



# Covey Consulting News

April 2008

## In this edition,

- Is Solar the right equation for the future?
- Jet-lag = Shift Work = N-off-D-off
- Crosswords...solution and a challenge
- The dimensions of CO<sub>2</sub>
- Left over right and right over left is it knot?

*Dianne Jones*

## Solar Electricity

**Geoff Covey**

Concerns about global warming and depletion of fossil fuel reserves have led to increased interest in renewable energy. One approach that has generated particular interest has been solar electricity. This has been successfully employed on a small scale in remote locations and some demonstration facilities. The question remains of its practicality on a large scale.

The difficulties of working on a large scale are demonstrated by a proposal put forward recently by PrimeStar Solar. They proposed to supply 69% of the 2050 USA electricity demand (equal to 35% of its total energy demand) by construction of massive photovoltaic and concentrated solar power generators coupled with energy storage based on subterranean compressed air reservoirs.

The plan calls for massive installations of solar collectors in south-west USA plus similarly large scale ancillaries:

- 80 000 sq km of cadmium telluride photovoltaic cells (current total world installations 25 sq km).
- 40 000 sq km of concentrated solar power collectors (parabolic mirrors focussing onto tubes filled with brine which generate steam to drive turbines) (current total world installations 25 sq km)
- 10<sup>9</sup> m<sup>3</sup> of compressed air storage, plus associated compressors and power turbines (no existing installations)
- 200 000 – 1 000 000 km of new high voltage DC grid to transmit electricity from point of generation to point of consumption (currently about 1 000 km exist).



It is suggested that the installations be built in desert areas on publicly owned land. It is claimed that there should not be environmental problems. The area selected would be regarded by many as 'wilderness' and it seems improbable to me that such large areas of land (19% of the 'suitable' land in USA) could be converted to industrial use without considerable objections.

The land selected for the proposal receives high solar radiation (about 8kWh/m<sup>2</sup>/day). However, energy is only generated for about 8 h/d, therefore some form of storage is required. The proposal calls for the electricity to be used to mechanically compress air to 75 bar (not a highly efficient process and requiring compressors of enormous capacity) and to store this gas in underground cavities. Energy is then recovered by using this compressed gas in gas turbines fuelled with natural gas. It is claimed that this saves about 60% of the fuel that would otherwise be required to run such turbines.

The land to be used is arid and has high air temperatures, but to run steam turbines (especially low pressure turbines as proposed for the concentrated solar power collectors) requires a condensing sink. Although such a sink can be provided from atmospheric air, it is an expensive and inefficient method.

In addition to these problems, there is the issue of the materials needed to make the solar collectors. The plan calls for about 2-3% of the facilities to be built by 2020, and the rest to be built by 2050. This creates considerable issues relating to the rate of supply of construction materials:

- Assuming the facility is to be built over a 30-year period.
- For the concentrated solar power, if stainless steel mirrors 1mm thick are used this will require about 10.8 million t of stainless steel per year – this represents 40-50% of the present **worldwide** production of stainless steel (25 million t/a).
- According to Desai et al the thickness of the cadmium telluride in a photovoltaic cell is 3-10  $\mu\text{m}$ , Karpov et al give 1.5-7  $\mu\text{m}$ . For the present purpose it is assumed that a thickness of 5  $\mu\text{m}$  will be used. This implies that to make the photovoltaic cells in the PrimeStar Solar plan, a total of 1.1 million t of cadmium and 1.28 million t of tellurium would be required.
- Current world production of cadmium is about 21 000 t/a . Therefore the amount of cadmium required for this one project for the thirty years of its duration would be about twice the present annual world production.
- The world annual production of tellurium is about 180t so each year this project would require a quantity of tellurium equal to about 240 times the amount currently produced. Furthermore, there is little prospect for increasing tellurium production significantly as tellurium is one of the rarest elements in the earth's crust and it is rarely found at high concentrations (estimates give its total abundance as a high of similar to platinum, down to about 1/40 of the abundance of platinum).

Clearly this proposal is impractical or even impossible. Further, despite the magnitude of the proposal, it is only covering part of the power supply of one county (albeit the world's largest energy user). Currently the USA uses about 23% of the world's energy, but this proportion is falling. It is expected to be down to less than 19% by 2030<sup>1</sup>. Longer term projections are very unreliable, but by 2050, if current trends continue, the USA will be responsible for no more than 15% of the world energy consumption.

