



# SUSTAINABILITY IN SUPPLY CHAINS

Using systems thinking to work towards sustainability in corporations and their supply chains

CASE STUDY:  
Sustainability in food distribution systems



Australian Government  
Department of the Environment,  
Water, Heritage and the Arts



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## SUSTAINABILITY IN FOOD DISTRIBUTION SYSTEMS\*

In 2007 recognition of the potential consequences of climate change and emissions trading systems (ETS) heightened awareness of the crucial role of effective supply chain delivery systems in Australia.

As a food manufacturer and distributor, Goodman Fielder was aware of growing market competition and rising prices for grain as input for both fuel and food. Advances in alternative fuels, gas, electric and hybrid electric vehicles (HEV) technologies appeared to be showing promise for reducing GHG and fuel consumption.

This study discusses a collaboration among Goodman Fielder, ORIX and truck manufacturers to reduce greenhouse gases from food distribution networks.



This case study facilitates discussion on using critical systems analysis with emerging research and innovation to understand options for distribution networks and alternative fuels and vehicle transport.

Learning objectives:

- 1 > Explore the challenges faced by GF in the baking supply chain.
- 2 > Examine measures taken by GF and ORIX to address these challenges.
- 3 > Describe the systemic enquiry process as applied to this project.
- 4 > Discuss the rationale behind GF sustainability strategies.

\* This case study was developed as part of the ARIES project, *Sustainability in Supply Chains* (Woodhead et al 2009)

## BACKGROUND

Goodman Fielder (GF) is an Australian/Asia-Pacific company that has expanded greatly through takeovers of small niche brands. They manufacture and distribute a wide range of food products – fresh bread, frozen pastries and dairy products, requiring a range of storage systems. The range of variables includes delivery schedules and locations, traffic regulations (e.g. routes for large trucks); storage and freighting requirements for different products (e.g. heavy oils versus voluminous bread products, refrigeration needs); and variable shelf life (from one day for fresh bread to months for frozen pastry). Their truck delivery systems reflect this diversity of frozen, refrigerated and fresh products. Manufacturing plants and distribution centres are dispersed throughout Australia and the Asia-Pacific region.

GF has shifted its corporate focus from environmental compliance to improved efficiencies, and is now addressing issues such as climate change (e.g. measuring GHG footprint of supply chain logistics). GF is planning its first sustainability report – internally in 2008, and publicly available in 2009. A primary influence on this shift in focus has been the perspective at the executive board level, with awareness of external drivers

such as carbon pricing; consumer, shareholder and investor values; and employee attraction and retention. The senior management of GF has demonstrated leadership by canvassing potential sustainability projects (including links between food and health) that went beyond its own corporate boundary. Senior management nominated the right people to lead the project and ensured they had adequate support and resources.

## THE PARTICIPANTS

The GF supply chain project required time, insight and input from a wide range of GF staff and industry players. GF had representation from staff in the bakery, commercial and corporate divisions, including specialists in supply chains, logistics, marketing, customer relations, environmental and sustainability management. This meant that divisions, which had previously seen each other as separate businesses under the one corporate banner, came together and learnt about each other's operations.

GF invited ORIX to participate once it became evident that alternative truck bodies, engines and fuels were key initiatives to reduce GHGs. ORIX lease commercial vehicles to the bakery division. ORIX in turn invited specialist alternative fuel

and technology suppliers to present their products to the project team. These companies were: Green Fleet Systems International; Clear Sky Solutions; OES CNG; HINO (subsidiary of Toyota); and ISUZU. The Australian Government Department of the Environment, Water, Heritage and the Arts also provided expertise in GHG policy and measurement for alternate fuel vehicles.

## CRITICAL SYSTEMS ANALYSIS

Between November 2007 and May 2008 workshops were held with GF and supply chain partners. GF's vision for the project had this objective: to reduce the GHG footprint of distribution and develop a model of the change process that can help to further improve the sustainability of its supply chain activities. The initial meetings with GF aimed to build mutual understanding about:

- sustainability
- the culture and operational environment
- boundaries of the systems and the sub-systems
- potential stakeholders
- perceptions of risk, barriers, challenges and systemic problems.



Establishing the range of mutual benefits is essential for effective and ongoing collaboration. The benefits need to connect the stakeholders and the sustainability vision. As new parties join the project and understanding evolves, the vision and mutual benefits should be revisited.

