Report by the Commission on the Measurement of Economic Performance and Social Progress. J. Stiglitz, A. Sen, & J-P Fitoussi *September, 14, 2009* http://www.stiglitz-sen-fitoussi.fr/en/index.htm

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## System

Gianfranco Minati and Arne Collen provide the following definition of system.

> *"At a specific level of description adopted by the observer, a system is an entity, established by interacting components, assuming properties different from those of its components. The transition from a set of components to a system of interdependent components takes place during and not as a result of interaction. In the process of interacting, new properties are established, as detected by the observer, thanks to the continuous process of interacting. Congruent with the above distinctions, two principal categories of examples are 1) human made devices assuming properties, that is those becoming systems, such as electronic and mechanical devices (specifically TVs, radios, telephones and engines) when power is supplied to enable their components to interact; and 2) natural, living systems comprised of human beings interacting in social contexts (specifically, transportation, markets, businesses, governments, festivals, sports events, ceremonies, private celebrations, and community affairs). While elements are considered to possess non-systemic properties like age, quantity, location, speed and weight; in contrast, systems acquire new properties when interactions among components occur."*
> Gianfranco Minati & Arne Collen, 2009. Architecture as Self-Design in Human Social Systems. Cybernetics and Human Knowing, v 16 n 1-2 p103.

Systems can be non-living like a bicycle or a house; living like a single cell, or a person or frog or plant made up of many cells; or they can be social systems like a club or an organization. There seems to be two major ways of visualizing these systems. The first is to consider a system in terms of a whole and its parts, for example a bicycle made up of seat, wheels, cross bar, breaks etc; or a frog made up of heart, liver, lungs etc. A parts/whole perspective can be useful for examining non-living systems however it can be difficult to examine living systems in this way because you might have to kill the whole to examine the parts.

The second way to visualize a system is as an integral part of an environment, for example a plant growing in a particular ecosystem or a child in a family. A system/environment perspective is more like a network of relationships in which parts of a system only make sense in the context of the whole. For example take the child out of the family and everything about the family changes; an ecosystem minus one of the plants that makes it this particular interdependent ecosystem becomes something entirely different. When you look at them this way systems, far from being understood if you take them apart, will cease to exist if you take them apart. In this interdependent world there is no linear hierarchy of parts stacking up step by step to make a whole. Instead there is a network of relationships in an interacting whole where every bit is just as important as every other. With its central idea of circularity it is easy to see why cybernetics embraces a system and environment way of carving up the world rather than the hierarchical system of parts building up into wholes.

Now comes the tricky bit. If I create the world by living in it, which is a conclusion I reached above when I examined the implications of a cybernetic view of the world, and if I see the world in terms of system and environment, then I must also create the system and environment. Again the implications of this idea are far reaching. I can draw boundaries for systems and environments wherever I like. I may see myself as a system in the environment of my family or my work or my local ecosystem. Another member of my family, my work or my ecosystem will not be able to draw the same boundary as I do, the boundary that separates my system from its environment. They will make their own distinction between system and environment and will therefore be in a different environment. For a start their environment will include me – this leads to the idea, used in some branches of family therapy, that every family member is in a different family. I may also distinguish my family as a system in the environment of my community, or my ecosystem in the environment of the country's ecology.

The universe is an environment out of which I can carve many systems. A system jumps out from the background environment when I notice it as a coherent whole against the background noise. For example, I may notice that car drivers are becoming more aggressive, this is a difference in the normal pattern of events. It jumps out from the background of car driving. I give it a label, road rage. I identify conditions in which I think it occurs and talk about it. Road rage becomes a phenomenon, soon it is noticed by others. The distinction I made between road rage and other driving arose from my interest in pondering over this phenomenon and in extracting this particular meaning from it. Once I have made this distinction the system I have distinguished from other driving (i.e. Road Rage) becomes information to me. The information did not belong to me independent of the phenomenon, I had to notice something, a difference, for there to be any information to know. Nor did the information belong to the phenomenon, which did not 'exist' until I distinguished it from the background environment of everyday driving and gave it a name. The information, and associated learning, arose in interaction between living system (in this case me) and environment, it belongs to us both, created somewhere in the space between us.

Through a cybernetic lens a particular system and a particular environment do not have an existence as system-and-environment until I, the observer, distinguish them from background noise and define them as system-and-environment. This idea of noticing a difference is, like circularity, central to cybernetics. Once we distinguish something from the background as 'different' it becomes 'information' to us. We learn something new, and in the learning we change the phenomenon as we bring it into focus, provide it with attributes and communicate our observations to others; and we are changed by it, as it becomes part of our lives.