This means that to have the same impact globally as PrimeStar Solar envisage for the USA would require seven times the resources of land and material described above.

On first impressions, solar electricity is an attractive proposition. Even at an average daily solar radiation of 4.5 kWh/m<sup>2</sup>/d (most of the USA and similar temperate lands will receive at least this)

and a conversion efficiency of 14%, the rate of fuel generation is about 15 times what can be achieved with most types of biomass over an equivalent area.

The problem is that, as shown above, present methods of using solar energy will be impractical on a large scale unless there is an enormous change in our industrial infrastructure to produce greatly increased quantities of special materials. Such changes are conceivable in the times scale of 30-50 years, but they represent a very high-risk strategy if solar energy is to be the primary energy source of the future.

*"This piece is adapted from a section of a paper to be presented at the Appita Annual Conference in April in Rotorua by Geoff Covey and Steve Grist "What is the role for biorefineries?" Contact us if you would like a copy of the full paper.*

## Jet Lag by Not Travelling

**Allan Jamieson**

This opinion piece was submitted in the hope of prompting input from others who may have studied the Shift Work situation in depth.

Jet Lag is usually thought to be a consequence of *flying* eastwards or westwards over several time zones. There is extensive experience and many studies on the matter of flying and general agreement that the impact on the body of travelling eastwards (against the sun) is greater – requiring a longer “recovery time” – than is flying westwards (with the sun). There are even ‘rules of thumb’ showing that the recovery time is in proportion to the number of time zones involved (*e.g.*, to fully recover, the body will take one day per time zone crossed eastwards) but the actual recovery period can vary, sometimes drastically, between individuals.

The impact of Shift Work on workers has also been studied, including examination of the “jet lag” effect that comes about, not by travelling through time zones but instead as a result of workers being forced to change their sleep and work times. It seems to this writer, however, that very little attempt has been made in our Industry – or, indeed, in shift work situations in general – to utilise shift cycles that minimize “jet lag.”

It is a further opinion of the writer that shift workers sort themselves out, *i.e.*, those who find a way of coping with a particular shift work cycle stick

with it – presumably for the money – while those who cannot find a way to cope will soon resign and that it is hard to persuade a group of shift workers to change their cycle – regardless of what this cycle is – possibly because those workers have learned to cope with the cycle they currently work (which makes them an ‘exclusive group’) and they are wary of having to change.

These views led the writer to conclude that the question of which cycle to establish in a workplace must be thought through *before* work starts at the site. A carefully chosen cycle, put in place at the beginning, will maximise the probability that any worker will be able to cope, thereby enhancing Management’s ability to retain the best possible workers on shift, rather than find itself restricted to relying on a special sub-set of workers which may not include the best employees overall.

#### What about cycles?

The eastwards versus westwards experience in flying suggests that the most commonly found shift cycle (Day→Afternoon→Night, or “D-A-N”) on a 7-day rotation is close to being the *worst* option. This imitates flying eastwards and the relatively slow cycle rotation rate means that the body has possibly just managed to recover from the equivalent of a flight eastwards over 8 time zones when it has to undergo the next 8-zone flight in the same direction and this goes on *ad infinitum*.

The writer has the strong belief that any workplace in which a “D-A-N” 7-day cycle is in use reflects a situation where Management has relinquished its Duty of Care.

Is this belief going too far? What evidence exists in support?

The American Sleep Association has observed that there are “*conflicting reports*” as to who is affected more by jet lag, younger or older people, but “*all studies agree*” that women are at a higher risk than men. This must have consequences for Management at hospitals.

One early and interesting study was reported in Britain in 1946. As a result of travelling disruptions due German night time bombing in 1940, many workplaces were forced to change to an unusual shift system that repeated every three weeks:

<u>Week</u>	<u>Days</u>	<u>Hours</u>
1	Tues., Thurs., Sat.	4 p.m. to 8 a.m.
2	Mon., Wed., Fri.	4 p.m. to 8 a.m.
3	Mon. to Sat.	8 a.m. to 4 p.m.