After several months of exploring potential projects, and discussing project options with some suppliers and customers, GF corporate, commercial and bakery divisions identified two areas to focus on to improve the GHG footprint of its supply chain performance:

- their short- and long-haul trucking fleet
- transport logistics between distribution centres.

The key objective was to explore opportunities to reduce GHG per unit of product delivered, through such options as fuel efficiencies, substitute fuels or new engines. This case focuses on the baking division's analysis of alternatives for its light-weight, short-haul vehicles.

### PRESSURE: WHY ALTERNATIVE FUELS AND GHG AND THE BAKERY DELIVERY SYSTEM?

In GF, the bakery division has the largest financial investment in distribution. The main drivers influencing GF are:

- Reduce exposure to increasing fuel costs by improving logistics.
- Maintain current product pricing, given the likelihood of substantial increases in both fuel and food commodity resources.
- Anticipate compliance to emerging regulations – emissions trading scheme (ETS), which will provide strong cost incentives to reduce energy use and GHG.
- Do the right thing – GF developed a corporate sustainability strategy that requires futures thinking and actions to be aligned with improving the sustainability of GF.
- Expectations of carbon content labelling, and emerging demands for information about a product's GHG.

### CURRENT STATE: WALKING THE GF BAKERY DELIVERY SYSTEM

The context to serve as a case study in this project was the delivery of bread in the Sydney metropolitan region. The baking delivery system is a 'spider web' from the distribution centre to large and small retailers with fixed routes and low variability in load size and orders.

Specify your system boundary and determine what the project group can control or influence, and how. If something affects your project but you can't influence it, then monitor it.

The boundaries of the system were defined as from GF bakery distribution centre to retail distribution centres. Key sub-systems included: transport and logistics; the bakery; depot; trucks; transit; logistics; and environmental and social systems. The main stakeholders in the alternative fuel project were GF permanent staff and contractors, ORIX, suppliers, customers and the retail sector.



GF's Ermington Distribution Centre (DC) is the largest stand-alone DC in NSW with half a million deliveries of fresh bakery products per day. Products are delivered from the Moorebank Bakery which services the whole of Sydney. Deliveries from Ermington cover Bondi, the city, the north shore and the northern beaches. Contractors are paid by commission on cents per unit sold. This is a strong incentive to reduce per unit delivery costs through improved efficiencies. A software package called Transit schedules distribution according to the most efficient routes and vehicle type. Inputs include satellite information,

roadmaps, peak traffic times, vehicle size, etc. This provides a platform for building an efficiencies analysis. Figure 7 shows the initial discussion points for starting a CSA into the Ermington sub-systems.

Scan for issues that currently impact the supply chain systems. Potential impacts of interventions (micro and macro) include societal and environmental issues.

In a systemic enquiry into whole-of-supply-chain sustainability, participants scan for issues that currently impact the system. Potential impacts of making changes to the system should also be considered. Some issues considered during multi-disciplinary discussions during the project were:

- Regulations are likely to become more stringent, and carbon-intensive fuels will become more expensive. Commonwealth Government mandated GHG reporting is currently under development and it is anticipated that ETS will be introduced in 2010. Information on GHG emissions may need to

