Inland Rail Information Paper

The importance of time and distance for Inland Rail

August 2020

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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Introduction

Adopting a route that is as direct as possible has been a critical consideration in route selection for Inland Rail. The length of the route, and hence the overall transit time between Melbourne and Brisbane, drive key economic benefits that underpin the 2015 *Inland Rail Programme Business Case* (the Business Case).

1 Inland Rail Service Offering

The Inland Rail Service Offering – developed in close consultation with key stakeholders in the transport and logistics industries – identifies four key factors driving rail's competitive position against road that underpin the market share gains that Inland Rail will deliver – transit time, reliability, price and availability.

The four factors are closely inter-related, and transit time is particularly critical – as well as being an important factor in its own right, it strongly influences the achievement of the other three factors, as explained in this paper.

At the time of the development of the Service Offering, key stakeholders emphasised the criticality of a core transit time of under 24 hours plus the ability to offer faster and slower services to meet customer needs. More recently, a wide range of industry stakeholders have again emphasised the importance of achieving a Melbourne-Brisbane transit time of under 24 hours in their submissions to the Senate Inquiry into Inland Rail.

The CEO of the Australian Logistics Council, Kirk Cunningham OAM - representing a diversity of industry participants from logistics providers to end-users such as supermarket chains – provides a representative view:

> *A transit time of less than 24 hours for freight moving via rail between Melbourne and Brisbane will be reflected in cheaper consumer prices, as rail transport costs become more competitive with road…..*
>
> *Woolworths Group, which has one of Australia's largest supply chains, noted the project's potential to allow the company to continue to move more of its freight via improving sustainability, congestion and safety outcomes…*
>
> *Woolworths also highlighted Inland Rail's potential to further support and build up regional suppliers. An efficient supply chain utilising Inland Rail, providing transit times of less than 24 hours end-to-end, will allow providers of fresh produce to increasingly supply product to city consumers, thus further building their customer base." Kirk Cunningham OAM, CEO of ALC*

2 Calculating transit time

Train performance (and hence transit time) is calculated using a simulation program that applies physics principles to determine train speed. One of ARTC's technical advisors, ARUP, used the program RailSys, which is one of the two programs most commonly used in the industry. Key parameters used in the modelling include:

- Train configuration, including weight, length, number of wagon axles and locomotive type
- Locomotive tractive effort and braking curves
- Tractive effort variance adjustment factor (to account for natural variation in adhesion)
- Rolling resistance formula and coefficients
- Maximum braking rate
- Run time adjustment factor (to account for natural variation in train driving style)

The rolling resistance formula includes a parameter for wind resistance. However, this relates to the natural resistance of air, rather than to ambient wind conditions. As ambient wind conditions are highly variable, and can either benefit or hinder train performance, it is not meaningful to include them in the modelling.

3 Time and distance impact on operating costs

Transit time and distance drive operating costs, which in turn determines the price that Inland Rail can offer against road. Reduced transit time drives lower labour costs (as faster services lower the hourly crew requirements) and improves rolling stock utilisation (meaning a smaller rolling stock fleet can service the total demand), significantly reducing the unit cost per tonne of freight transported.

Reduced distance also directly reduces fuel consumption and rolling stock maintenance, which together constitute around 30% of rail operating costs.

Together with improved operating parameters (train length and double stacking), the twin factors of time and distance drive the cost saving per tonne for moving freight from road to Inland Rail. The Business Case estimated that Inland Rail will offer a one-third saving in price to the market compared with road. The Business Case estimated that freight operating cost savings represented nearly 50% of the total economic benefits provided by Inland Rail.

4 Lower transit time generates 'value of time' savings for freight customers

This relates to the value placed by freight customers on having time sensitive freight delivered earlier than delivery times offered by alternative options. Market consultation during the development of the Inland Rail Service Offering during both 2010 and 2014 highlighted the need to offer a range of transit times to meet market needs, with a Melbourne to Brisbane transit time of under 24 hours necessary to compete with road in the time sensitive express market for intercapital city freight.