What was interesting was that when the war ended, management and unions wanted to change the system back to the usual “D-A-N” 7-day system but the workers resisted. Eighty-eight percent of them preferred the longer night shifts because: “... *the 32-hour break between night shifts provided more time at home and for social life.*” The long alternate nights’ sleep between shifts was credited by 65% of the men as meaning “.. *they went to work fresher, their health was better and there was less digestive disturbance as most meals could be taken at normal times.*”

Our own NHMRC in 1981 stated that: “...*weekly rotating shift systems ... are ... unsuitable because no sooner has a worker achieved some degree of adaptation than it is time for him switch to another shift.*” Maximum adaptation is not achieved in under 20 night shifts, so rotation periods of one or two months would be necessary but social – *i.e.*, non-work – reasons will usually block such a long stint on night shift, so “... *it may be better to use a rapidly rotating shift system.*” It was observed that having time off after a maximum of two consecutive night shifts: “... *appears to be sufficient for recovery from minor disturbances of the circadian rhythms.*”

A University of Virginia study [Block *et al*, “**Chronic Jet-Lag Increases Mortality in Aged Mice**”, *Current Biology*, Nov. 2006] found that, while young mice generally survived well under the various light-cycle changes introduced by the researchers (*e.g.*, a weekly shift of six hours), the changes had a statistically significant effect on the survival rate of older mice: After eight weeks, 83% of old mice survived under the “control” (no deliberate change in light-cycle), 68% survived under the backward-shift (flying westwards) regimen and only 47% survived under the forward-shift (flying eastwards) regimen. Increasing the rate at which light-cycle changes occurred to once every four days caused forward-shift mice to die faster than was the case with weekly shifts and backward-shift mice again fared much better than the forward-shift mice.

The Virginia University researchers observed that, despite the fact that trans-meridian travel and shift work are commonplace in our 24/7 society, “*few controlled studies have addressed the health effects of repeated phase shifts of the biological clock.*” They mentioned that shift work and chronic jet-lag reduce mental acuity and increase the risk of a number of medical problems including cancer,

digestive diseases including peptic ulcers, and sleep disorders.

**A suggestion**

The writer believes that it is feasible to devise a system of shift work that imposes little or no “jet lag” on workers. Such a cycle must involve a fast rotation (no more than two shifts in a row) and 12-hour shifts. Working 12-hour shifts is quite feasible in this age when prolonged manual labour is a rarity and intense mental concentration is required occasionally but not continuously.

Is this the best shift system? Lets call it a Clayton’s cycle; it could be difficult to persuade a worker on this system that he is a shift worker!

**Rapid (4-day) 12-hour shift cycle**

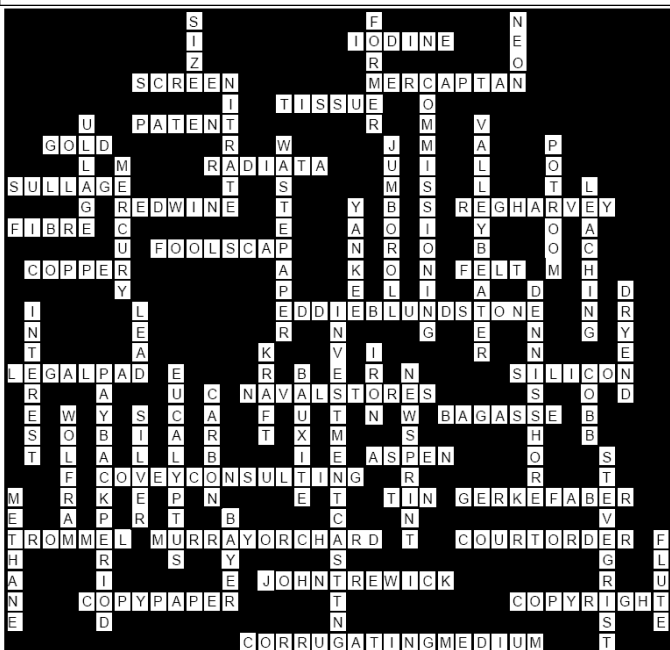


Day 1	Day 2	Day 3	Day 4
-------	-------	-------	-------

These four days (“N-off-D-off”) repeat. Given five shift crews, all-year manning is possible while still providing annual leave, *etc.* for the shift workers.

With this system, the night shift is effectively a “long night” in the same sense as experienced by a day-worker who is a cricket fan and who stays up all Saturday night to watch a telecast of a day’s play at Lords, knowing that he doesn’t have to go to work on the Sunday. The cricket fan doesn’t consider that he has become a shift worker!

**Christmas Crossword Solution**



**ANOTHER CROSSWORD!**  
**ANOTHER \$100!!**

We received NO correct answers for our first competition crossword (though we know several people finished it – almost). So we will re-offer a \$100 Amazon voucher for a correct answer drawn from entries received by 30th May 2008 – or in event of no correct answers, for the nearest correct.