### GF / Ermington Depot: Current supply chain

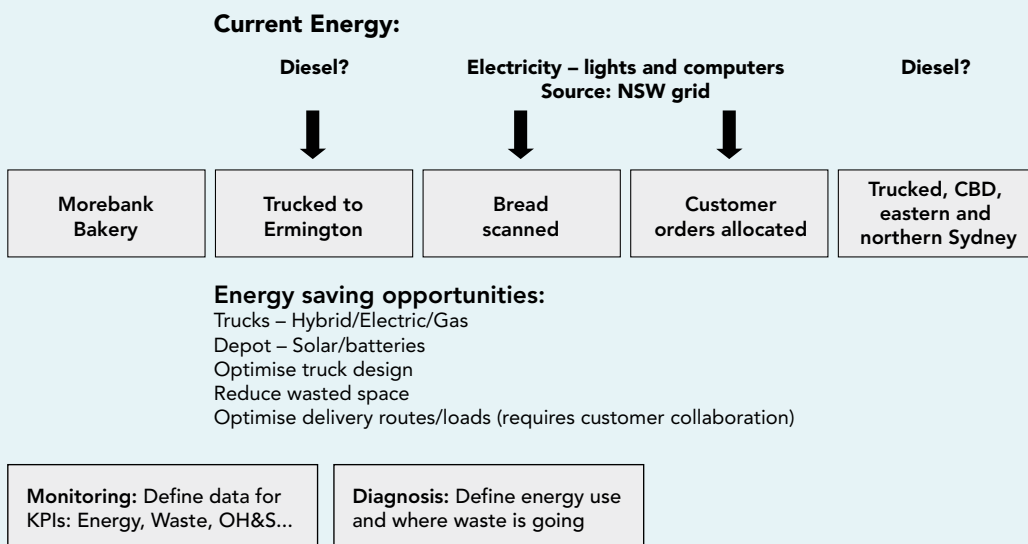


Figure 7 Ermington DC analysis

be communicated along a supply chain. Transport fuels are also included in a mandatory federal energy efficiency program. Potential future impacts on GF of evolving sustainability and climate policy, government incentives and regulations, local and international market drivers were considered.

- Vehicle design optimisation opportunities included the weight-carrying capacity of vehicles, the options to redesign vehicles, chassis, and the number of wheels. Operations and maintenance of vehicles would be required but at no additional cost to GF. Some changes may require OH&S training for drivers. Operational procedures would be provided by suppliers and managed by ORIX as part of the leasing

arrangement. Maintenance costs are included in the lease. It was anticipated that the commercial leasing arrangements with ORIX would incur no immediate additional costs to GF.

- Options to reduce the distances travelled or the frequency of deliveries involved trade-offs. Opportunities to improve the logistics required discussion with retailers whose contracts can constrain efficiency options by specifying such things as delivery times, the choice of engines and truck body sizes. Travel distances may increase if GF depots are consolidated or if fuel locations are changed (compressed natural gas (CNG) depot option). Can the empty space be reduced and load capacity increased within current weight restrictions?

- Societal attitudes towards fuels were also considered important. What are the community/ consumer perceptions of petrol? Community considers this fuel to be a major contributor to climate change. Community perceptions are likely to continue to drive consumers away from petroleum fuels towards more alternative fuels. Bio-fuels were not considered a viable alternative fuel. GF is a food manufacturer and there is growing concern about the impact of using food for fuel on global food supplies. Any electric vehicles drawing on coal-generated electricity along Australia's east coast would emit more GHGs than traditional fuels, according to one participant. Was it possible to put solar panels on factory roofs to charge the solar batteries for the electric vehicles?

### Alternative fuel options

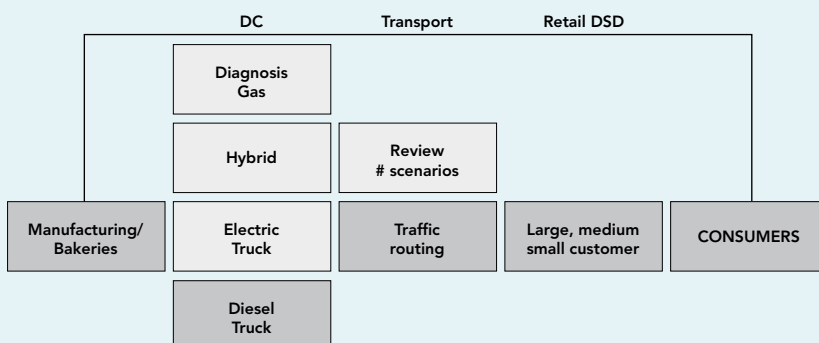


Figure 8 Alternate vehicle fuel options

Figure 8 shows the alternatives identified for further review. Suppliers were invited to provide detailed information on alternative vehicle and fuel options. This included the advantages and disadvantages of each option in relation to the upcoming ETS and the broader context of climate change.

DEWHA also participated and made these points during a forum with ORIX, GF and the gas suppliers:

- It is a myth or an assumption that alternative fuels must be better. The new generation diesel engines made to European standards (Euro IV) are a lot cleaner and emit less GHG. At the heavy-vehicle end of the market there is no current evidence that there are better alternatives to diesel.
- In some cases, attempts to decrease CO<sub>2</sub> can increase emissions of CH<sub>4</sub> (methane). Currently it is difficult to measure CH<sub>4</sub> and NOx as the equipment is not available in Australia. Engine tests conducted overseas may not be a reliable guide to emissions under Australian conditions.
- Hybridisation is a key enabling system for going forward, but battery cost, life, space taken on truck and weight are constraining issues.

A decision support matrix helps to consider the range of perspectives. There were differing views on what the important factors were for making a decision.