## Systems thinking

According to Asayesh (1993) ‘Systems thinking’ emerged from the Massachusetts Institute of Technology in the late forties and early fifties where scientists began applying software developed for mapping electronic systems to other kinds of systems (Asayesh, 1993). This field of study, Asayesh says, used single and double loop learning as metaphors to explore change in organisations, which those working in the field of oganisational change viewed in terms of the relationship of the parts to the whole and the interactions between the two. It assumed that the system could be objectively observed.

In the 1980s systems thinking began to be applied to schools as organisations. It employed such tools as ‘organisational storytelling’ to generate a feeling of shared knowledge and values and ‘feedback loop diagramming’ to help people map out long and short term consequences of their actions (Asayesh, 1993). Organisational story telling was critiqued by Hargreaves and Fullan (1992:13) as possibly “self indulgent navel gazing” and “top down control” disguised as therapy.

The whole area of applying systems thinking to organisations was further advanced by Senge, in his book *The Fifth Discipline: The Art and Practice of the Learning Organization* (1990) where ‘systems thinking’ was in fact Senge’s ‘fifth discipline’.

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## The Carbon Trust[22]

The Carbon Trust is an independent, UK government funded organisation set up to assist business and industry and the public sector measure, account for and reduce their carbon emissions. The Carbon Trust has developed a Carbon Reduction Label to provide the public with an indication of the carbon footprint of products and services. The Carbon Trust also has developed a standard that certifies that an organisation has reduced its carbon footprint.

The Carbon Trust and the Department of Environment, Food and Rural Affairs (Defra) requested the British Standards Institute to develop a Publically Available Specification (PAS) to standardise the measurement of embodied GHG emissions. PAS 2050 was launched October 2008.

[22] http://www.carbontrust.co.uk/default.ct

## The Club of Rome[23]

The Club of Rome was founded in 1968 following a meeting of members of the diplomatic, industrial, academic and civil society. They were called together by an Italian industrialist, Aurelio Peccei, and a Scottish scientist, Alexander King, who were concerned about resource consumption and short term thinking in an increasingly interdependent and globalised world. Each participant agreed to spend the following year raising awareness of the issues with world leaders and decision makers. Their focus was to apply systems thinking to understanding of the long-term consequences of the growing globalization.

A group of systems scientists at the Massachusett's Institute of Technology was commissioned in 1972 by the Club of Rome to report on the results of its modeling of the interaction of five global economic subsystems: population, food production, industrial production, pollution and consumption. The report, *The Limits to Growth* (Meadows et al, 1972) caused a stir at the time and has been misquoted ever since. The report presented a number of scenarios and the choices open to society for 'sustainable progress' within 'environmental constraints'. The establishment of Ministries of the Environment in many countries is attributed to the report and its influential ambassadors.

In 2008 CSIRO produced a report[24] comparing historical data 1970 – 2000 with the scenarios presented in *The Limits to Growth.* The report found that key-features of the 'business as usual' scenario compared favourably with the 30 years of historical data. This study validates the report's conclusion that "Unless the LtG [Limits to Growth] is invalidated by other scientific research, the data comparison presented here lends support to the conclusion from the LtG that the global system is on an unsustainable trajectory unless there is substantial and rapid reduction in consumptive behaviour, in combination with technological progress." (Turner, 2008).

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[23] http://www.clubofrome.org/eng/home/
[24] http://www.csiro.au/files/files/plje.pdf

## Trial Balance

"A trial balance is a list of accounts and their balances at a given time. Customarily, a trial balance is prepared at the end of an accounting period. The accounts are listed in the order in which they appear in the ledger. Debit balances are listed in the left column and credit balances in the right column. The totals of the two columns must be equal." (Kimmel, P.D., Carlon, S., Loftus, J., Mladenovic, R., Kieso, D. E. & Weygandt, J.J. (2003). *Accounting; Building business skills*. John Wiley & Sons Australia, Ltd: Queensland p. 95).

A trial balance does not guarantee that there are no errors, transactions may have been missed or items may have been entered in the wrong columns. Items may have been entered twice.

A trial balance is prepared to check the accuracy of accounting – to check the mathematical equality of debits and credits.