Come on, we can’t be fairer than that!

As the last crossword was all about your work, most of you got stuck. So this time we will try a topic in which most of you have expertise. All of the answers are names of drinks or related items (no brand names – except martini as a cocktail, not a brand of vermouth)

Compiled by Dennis Shore, cryptology by Geoff Covey, special thanks to Reg Harvey for testing all of the answers (the hogshead almost had him beaten!)

Those of you who find even this too difficult might like to try the one below?

1	2	3	4	5
6				
7				
8				
9				

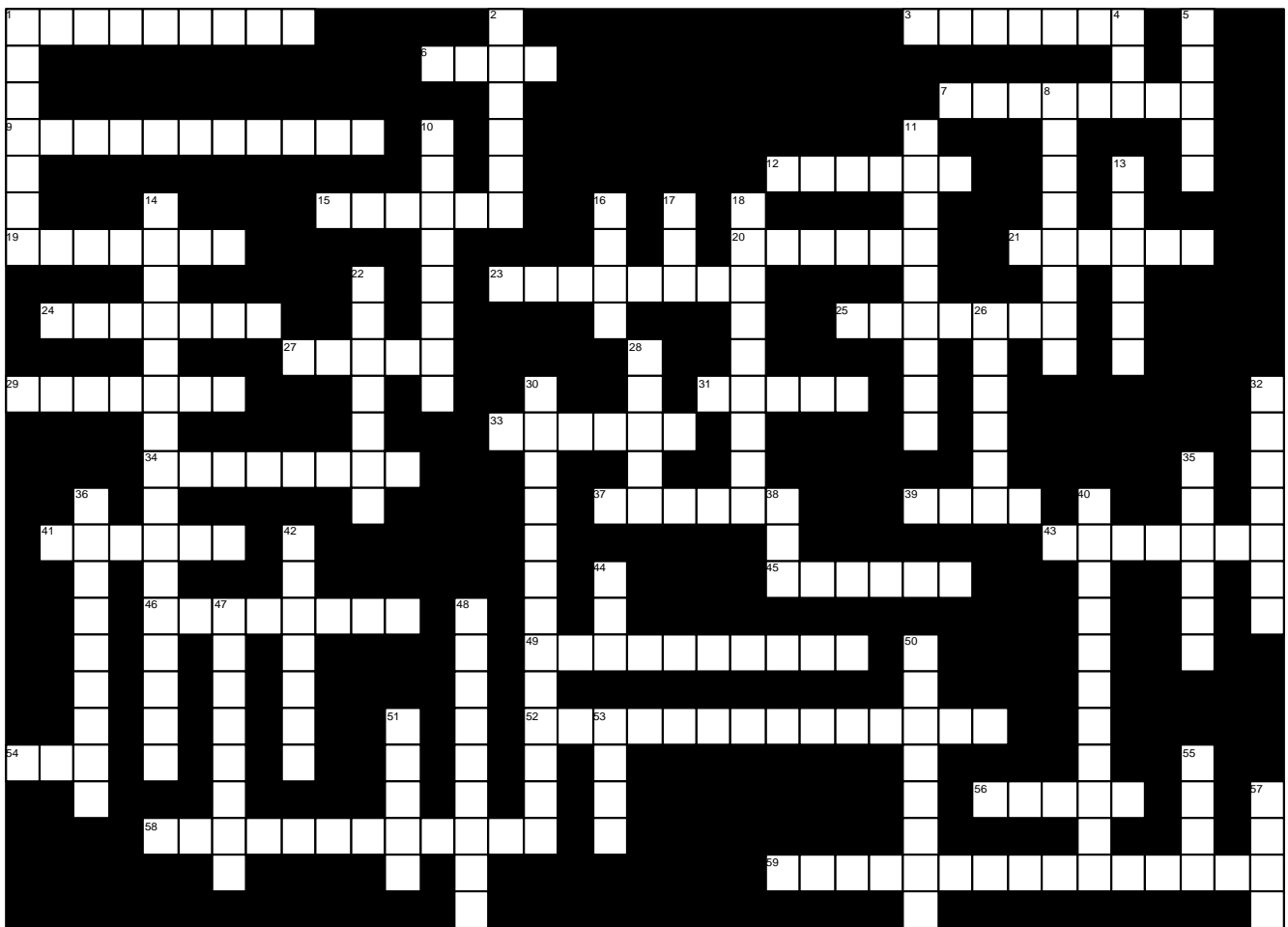
**Across**

- 1 Judy’s husband
- 6 Boxer’s blow
- 7 What inspector does to your ticket
- 8 Fruit drink
- 9 Used to make holes

**Down**

- 1 They roll off the knife
- 2 Female sheep
- 3 They lay eggs
- 4 They are full of fish
- 5 Some people drop them!