Table 1 following is drawn from Table 5.2 in the Business Case and illustrates the significant gains in competitiveness with road that will be afforded by Inland Rail. The Inland Rail transit times quoted in Table 1 are for a 2.7hp/tonne Inland Rail Reference Train service.

Table 1 Comparison of Melbourne to Brisbane rail and road service characteristics (average 2014-15 to 2049-50)

MELBORNE - BRISBANE	2014/15	2029/30	2039/40	2049/50
Transit time (line haul terminal to terminal - hours)				
Inland Rail		**21.9**	**22.66**	**24.1**
Coastal rail	31.3	33.8	35.5	37.3
Road	23.8	25.8	27.2	28.7
Transit time (door to door - hours)				
Inland Rail		**31.6**	**32.3**	**33.8**
Coastal rail	40.3	42.8	44.5	46.3
Road	25.8	27.8	29.2	30.7

It should be noted that the Inland Rail line haul and door-to-door transit times increase over time as more trains enter into the system. However, as can be seen from Table 1, these increased transit times are less than the projected transit time increases for each of the coastal rail line and road, in fact enhancing the competitiveness of Inland Rail over time.

The Business Case estimated the 'value of time' savings represent a further 25% of the total economic benefits provided by Inland Rail.

5 Lower transit time is critical for improved reliability

Shorter transit times are critical for improved reliability, as a reduced transit provides a buffer time between train arrival and the advertised availability (pick up time) of freight at the terminal. This is essential to the achievement of the 98% reliability target in the Inland Rail Service Offering making rail highly competitive with road for freight transport.

The Business Case assumed a reliability 'buffer' of 3.7 hours between a train arriving at a terminal and the advertised pick-up time for the unloaded freight, allowing any rail operational delays to be recovered and freight companies to still achieve the 98% reliability target.

6 Lower transit time improves availability

Availability refers to the ability of rail to offer services with departure and arrival times that meet customer requirements to dispatch and receive freight. Availability is directly linked to the terminal to terminal transit time, as reducing the transit time increases the range of the feasible departure and arrival times to meet customer needs.

A transit time of 24 hours or less provides for a very wide range of feasible arrival and departure times in the Melbourne to Brisbane market.

A terminal to terminal transit time of less than 24 hours allows the inclusion of the 3.7 hour 'buffer' while meeting customer preferences for despatch and receiving of freight.

7 Shorter distance encourages a greater volume of freight to rail

The *2010 Inland Rail Alignment Study* (2010 IRAS) examined the impact of distance on preliminary forecast freight volumes by comparing forecast freight volumes on an Inland Rail route of 1,730km (achieved by a new greenfield line between Narromine to Narrabri) with forecast volumes on an 1,880km Inland Rail route (via Dubbo and Werris Creek).

As part of 2010 IRAS, ACIL Tasman developed a logit model to calculate estimated future rail tonnages based on a range of factors. The model was developed from a questionnaire and interviews with key freight companies and customers to aid understanding of how modal choices are made in respect of transporting freight.

The below Table 2 is taken from the ACIL Tasman model showing per annum intercapital freight volumes for the two route scenarios expressed in million tonnes (MT) per annum. The Table clearly shows that the shorter the route the more freight will be attracted to Inland Rail.

Table 2 Forecast Intercapital Freight Volumes on Different Length Inland Rail Routes

Year	1880km	1730km	Difference
2030	4.1MT	5.1MT	1.0MT
2040	5.9MT	7.2MT	1.3MT
2050	8.4MT	10.3MT	1.9MT
2060	12.1MT	14.7MT	2.6MT
2070	17.4MT	21.0MT	3.6MT
2080	24.8MT	29.8MT	5.0MT

Source: IRAS 2010, Appendix E, page 64

8 Distance is a key driver of capital costs – upgrading an existing line is not always the best option

Capital cost is directly influenced by the length of the route. A shorter and more direct greenfield route will generally be less expensive than upgrading a longer brownfield route to meet the full Inland Rail performance specifications.