# Triple Bottom Line (TBL)

### Where did it come from?

John Elkington[25] coined the term *triple bottom line*[26] in 1997. Elkington used the term to mean an expanded baseline for measuring performance. Instead of the usual financial bottom line he talked of the social, environmental and economic *bottom lines*.

The difference between *economic* bottom line and *financial* bottom line is blurred. Some say there is no difference and others draw a distinction between the traditional financial reporting and what they see as reporting on the economic impact of the organisation's activities on the life of a community. The Australian *Group of 100*[27] sees economic and financial as different but intimately connected, with TBL reporting identifying risks that can affect financial performance[28]. In the Group of 100's view, the business case for reporting on TBL centres on improved relationships with key stakeholders as well as specific commercial advantages, the enhancement of reputation and brand being top of their list.

There is also a move to add *governance* to the bottom line, making Quadruple Bottom Line reporting. Other commentators see good governance as a consequence of TBL reporting. Both discussions are ongoing.

### What is it used for?

Triple Bottom Line can be viewed as a reporting device (e.g. information presented in annual reports) and/or an approach to improving decision-making and the fundamental functions of organisations (e.g. the provision of tools and frameworks for considering the economic, environmental and social implications of decisions, products, operations, future plans).

TBL provides a framework for measuring and reporting corporate performance against economic, social and environmental benchmarks. Reporting on TBL makes transparent the organisation's decisions that explicitly take into consideration impacts on the environment and people, as well as on financial capital. [29]

### Useful proxies to indicate the economic, environmental and social impact of doing business

An indication of economic impact can be gained from such items as:

- gross operating surplus
- dependence on imports

[25] UK based: consultant to companies like BP, DuPont and the World Bank; member of the European Forum on the Environment & Sustainable Development; co-founder of SustainAbility in 1987; elected in 1989 to the UN Global 500 Roll of Honour for his 'outstanding environmental achievements'.
[26] In his book *Cannibals With Forks: The Triple Bottom Line of 21st Century Business* (Capstone, 1997).
[27] The Group of 100 is an association of senior accounting and finance executives representing the major companies and government-owned enterprises in Australia (http://www.group100.com.au/home.htm).
[28] Group of 100 (2003) *Sustainability: A guide to triple bottom line reporting*. Group of 100 Inc.
[29] http://www.cpaaustralia.com.au

- stimulus to the domestic economy by purchasing of locally produced goods and services.

An indication of social impact can be gained from, for example:

- OH&S records
- the organisation's tax contribution
- employment.

An indication of environmental impact can be gained from measures like:

- the ecological or carbon footprint
- emissions to soil, water and air
- water and energy use.

Such *indicators* can distil complex information into a form that is accessible to stakeholders. Organisations report on indicators that reflect their objectives and are relevant to stakeholders. One difficulty in identifying and using indicators is to ensure consistency within an organisation, over time, and between organisations. This is important for benchmarking and comparisons.

A 2005 CSIRO/University of Sydney publication[30] *Balancing Act* uses a set of ten indicators to benchmark 135 sectors of the Australian economy providing a snapshot of the TBL performance of the Australian economy.

[30] http://www.isa.org.usyd.edu.au/publications/index.shtml

## Upstream and downstream

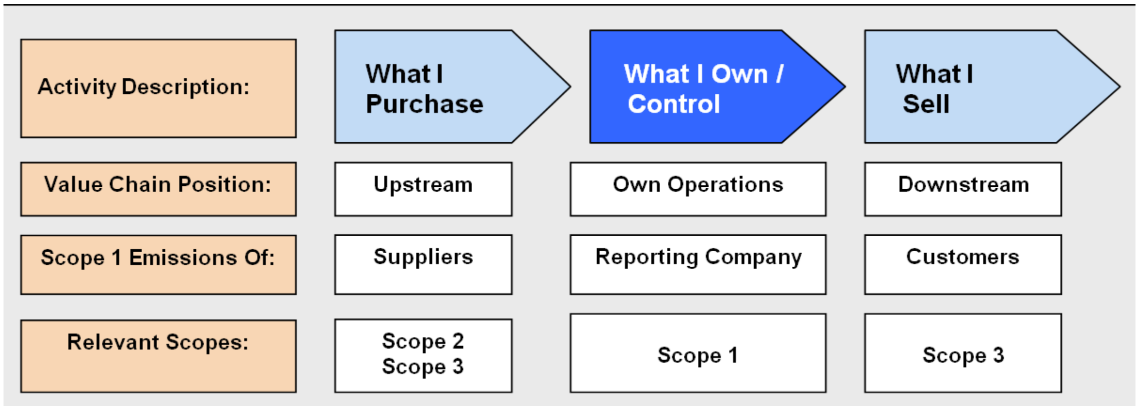


Fig. 1: Spheres of corporate responsibility; internal review draft for Greenhouse Gas Protocol Technical Working Group members, 17th June 2009.(reproduced with permission in: Lenzen M and Murray J, Conceptualising environmental responsibility, *Ecological Economics*, **70**(2), 261-270, 2010)

***Upstream***

In the ISA model upstream refers to: suppliers, suppliers of suppliers, suppliers of suppliers of suppliers and so on to infinity.