## COVEY DRINKS CROSSWORD



www.CrosswordWeaver.com

### ACROSS

- 1 Ships company from Irish country makes an opening (9)
- 3 Tear month and mix it for white spirit flavour (7)
- 6 Ale from an insect Queen (4)
- 7 Top of pig for a lot of wine (8)
- 9 Is dark material just stout and champagne? (5,6)
- 12 I replace her in pickle that changes note for 9 gallons of beer (6)
- 15 Red automobile rental is muddled (6)
- 19 Confused chicken rock? Enough! (3,4)
- 20 Three G's and one for a drink (3,3)
- 21 Woodwind without an in for red wine? (6)
- 23 Sailing boat for a large beer or sherry (8)
- 24 Cocktail, but in America it hardly contains any! (7)
- 25 Heal a pig, we hear, and you will get many coloured liqueur (7)
- 27 Nip returns ancient volume for wine (5)
- 29 Trader drops his "H" and changes, but not for champagne (7)
- 31 Rather fat and dark (5)

- 33 Do it yourself- without me - and some cereal for spirit (6)
- 34 Taxi, er, mesh - wine! (8)
- 37 Left anger changes for a beer (6)
- 39 Pawn, ankle or Rhenish wine (4)
- 41 Cheri for Jerrez? (6)
- 43 Cake and wine (7)
- 45 Lots of bubbles, the big-shot! (6)
- 46 Red that is sometimes white? (8)
- 49 The oldest man can hold a lot of drink (10)
- 52 Drink fit for an Emperor? (8,6)
- 54 Rummy? But not rum! (3)
- 56 Como or pear drink? (5)
- 58 Six on about gas noise confusion for a standard drink (3,9)
- 59 Lamb says it spoils two good things (7,3,5)

### DOWN

- 1 French Lily after composer's arrangement for white wine (7)
- 2 French sea in plenty for a grape (6)
- 4 Are you whiskey? (3)
- 5 Queen Elizabeth after the Criminal Investigation Department? She'll be

- apples! (5)
- 8 Half of fifty 'lon' for a bland wine! (8)
- 10 Vicar returns facial feature for fortified wine (8)
- 11 Beer with a red head? (6,3)
- 13 Goods carrier and what he traditionally drank (6)
- 14 Jocularly pretentious boxed wine? (8,9)
- 16 Flowery sherry? (4)
- 17 A tot returns for half of 17 (3)
- 18 How old is the recluse to be a red? (9)
- 22 Swiss gin (7)
- 26 Pinion returns container for brandy (6)
- 28 Very old Australian trouser turns into white spirit (5)
- 30 The men deer mice change without me for "green death" liqueur (5,2,6)
- 32 Wine label note of the year? (7)
- 35 Scotch inclined to be beaten? (6)
- 36 Apparently its not a real ache but used to celebrate (9)
- 38 Reached under mast initially for a sailor's tot (3)
- 40 Socialist at a cook-out? (8,3)
- 42 King's whiskey? (7)
- 44 Highest return for small beer (3)
- 47 Throw grain we hear for hock (8)

- 48 Deer sparkle with champagne and orange juice (5,4)
- 50 If you swim in it, you might not know or care if you sink, what alcoholic excess (4,4)
- 51 Slap down a cheap bottle in England (5)
- 53 City loses two rings for desert wine (4)
- 55 Got to have grape juice (4)
- 57 Irish stopper? (4)

## Lead me knot

Ross Patterson

A certain large company has a glitzy new 2D parametric staff evaluation system; the chosen parameters being “Results” and “Leadership”. When asked to explain how to evaluate the “Leadership” of a technical person who works alone in his office, the HR directive is to consider his ability to lead himself. “Lead himself” ? Mmmm.

A certain state cricket team which has had a very poor record over the last few years, is reported to have deployed dynamic new motivational coaching and management staff. But apparently none of these new recruits have actually played serious cricket. Unfortunately the team’s results so far this year have been even worse. Mmmm.