The decisions around where to construct greenfield versus redevelop existing lines were based on a wide range of factors that included considerations of length, transit time, constructability, construction cost, environmental impact, geotechnical considerations as well as impacts on privately and publicly owned properties (including the number of properties impacted).

ARTC has direct experience in the upgrading of existing low volume railway lines to meet Inland Rail mainline standards in the Parkes to Narromine project, which is currently well advanced into construction. ARTC's practical experience is that very little of an existing low volume line is salvageable. Rail, sleepers, ballast and load-supporting structures (such as underbridges) require complete replacement to meet the performance standards required for Inland Rail, and in fact even much of the underlying formation needs to be excavated and replaced to meet main line speed and axle load requirements and the much higher annual tonnages that will traverse Inland Rail.

As a result, there are few if any savings to be made in seeking to upgrade an existing low-volume line relative to the cost of greenfield construction, and in fact the upgrade option can be more expensive when the costs of removal and disposal of the pre-existing infrastructure are taken into account.

Furthermore, routes that seek to re-use existing lines are often longer (and sometimes significantly so) than the direct greenfield routes and can also require significant greenfield connecting lines to be built.

Because of the significance of these factors, route selection has a major bearing on the overall performance of the Business Case and is the principal reason why Inland Rail includes significant greenfield sections – the greenfield sections underpin the improved economic performance driven by the reduced distances and transit time.

The 2010 IRAS examined the greenfield Narromine to Narrabri section in comparison with a circuitous route using existing corridors via Werris Creek. The IRAS found that a direct greenfield Narromine to Narrabri route would be more than 150km shorter and five hours 30 minutes quicker because of the slower average train speed on the longer route, with significantly improved economic performance flowing principally from the decreased above-rail operating costs of the shorter and faster route. [The IRAS also found that the shorter route would result in higher demand for intercapital freight than the longer route.]

The improvements in speed, reductions in transit time and resulting reductions in operating costs flowing from the greenfield sections of Inland Rail are central to achieving the economic outcomes in the Business Case.

Inland Rail Business Case Briefing Paper No. 1

Strategic context and rationale

August 2020

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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Introduction

This paper contains information drawn from Inland Rail's 2015 *Programme Business Case* (the Business Case). The Business Case, prepared for ARTC by PricewaterhouseCoopers, was published in 2015. Infrastructure Australia subsequently included Inland Rail as a Priority Project on the *Infrastructure Priority List*. Where available and applicable, updated information is included based on work undertaken during Inland Rail's continuing development.

The paper includes information under five headings:

1. Australia's freight challenge
2. Strategic options assessment
3. Inland Rail's service offering
4. The importance of transit time
5. Port connectivity

1 Australia's freight challenge

The Business Case noted that, at the time of its preparation, Australia's interstate freight task was projected to increase 70% to 140 billion tonne kilometres by 2030. The Melbourne to Brisbane corridor already accounts for 17% of these interstate movements. [1]

As the east coast freight task grows and population growth in our capital cities continues, there will be increasing pressure on freight capacity between capital cities and from the regions as competition for scarce road space and rail network capacity increases.

The ability of existing freight transport modes to cater for growth and offer efficient, cost effective freight transport services in the north–south corridor between Melbourne and Brisbane is projected to become increasingly constrained, characterised by problems relating to capacity, productivity, society and environment, regions and growth, and resilience.

The key problems can be summarised as:

1. *Capacity:* Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand.
2. *Productivity:* Current north–south freight infrastructure is constrained, and this will increasingly impact negatively on freight productivity.
3. *Social and Environmental:* The continued reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs.
4. *Regional Growth:* Existing north–south freight infrastructure is impacting accessibility to supply chain networks for regional producers and industries and inhibiting the productivity and economic growth potential of regional communities.

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[1] *BITRE Research Report 120: Interstate Freight in Australia, 2010. Subsequently, the National Freight and Supply Chain Strategy adopted in August 2019 forecast a 35% increase in Australia's freight demand by 2040 (in terms of volume). Interaction with the National Freight and Supply Chain Strategy has previously been addressed in ARTC's Submission to the Senate Inquiry (Appendix A Part 4). It should be noted that the Inland Rail Business Case pre-dates the Strategy, and that accordingly the Strategy includes later data sources that were not available at the time of the Business Case. Nevertheless, the Business Case is materially consistent with the Strategy.*

5. *Resilience:* Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and suboptimal reliability.