The suppliers informed the group about the range of issues to be considered when looking at alternative fuels. General points made by suppliers included the importance of driver skills (a 10% difference in fuel consumption); collaborative opportunities (six-month free trials for new hybrid electric vehicles); and how government assistance is needed to install fuel depot infrastructure for CNG (a low GHG fuel option which has advantages for Australia). Simply upgrading the vehicle fleet with new automatic/manual transmissions (AMT) would result in economic and environmental benefits from lower diesel consumption. AMT helps to take the 'bad driver' out of the equation – this in turn reduces maintenance costs and fuel use.

There were differing views on what the important factors were for making a decision. The government focused on GHGs; whereas suppliers were also concerned about particulate matter and air quality. Suppliers emphasised cost savings. Some suppliers lacked knowledge about climate change implications and emissions trading; others had high awareness but their initiatives to develop technologies that emitted less GHG were hampered by the lack of vehicle testing facilities and specific information to guide their activities. Some frustration was expressed that government tests had a limited range of applications.

The decision support matrix below is a useful tool for scoping the options. Data in the matrix and notes captures some of the discussion about options during project meetings. The accuracy of this data hasn't been verified.

TABLE 1 ALTERNATIVE FUEL DECISION MATRIX

	PETROLEUM-DIESEL	ELECTRICITY	GAS LPG	GAS-CNG	HYBRID ELECTRIC VEHICLES
+ Positives	<p>Conventional fuel currently used. Supply infrastructure in place.</p> <p>Can extend with biofuels but lack of consistency in product.</p> <p>New generation of diesel engines are much cleaner.</p>	<p>Battery power can mean zero emission by vehicle. Good for back-to-base runs.</p> <p>Probable lower running cost. Low maintenance cost.</p> <p>Introduced in Europe but not currently available in Australia.</p>	<p>LPG infrastructure in place. Readily available and good supply in Australia.</p> <p>Lower price – no tax on LPG. Lower fuel running cost and maintenance. Zero emissions.</p> <p>Add-on LPG kits – if breakdowns, turn back to diesel automatically.</p>	<p>Australian pricing of CNG currently not influenced by world prices. Lower fuel running cost and maintenance. No tax. Zero emissions.</p> <p>Helps to break the reliance on petrol/oil and sources fuel in Australia. Good supply.</p> <p>Lower GHG.</p>	<p>New lightweight trucks available for collaborative trial.</p> <p>Lower fuel running costs. Hybrid vehicles gaining support from government for GHG benefits, lower emissions. Good for the stop/start nature of the baking delivery operations.</p>
- Negatives	<p>High emissions especially CO<sub>2</sub>.</p> <p>Limited crude oil supply with demand increasing and price forecast to increase.</p> <p>Less resilience if dependent on one fuel supply.</p>	<p>New technology, in development stage. Batteries heavy and bulky. Limited vehicle options. Australian compliance is required.</p> <p>Larger upfront capital costs. Re-charge through domestic main. GHG impact when using coal-fired power stations.</p> <p>May only be feasible with solar panels &amp; inverters/batteries.</p> <p>Battery life &amp; cost of replacement. Potential rapid depreciation of investment (resale value).</p>	<p>Infrastructure cost for refueling. If 100% LPG, short runs or sacrifice load space to carry gas. Larger upfront vehicle costs.</p> <p>Maintenance issues. No warranty insurance from diesel engine manufacturers with retrofitted systems.</p> <p>Low resale value of vehicle.</p> <p>LPG still emits GHGs.</p>	<p>If 100% CNG, distance of runs limited to within fuelling station. Substantial upfront capital costs for establishing infrastructure for refuelling (\$0.25million per station).</p> <p>Larger upfront vehicle costs.</p> <p>Maintenance issues. No insurance from engine manufactures with add-on systems.</p> <p>No secondary market for CNG trucks (related to lack of fuelling infrastructure). Option: use after-market kit and convert back to diesel.</p>	<p>New technology in development stage for lightweight commercial vehicles.</p> <p>Larger upfront capital costs, not cost neutral, capital and operational expense high.</p> <p>No market history, presumed low resale value.</p>

TABLE 1 ALTERNATIVE FUEL DECISION MATRIX (continued)

	PETROLEUM-DIESEL	ELECTRICITY	GAS LPG	GAS-CNG	HYBRID ELECTRIC VEHICLES
<b>RISK</b>					
Short term	LOW-MEDIUM	HIGH	MEDIUM	HIGH	HIGH
Long term	HIGH	MEDIUM-HIGH	LOW	MEDIUM	MEDIUM
<b>TIME FRAME</b>					
	Current	Longer term – dependent on technology and infrastructure costs.	Short term. LPG dual fuel add-on (life expectancy six years) is available now.	Longer term – possible for collaborative fuel depot. Dependent on infrastructure and technology.	Medium term – dependent on infrastructure and technology.