These are sometimes referred to as supply chains or value chains. In the ISA model they are defined by what an organisation spends money on – analysis of the expenditure accounts captures all upstream inputs into an organisation.

The following is taken from: Huang A, Lenzen M, Weber C, Murray J and Matthews S, The role of input-output analysis for the screening of corporate carbon footprints, *Economic Systems Research*, **21**(3), 217-242, 2009

“In an upstream scope-3 calculation, supply chains start with an emitting upstream sector, and end with the purchasing industry sector under investigation. The meaning of *upstream chain* is best explained using an example. Consider the supply chain ‘Beef cattle > Meat processing > Restaurant’. The emissions associated with this supply chain are caused, for example, by land clearing or enteric fermentation in animals slaughtered for meat that is supplied to a restaurant’s kitchen. Another way of expressing this is to say that emissions from beef-cattle farming become ‘embodied’ in the restaurant meal. The logic of upstream responsibility is that by choosing to buy from a meat processor that buys in turn from the beef cattle sector, the restaurant indirectly enables the beef cattle sector to sell beef, and hence to produce, and hence to emit. The more the restaurant buys from the meat processor, the more it is responsible for the upstream emissions liability caused by meat processing through buying beef cattle. The crucial aspect here is the *choice* of buying from someone: to *enable someone to produce, to emit, and to buy onwards, by buying from them an operating output*.”

***Downstream***

In the ISA model downstream refers to: customers, customers of customers, customers of customers of customers and so on.

In the ISA model this is defined by where an organisation gets its income from – analysis of the revenue accounts captures all downstream outputs from an organisation.

The following is an excerpt from Lenzen M and Murray J, Conceptualising environmental responsibility, *Ecological Economics*, **70**(2), 261-270, 2010

"Downstream emissions responsibility has been defined quantitatively in an input-output context (Gallego and Lenzen 2005; Rodrigues *et al.* 2006; Rodrigues and Domingos 2007; Lenzen 2008). The contribution of this article is to add understanding and intuitive terminology, so that downstream responsibility can be used amongst non-experts, in the same way as upstream responsibility is commonly articulated through terms such as "footprints", "life-cycle", and "embodied". In the following Section we mirror the input-output terminology for upstream effects in order to create an equivalent downstream vocabulary. Talking about upstream and downstream emissions invariably means talking about suppliers, customers, supply and sales chains and transactions. The definitions below are all plain-English interpretations of input-output parlance; they provide a quick-reference glossary for what follows:

- A *commodity* is a good or a service.
- A *primary* input is a commodity that is not produced using something else (for example labour, or capital such as land and resources).
- *Intermediate* inputs and outputs are commodities (for example coal) that are traded between companies in order to produce something else (for example electricity).
- A *final* output is a commodity (for example household electricity) that is not used to produce something else.
- *Suppliers* can be sellers of primary inputs into production (labour), such as households (as workers), or they can be sellers of intermediate inputs (coal), such as companies (coal mines).
- *Customers* can be buyers of final outputs of production (household electricity), such as households (as consumers), or they can be buyers of intermediate outputs (coal), such as companies (power plants).
- A *supply chain* is a succession of buyers and sellers, starting with an emitting intermediate seller (for example coal mines), and ending in a final output (household electricity).
- A *sales chain* is a succession of buyers and sellers, starting with a primary input (labour for a coal mine), and ending in an emitting intermediate buyer (power plant).
- A *transaction* is the exchange of a commodity between a primary or intermediate seller, and an intermediate or final buyer.

...
1.1. Responsibility

In the complex interconnected web of supply and sales chains, everyone is supplier and customer at the same time. This is true from the perspective of a corporation (buying primary and intermediate inputs, and selling intermediate and final outputs), as well as from the perspective of a household (buying final outputs and selling primary inputs).

