Mr John Hall
Chief Executive
Queensland Competition Authority

RE: Aurizon Network DAAU relating to Electric Traction Issues

Dear Mr Hall,

I am writing to respond briefly to some incorrect statements made by the Competition Economists Group concerning my discussion paper "*Cost recovery options for electric infrastructure*" (25 Sep 2012) that was submitted by Aurizon Network. I appreciate that this is late in the process, however I request your indulgence in order to provide additional factual material to facilitate consideration of the conflicting viewpoints. I confine myself to paragraphs 29 – 49 of CEG's November 2012 report "*Recovery of QR Network Electric Investments*" that was submitted by Asciano.

At paragraph 30, CEG speculates about my reference to the full cost recovering level of AT5, and proposes two possible interpretations. Neither of these interpretations is correct. I simply meant that because AT5 is currently calculated as the ratio of electric traction costs to electric GTK, increasing diesel penetration will, at some point, make it impossible to recover the fixed costs of electric traction infrastructure: the cost-recovering price will become unaffordable.

Paragraph 33 claims that my 25 September 2012 proposal involves a cross-subsidy. That claim, repeated throughout CEG's discussion, is quite incorrect and misleading. It is well accepted in economics that there is no cross subsidy as long as the following three conditions are all satisfied:

1. No customer or group of customers pays more than their stand-alone cost;
2. No customers pay less than their incremental cost;
3. All customers receiving the same service pay the same price.

These conditions are all satisfied by my proposal. My proposal is that mines using rail infrastructure on which electric traction is available pay an annuitized lump sum electric traction availability charge. They receive a valuable benefit in the form of the option to switch to electric traction with minimal capital outlay, and my proposal is simply that they pay something for that option. Mines that use electric locomotives also pay AT5 (although this would be calculated in a different way under my proposal): they pay more than diesel-only mines, notwithstanding the electric traction availability charge. This is not a cross-subsidy.

In paragraphs 34-36, CEG mischaracterises my description of the problem. To put an end to the confusion, I should say that the quoted passage from my report implies that AT5 only recovers maintenance costs of the overhead system. That was not my intention. Clearly, AT5 also recovers capital costs associated with the overhead system.

In paragraph 37, CEG misconstrues my reference to "regulatory mispricing." The mispricing occurs because an average cost rule for AT5 creates a dependence on electric gtk that distorts the incentives of train operators in a way that is inconsistent with overall cost minimisation. The attachment explains why this occurs and shows that a different AT5 pricing rule would correct the problem. Importantly, the solution to regulatory mispricing that is proposed by CEG—involving back-loaded depreciation—fails to address the real issue, which is the average cost pricing rule.

Paragraph 39 and footnote 8 repeat the incorrect claim that I am proposing a subsidy from diesel train mines to electric train mines. In the footnote, CEG says, "*However,* [Sapere] *acknowledges that there is no basis for believing that the value of* [the option to use electric trains in the future] *would reflect the charges imposed.*"

In fact, I say the opposite. In my report, section 3.1 (third paragraph), I say,

> "*It is possible that the Blackwater mines might object that the amount of the annuity is out of proportion to the benefit that they achieve through electrical availability. However, if that has consistently been their view, one must wonder why they voted in favour of this investment in 2008, and then subsequently elected not to use the asset ...*"

I take the fact of the majority vote in favour of the Blackwater electrical system investment through the CRIMP process as prima facie evidence that these mines saw value in the investment, whether they elected to use electric locomotives or not in the first period.

CEG sets out its counter-proposal in paragraphs 40-41. CEG's proposal, as I understand it from this brief presentation, is problematic in the following ways:

1. It misses the point about the perverse incentives created by an average cost pricing rule for AT5. Temporary price reductions and back-loading depreciation do nothing to address that problem.
2. It substantially amplifies the stranding risk by pushing cost recovery far into the future.
3. It insists that mines on electrified lines pay nothing for the valuable option to switch to electric traction in the future with minimal capital outlay.

Paragraphs 42-43 canvass the possibility that the initial Blackwater electrical system investment was socially wasteful. I do not believe that is the case. References in my report to the cost recovery problem posed by this investment are to the perverse incentives created by an average cost AT5 pricing rule. For a variety of reasons, that investment has created an environment where these incentive problems pose a real danger of leading to sub-optimal outcomes. These include the potential stranding of a socially worthwhile investment, the inefficient overuse of diesel traction, and unnecessarily high costs to the Queensland economy to export a given quantity of coal.

Paragraphs 44-49 attempt to use the completely artificial numbers in my worked example to make several empirical points. My example was hypothetical for the purpose of illustration, and the numbers were not intended to be used in that way.