**Technical notes on fuel options**

The LPG and CNG systems were available as dual-fuel add-on for diesel engines, Dual Phase Induction Systems. Suppliers claimed that adding LPG or CNG to diesel engines helps to reduce CO<sub>2</sub> by reducing diesel consumption. In addition to running the engine, diesel also acts as an engine lubricant and a solvent to help keep the engine clean. Therefore, the balance of gas to diesel has tradeoffs with engine efficiency, maintenance

and fuel economy. LPG and CNG also have GHG impacts. CNG has the lowest GHG impact but there are few fuel stations.

Hybrid vehicles use either Exhaust Gas Recirculation (EGR) or Select Catalytic Reduction (SCR) technology. The EGR + Diesel Particulate Diffuser (DPD) achieves Euro 4 standard (the highest). DPD is a ceramic filter that collects and incinerates particulates. EGR and DPD vehicles can potentially achieve up to 30% reduction in

fuel use and 25% reduction in GHG emissions. Some vehicles use EGR + DPD + Variable Geometry System (VGS) turbo chargers, with potential to reduce particulates by 81.25% and NOx by 30%.

NB: Particulates in the exhaust are an air-quality not a GHG issue. Suppliers urged the need to also understand the impact of particulates on air quality. The relationship between particulates and climate change surfaced, but wasn't addressed.

Alignment of strategies and policies in collaboration with suppliers enables more sustainable practices in the supply chain.

## INITIAL OUTCOMES FROM THE PROJECT

There was uncertainty about how alternative fuel regulations would evolve. Changes in alternative fuel policies in relation to CNG infrastructure, hybrid and electric vehicle tariffs could substantially alter the economics of the vehicle. Financial data from ORIX indicated the cost of leasing hybrid trucks was substantially higher than leasing the new diesel vehicles with AMT. The problem was the uncertainty around the re-sale value of these vehicles in three years and the additional costs such as battery and inverter maintenance. The batteries are expensive and battery life is unknown. There is currently no market for hybrid vehicles, whereas diesel vehicles have an established re-sale market.

Sustainability issues cannot be viewed in isolation of financial considerations, where substantial investment is required. The risk would be perceived as being too high if there isn't reasonable certainty about the costs. The information does not build a strong enough case to justify a substantial investment in gas, electric or hybrid vehicles.

While this presented a setback for the project team, they remained

optimistic about improving the sustainability of the vehicle fleet. Without having consulted a diverse range of stakeholders, GF may have pursued a 'quick win' using an alternative fuel under a mistaken impression about its environmental credentials. One of the outcomes from the discussion was the opportunity to work with ORIX and ISUZU on a collaborative six-month trial using a new hybrid diesel-electric truck. GF staff will monitor the performance of the hybrid and build a better understanding of the operational implications of this new technology. The trial progress will be communicated to GF staff and will be used to raise awareness of the sustainability opportunities and challenges in the trucking fleet.

**Sustainability issues in isolation of financial considerations will not convince the Board to make substantive investment.**

Some additional improvements occurred at GF. The GF team engaged a wide range of employees, including people from marketing, logistics, supply chain management, customer relations and sales in considering

a number of potential projects. Some project initiatives were explored but were delayed, for example, by an imminent change in suppliers, or the inability to obtain the information that was needed. Improving logistics management is also a key initiative, but progress on this area was slow due to data limitations and the complexity of the logistics network. There is also a need to collaborate with the retail sectors, but building these collaborative partnerships appeared to be challenging.

GF developed more systemic interactions and alignment between strategy and sustainability options, within its own corporation and with organisations along its supply chain. GF instigated the supply chain collaboration with ORIX, which in turn invited its suppliers to become involved in the project. GF kept senior management informed and consistently demonstrated openness to broader systemic issues and the need for new ways of thinking and collaborating. They also provided valuable feedback on the constraints of their business and industry sector. As discussed in Chapter 2, it is imperative that corporations engage in active discussions about sustainability and their values and roles in society as well as the business world.