Any effort to reduce emissions implies allocating responsibility to actors involved in causing these emissions. We accept some responsibility for emissions of those that we buy from (upstream) because we choose to buy their product or service. We have responsibility for what we emit (on-site) because we have control over our actions. We take some responsibility for the emissions of those that we sell to (downstream) because we choose to sell to them.

There is, in the above, an implied balance in the power relationship between supplier and customer: the supplier has the power to make decisions about to whom it sells (downstream); the customer has the power to decide from whom it buys (upstream). Every organisation is both supplier and purchaser and will therefore have both sets of responsibilities, and both sets of expectations of others.

In reality the power relationship is not always balanced. Sometimes in order to make a living it may be extremely difficult to choose a supplier or to choose to whom one sells. Monopolies can manipulate the market in their favour and to survive small companies may have to 'take it or leave it'. Likewise households may sometimes have little choice in where they sell their labour or from whom they purchase particular goods. However the actual responsibility remains despite all extenuating circumstances. The consequences of our decisions, no matter how compromised the ‘freedom’ to choose, remain the same: the emissions exist; the water has been used; the waste created. And in theory there is always choice, however difficult it is to make the decision. The arguments about power relationships are ultimately a societal issue, to be tackled through socio-political processes.

1.2. Downstream vs upstream

In order to be consistent, downstream responsibility will need to be conceptualised in a way that is consistent with upstream responsibility. In the following we achieve this by first giving familiar explanations for upstream responsibility, and then we mirror the phrases by replacing as few words as possible (Tab. 1).

Looking upstream, our demand enables the production of our suppliers' products, which in turn causes emissions. A part of the responsibility for these emissions is handed down to us, as embodied emissions. Looking downstream, our supply enables the production of our customers' products, which in turn causes emissions. A part of the responsibility for these emissions is handed up to us, as enabled emissions.

Whichever direction we look, we play a part in the production chain and have some responsibility for what occurs, because had we not taken our position in the chain – made our purchasing, production and sales decisions – emissions would have been different. Thus, upstream emissions are enabled by us having purchased goods or services. Had we not made that particular purchasing decision, the whole upstream cascade of interactions, initiated by our purchase order, including associated emissions, would have occurred differently. Downstream emissions are enabled by us having sold goods or services. Had we not made that particular sales decision, the whole downstream cascade of interactions, initiated and supported by our sale, including associated emissions, would have occurred differently.

There is always the 'road not taken' as Robert Frost reminded us in his 1915 poem[31]. Does this mean that we're only responsible for the difference between the two hypothetical scenarios in which we either act or we don't act? Such a point of view is taken for example in the additionality clause of the Clean Development Mechanism (Shrestha and Timilsina 2002), and in Consequential Life-Cycle Assessment (Sandén and Karlström 2007; Finnveden *et al.* 2009), whilst in everyday life this is exemplified by statements such as "the plane would have flown anyway, even if I had not bought my ticket". Additionality and future consequences of actions are difficult to assess, partly because the reality in which these actions take place is overwhelmingly complex, and partly because statements about hypothetical future events are fraught with uncertainty in any case. For the purpose of this article, we take an *ex-post* perspective, in which actions have occurred, so that the problem of evaluating alternative scenarios does not come up.

A practical example for the downstream scope-3 case is the sales chain 'Technical services > Coal mining > Electricity generation'. The emissions associated with this sales chain are caused by combustion in power plant boilers, of coal that was mined in a coal mine, which in turn was provided with technical services. If we look upstream we are used to saying for example that emissions from the coal seams of the mine are embodied in the electricity we use, even though there may be a considerably long supply chain between the coal seam and our power point. The logic of downstream responsibility is as follows: By choosing to sell to a coal mine that sells in turn to power plants, the technical service provider directly enables the mine to produce coal, and hence indirectly enables the power plant to buy coal, and hence to produce, and hence to emit. The more the technical service provider sells to the coal mine, the more it is responsible for the downstream emissions liability caused by coal mining through selling to power plants.

[31] http://www.poets.org/viewmedia.php/prmMID/15717.