Geoff recently wrote about new words infiltrating our language. One of my favourites is stunningly evocative when used sparingly, rather like chilli. That word is “bullshit”. There is just no alternative that hits the spot quite so well.

“Leadership” is a very IN thing these days. One of those flags one must wave, going forward, to leverage ones career. Research programs, academic papers, and professorships seem to abound. I suspect these are funded by the leaders of industry. Even “ENGINEERS AUSTRALIA” runs a regular column.

Let me say right up front that I have no expertise in this field. And when I did one of those “tick the box” exercises in a fairly reputable journal, it turns out that I have no Leadership ability either. However I do remember reading that Intelligence Tests are very useful in telling how good you are at doing Intelligence Tests. Perhaps the same is true here.

I re-ran the test for hypothetical box-tickers like Adolph Hitler, and Bonaparte, and they scored very well indeed. This made me feel a lot better about myself.

Some years ago I was required to attend a one-day seminar on “Leadership”, and this was the start of my loathing for this subject. It was an unpleasant experience for me, and the lecturer, and probably a few of the audience. The bright and personable speaker told us all about these wonderful qualities we should strive for, and had us busily ticking boxes. I pointed out to him how well Genghis Khan would score at his test.



But no ! There is more to the subject apparently. Out came another score sheet with lots of ‘moral’ type questions. Apparently the trick is to find not only a “Leader” but a “Good Leader”. I suggested that he was obviously looking for a cross between Genghis Khan and Francis of Assisi. There was a rather unpleasant silence, and we moved on to another question.

But are these not two independent sets? The “Leaders” and the “Good”? Or possibly even negatively correlated. Now there is a thought.

That the set “Leaders” exists, is an empirical fact. When a position of power becomes available there is always a scramble to fill it. And the successful scrambler is normally selected by a Leader one tier further up. It is interesting to speculate on the statistically dominant selection criteria. Surely any behaviourist would suggest “non-threatening” as a possibility.

And then there are Leaders selected by the democratic process. I have a delightful Leunig cartoon pinned to my wall. It shows Mum and Son sitting with a Vocational Councillor, who is saying, “... Our tests indicate that your little Robert is a vain, ruthless, and devious opportunist without empathy or imagination and we suggest that he pursue a career serving his country as a politician”. Enough said.

What is of real concern to me is the desperation with which the public seek and follow their chosen leaders. This foible seems related to the “celebrity” craving we see in pulp magazines. Folks, this is the serious point. Let us never forget the ease with which the Third Reich came to power and then did their terrible thing. When someone says “We need strong leadership”, let the warning lights flash.

I currently have an excellent boss. No big deal, but pretty unusual. He is competent and approachable, but is he truly a leader of men? Would I follow him into the valley of death, waving my cutlass? After some deliberation, I would have to answer “No” to this. But I suspect that he would never do anything as silly as that anyway.



# Covey Consulting

*Excellence in Engineering*

1st Floor, 660 High Street, Kew East. Victoria



Ph: (03) 9859 4290



P O Box 891

Fax: (03) 9859 4630

Eltham Victoria 3195

Australia

## Covey Team

Dr Geoff Covey 0417586735	Chairman	Mr Reg Harvey 0417 383 237	Process Engineer
Mr Gerke Faber 0419 134 659	Mechanical Engineer	Mr Robin Johnson 0412212557	Process Engineer
Mr Dennis Shore 0412 332 226	General Manager	Mr Stephen Grist 0414 460 729	Chemical Analyst
Mr Eddie Blundstone	Mechanical Engineer	Mr Roger Canty 0404111836	Chemical Engineer
Mr John Trewick 041177584	Information Consultant	Dr Abdul Qader 0407115715	Chemical Engineer
Mrs Dianne Jones 0419521391	Information Consultant	Dr Ajit Ghosh 0407936730	Chemical Engineer
Mr David Allan	Sustainable Outcomes	Dr Dennis Creasy	Chemical Engineer
Mr Murray Orchard	Mechanical Engineer	Mr. David Wood	Electrical Engineer

## Associates

Mr William Springham	Consultant Process Chemist	Peter Brett	Electrical Engineer
Mr Mike Parkinson	Chemical Engineer		
Dr Alan Farrington	Chemist/Fibre Technologist		

## Covey Clean Tech Malaysia

Kam (Charlie) Chan	Development Consultant	Koh Hoo Beng	Country Representative
Mr Norm Lasslett	Process & Control Systems Engineer		

[www.coveyconsulting.com.au](http://www.coveyconsulting.com.au)