I hope that these factual points assist the Authority in its deliberations. If the Authority considers it appropriate, I would be happy for this letter to be put on the QCA's website or otherwise provided to interested parties.

Regards,

--Mike Smart

cc Mike Carter, EVP Aurizon Network

Attachment: Incentive problems caused by average cost rule for AT5

The purpose of this attachment is to demonstrate that the current average cost pricing rule for AT5 will, under conditions that are likely to be satisfied for the Blackwater system, create incentives for train operators to choose diesel over electric traction despite the fact that this choice maximises costs to the Queensland economy. I also show that a different pricing rule for AT5 would overcome this problem.

<u>Approach</u>

I present a simple game-theoretic analysis of the decision by two train operators to use diesel or electric locomotives. I show that the average cost pricing rule for AT5 will, in some situations, lead to a Prisoner's Dilemma wherein each train operator's dominant strategy is to select diesel, rather than electric traction. I then demonstrate that this outcome is suboptimal for the economy overall.

<u>Notation</u>

The identity of each operator is indicated by the subscripts, i and j. Each operator initially transports Gi gross tonne kilometres (gtk) of coal. An operator choosing diesel traction faces an above-rail operating cost of Di per gtk, which includes diesel fuel costs, locomotive capital and maintenance costs, provisioning costs, crew costs, etc. An operator choosing electric traction faces an above-rail operating cost of Ei per gtk, which includes the price of electrical energy (EC), locomotive capital and maintenance costs, any provisioning costs, crew costs, etc.

Both diesel and electric train operators face a below-rail access charge of B per gtk, comprising the non-electrical tariff components. In addition, the electric train operators face AT5 per gtk, which is given by the following formula under the current average cost pricing rule:

$$AT5 = F / (Gi\Delta i + Gj\Delta j)$$

Here, F is the annual fixed cost of the electric power system. Δi is equal to 0 when operator i chooses diesel traction, and 1 when electric traction is chosen.

Operator i's total costs are:

$$Ci = Gi\ Ui, \text{ where the unit costs are}$$

$$Ui = Di\ (1-\Delta i) + Ei\Delta i + B + \Delta i\ F/(Gi\Delta i + Gj\Delta j)$$

<u>The game, strategies and payoffs</u>

There are two players, i and j. Each player decides, simultaneously, whether to use diesel or electric traction. I assume, for the purpose of presentation, that operators either select 100% electric or 100% diesel.

Since the two train operators are in competition with each other and costs that are symmetric and unavoidable can be passed through to their customers, I argue that operator i will try to maximise its unit cost advantage: Ai ≡ Uj – Ui. This is the only factor that is relevant to its competitive success, hence its future profits.

Operator i's payoff

$$A_i = D_j(1-\Delta_j) + E_j\Delta_j - D_i(1-\Delta_i) - E_i\Delta_i + F(\Delta_j - \Delta_i)/(G_i\Delta_i + G_j\Delta_j)$$

If both operators choose diesel traction, then $\Delta_i = \Delta_j = 0$.

$$A_i = D_j - D_i, \text{ and } A_j = D_i - D_j$$

If both operators choose electric traction, then $\Delta_i = \Delta_j = 1$.

$$A_i = E_j - E_i, \text{ and } A_j = E_i - E_j$$

However, if operator i chooses electric and operator j chooses diesel, then $\Delta_i = 1$, $\Delta_j = 0$.

$$A_i = D_j - E_i - F/G_i, \text{ and } A_j = E_i + F/G_i - D_j$$

Finally, if operator j chooses electric and operator i chooses diesel, then $\Delta_i = 0$, $\Delta_j = 1$.

$$A_i = E_j + F/G_j - D_i, \text{ and } A_j = D_i - E_j - F/G_j$$

<u>Cost conditions</u>

Either electric traction is commercially feasible or it is not. If it is strongly feasible, then the highest cost electric operator has a lower unit cost than the lowest cost diesel operator:

$$(\mathrm{Max}(E_i,E_j) + F/(G_i + G_j)) < \mathrm{Min}(D_i,D_j) \qquad \text{(strong feasibility of electric traction)}$$

If electric traction is not even weakly feasible:

$$(\mathrm{Min}(E_i,E_j) + F/(G_i + G_j)) > \mathrm{Max}(D_i,D_j) \qquad \text{(electric traction is not weakly feasible)}$$

then clearly the fixed cost of electric traction infrastructure F should not be incurred.

Even with strong feasibility, there will be some level of electric utilisation, G^*, below which diesel traction will have lower unit costs:

$$G^* = F/(\mathrm{Min}(D_i,D_j) - \mathrm{Max}(E_i,E_j))$$

It is necessary to know F, D_i, and E_i in order to evaluate G^*. Without this information, it is not possible to say what $G^*/(G_i + G_j)$ might be.