In the literature, downstream responsibility is much less often elaborated, and hence this logic sounds less familiar. The crucial aspect here is the choice of selling to someone, that is, to enable someone to produce, to emit, and to sell onwards, by selling them an operating input. Downstream responsibility is perhaps more intuitive when considering the popular example of the responsibility of someone working (i.e. selling their labour) to a company that produces cigarettes, that in turn cause lung cancer in customers further downstream. In principle, this downstream responsibility also exists for someone working for an advertising services provider that produces ads for the cigarette company, or – to draw a long bow – for someone working for a logging company that produces timber that is made into pulp and then into paper that in turn is used by an advertising service provider that produces ads for the cigarette company. Of course, the latter sales chain is very complex and would enable the cigarette company to produce only to a very small extent.[32]

Downstream responsibility is often associated with the emissions from the use phase of a product. For example, a truck manufacturer is responsible for emissions caused by a freight company that uses their trucks presumably because the truck manufacturer controls to a certain degree how fuel-efficient their trucks are. Here we argue that downstream responsibility must be seen in a wider context. Let us revert to the aspect of enabling someone to produce and emit by selling to them. The truck manufacturer alone cannot enable the freight company to emit; they have to buy petrol as well. And in a sense, the product-use emissions are even more directly due to the choice of the refinery to produce and sell their petrol so it can be combusted. The truck – albeit necessary – is the mere device for this very combustion. In the same sense, an accounting services provider selling to our freight company enables it to emit, because our company would not be allowed to operate without proper accounts. So, downstream responsibility includes, but is not restricted to, the selling of products that directly cause emissions during their use.

| | Upstream | Downstream | |
|---|---|---|---|
| Emissions are caused by our | suppliers, | customers, | |
| because we | buy from our suppliers, | sell to our customers, | |
| which enables | our suppliers | our customers | to operate. |
| We are responsible for the emissions that we | enable by our purchases. | enable by our sales. | |
| We are responsible for emissions | embodied in our purchases. | enabled by our sales. | |
| The more we | buy from our suppliers, | sell to our customers, | the more we are responsible for their emissions. |
| Our responsibility is calculated from | the fraction of our purchases in the output of our suppliers, and our suppliers' emissions. | the fraction of our sales in the input of our customers, and our customers' emissions. | |
| Ultimate | upstream | downstream | responsibility |
| rests with | buyers of final outputs (eg households) | sellers of primary inputs (eg workers and investors) | |

Tab. 1: Matching vocabulary for upstream and downstream responsibility. From Lenzen M and Murray J, Conceptualising environmental responsibility, *Ecological Economics*, **70**(2), 261-270, 2010

[32] Diminishing responsibility with increasing distance of buyers and sellers from emitters is an inherent feature in input-output theory of environmental responsibility (Gallego and Lenzen 2005).

**Weak and strong sustainability**
"Weak and strong sustainability are two concurrent concepts that are very frequently used to classify empirical approaches to durable development (e.g. Dietz and Neumayer, 2004).

The term of *weak sustainability* has been coined to characterize economic approaches to sustainability that emerged during the 1970s. These approaches were extensions of standard neo-classical growth theories. Standard growth models generally consider that output is only determined by technology and the available quantities of two production factors, labor and capital. The main innovation of this literature has been to introduce natural resources as an additional production factor in these models, and to specify the laws for the evolution of this natural factor, for instance a modeling of extraction behavior in the case of an exhaustible mineral resource - this literature developed after the first oil shock.

These models generally assumed large substitution possibilities between natural resources, capital and labor. Combined with exogenous technical progress, this offered one solution to the finiteness of resources, at least from a theoretical point of view: as oil resources decline, production is expected to use less and less of them but without any decline in standard of living, either thanks to pure technological progress, or by replacing oil by some alternative fossil energy or any other man-made production factor.

Promoters of *strong sustainability* rather consider that substitution possibilities necessarily face physical limits. Critical levels must be maintained for most of natural resources. These critical levels must be at least equal to those necessary for basic-life support functions, and more probably higher if we want to keep reasonable levels of environmental *resilience*, i.e. the capacity of eco-systems to regenerate and return to equilibrium after shocks. The concept of strong sustainability is often considered as irreducible to monetary approaches. All environmental variables of interest have to be followed in physical terms."

p. 236. Report by the Commission on the Measurement of Economic Performance and Social Progress. J. Stiglitz, A. Sen, & J-P Fitoussi *September, 14, 2009* http://www.stiglitz-sen-fitoussi.fr/en/index.htm

See also: Ayres, R.U., van den Bergh, J.C.J.M., & Gowdy, J.M. (1998). Viewpoint: Weak versus Strong Sustainability. Tinbergen Institute in its series Tinbergen Institute Discussion Papers with number 98 103/3 http://ideas.repec.org/p/dgr/uvatin/19980103.html