<u>Prisoner's Dilemma</u>

Clearly, operator i's decision affects the payoffs received by operator j in all cases, and vice versa. This fact makes game theory useful for analysing these strategic choices.

To simplify the presentation, let us assume for the moment that $D_i = D_j$ and $E_i = E_j$. That assumption is not fundamental to the analysis. Under that assumption, the payoffs to each operator when they make the same choice are zero. When operator i chooses electric and j chooses diesel, then

$$A_i < 0 \text{ if } G_i < G^*$$

When operator j chooses electric and i chooses diesel, then

$$A_i > 0 \text{ if } G_j < G^*$$

Therefore, when $G_i < G^*$ and $G_j < G^*$, i's strategy of always choosing diesel dominates a strategy of choosing electric traction.[1] This remains the case when $D_i <> D_j$ or $E_i <> E_j$.

<u>Social cost</u>

The total cost to society of transporting ($G_i + G_j$) gtk of coal is:

$$TC \equiv C_i + C_j = G_i U_i + G_j U_j$$

When both operators choose electricity,

$$TC_{ee} = B (G_i + G_j) + G_iE_i + G_jE_j + F$$

When both operators choose diesel,

$$TC_{dd} = B (G_i + G_j) + G_iD_i + G_jD_j$$

When only operator i chooses electric,

$$TC_{ed} = B (G_i + G_j) + G_jD_j + G_iE_i + F$$

Noting that

$$TC_{dd} - TC_{ee} = G_i (D_i - E_i) + G_j (D_j - E_j) - F$$

it is evident that the "ee" strategy set will be lower cost than the "dd" strategy set as long as strong feasibility of electric traction applies. Also,

$$TC_{ed} - TC_{ee} = G_j (D_j - E_j)$$

implies that the "ee" strategy set will be lower cost than the "ed" strategy set as long as $D_j > E_j$. This will certainly be the case when electric traction is feasible (as evidenced in systems running at close to full utilisation of available electric paths, that is Goonyella).

Therefore, the current average cost pricing rule for AT5 will prevent social cost minimisation under the following conditions:

1. electric traction is a feasible investment choice, and
2. both operators' $G_i < G^*$.

Under these conditions, both operators' dominant strategy will be to always select diesel traction, and this will prevent attainment of the lowest-cost strategy set.

<u>Alternative AT5 pricing rule</u>

The incentive problem outlined above (each operator is incented to choose a course of action that maximises social cost) is caused by the average cost pricing rule for AT5. The problem with this rule

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[1] If j chooses diesel and i chooses electric, then $A_i < 0$, but if i chooses diesel, then $A_i = 0$. If j chooses electric and i chooses electric, then $A_i = 0$, but if i chooses diesel, then $A_i > 0$. Operator i is better off in both cases choosing diesel.

is that it creates an opportunity for one operator to do things that adversely affect the other operator's costs.

This problem can be overcome by modifying the AT5 pricing rule in the following way:

$$New\ AT5 = F / X,$$

where X is a constant that does not depend on either operator's individual gtk, but X may depend on the total gtk. For example, $X = \beta (Gi + Gj)$, with $0 < \beta < 1$.

Operator i's payoff (still = Uj – Ui) would become:

$$Ai = Dj(1-\Delta j) + Ej\Delta j - Di(1-\Delta i) - Ei\Delta i + F(\Delta j - \Delta i)/X$$

If both operators choose diesel or both choose electric, the payoffs would be as before. However, if operator i chooses electric and j chooses diesel, then:

$$Ai = Dj - Ei - F/X$$

$$Aj = Ei + F/X - Dj$$

Now consider

$$Ai\ ee - Ai\ de = Ej - Ei - (Ej - Di + F/X) = Di - Ei - F/X \qquad (1)$$

$$Ai\ ed - Ai\ dd = Di - Ei - F/X \qquad (2)$$

Equation (1) is the improvement in payoff to i by choosing electric when j chooses electric. Equation (2) is the improvement in i's payoff by choosing electric when j chooses diesel. The right hand sides of these two equations are the same. They will be positive as long as $X > G^*$.

Provided this condition on X is met and electric traction is strongly feasible, this new AT5 pricing rule will make the cost-minimising strategy the dominant strategy for each operator. This pricing rule would overcome the incentive problem created by the average cost rule.

How likely is it that a suitable value of X exists? Note that strong feasibility implies that $(Gi + Gj) > G^*$. There must, therefore, exist some X within the range: $G^* < X < (Gi + Gj)$ that will create the right incentives.

My 25 Sep 2012 report proposed that AT5 be set by selecting a value for X that meets this requirement.