The potential consequences of inaction are significant. Without a decision to make a step change in rail performance, the growth in freight demand will likely see increasing pressure on road networks, increased freight costs and a loss of economic opportunity. Road will increasingly become the dominant mode with rail becoming less market relevant.

A future without Inland Rail would see:

- More trucks and a greater number of larger trucks (e.g. B-triples) mixing with passenger vehicles on major highways.
- Loss of community amenity, both in cities and the regions, from more and larger trucks sharing road networks.
- An increase in road maintenance requirements as a result of an increase in the number and size of heavy vehicles.
- Greater environmental impacts as the freight task grows, with more congestion, carbon emissions and noise.
- Lack of incentives for companies to invest in rail supply chains potentially locking them into road-based logistics options.

The continued reliance on road for freight transport will result in increasing safety, environmental and social impacts with associated costs to the community. Key roads used to transport the freight task in the north-south corridor are characterised by higher than average severity of incidents, including on the Newell and Warrego highways. This can be attributed to high speeds and a higher percentage of heavy vehicles along the highways. Road accidents causing death or serious injury are nearly three times more likely relative to rail.

The lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and sub-optimal reliability. There are limited options for rail freight to bypass incidents on the existing Melbourne to Brisbane coastal rail corridor, which means that incidents have the potential to impact freight along the entire length of the route.

During incidents such as floods, freight operators may experience considerable delays, or must allocate freight movements to road (which may also be constrained depending on the incident). Additionally, the shared nature of the coastal rail infrastructure between passenger and freight significantly impacts on freight reliability.

2 Strategic options assessment

In developing the Business Case a strategic options assessment was undertaken to consider a range of reform and investment options consistent with Infrastructure Australia's guidelines. A range of options was identified, including:

2.1 Reform options

These relate to regulatory reform, governance reform or better use of existing infrastructure, e.g. economic charging or demand management. While reform options may be lower in cost, they are likely to be challenging to implement and are expected to be ineffective in improving freight supply chain performance or productivity outcomes unless coupled with enhanced infrastructure capacity.

2.2 Capital investment options

Capital investments are defined by Infrastructure Australia as expansion of existing infrastructure or new infrastructure.

Options considered included:

- *Progressive road upgrades:* May be medium term solutions for freight; however, upgrades are unlikely to meet longer term needs for freight capacity, likely to be high cost, and road capacity would continue to be shared with general traffic.
- *Upgraded coastal railway:* Able to deliver improvements in capacity, performance and reliability, however structural limitations of the existing rail alignment and shared track with passenger rail in some locations will constrain future long-term capacity.
- *Inland railway bypassing Sydney:* The ability to provide dedicated freight capacity, avoid urban areas yet foster growth in regional areas and optimise environmental outcomes supports an inland railway overall.

2.3 Preferred option

- *An inland railway from Melbourne to Brisbane bypassing Sydney* is the preferred option, to service anticipated future freight demand, provide an increase in productivity, act as an enabler for regional development, and improve road safety whilst reducing congestion and environmental impacts. This represents a decisive step change in the capacity, capability and interoperability of the national freight system, supporting the backbone national freight network.

  Inland Rail will address a number of deficiencies in the existing rail network. These include the fact that all standard gauge rail freight from Brisbane must currently travel through the Sydney metropolitan area, conflicting with commuter trains and specifically being affected by curfews on freight trains at peak periods. By being dual-gauged from the terminal/s in Brisbane to the QLD/NSW border, Inland Rail will shorten the rail route from Brisbane to Adelaide and Perth by 500 kilometres, it will provide connectivity with regional tracks in NSW, and connectivity in Queensland to regional lines where the rail network is narrow gauge.

The Business Case defined the following program objectives for Inland Rail:

I. Provide a backbone rail link between Melbourne and Brisbane that is interoperable with train operations between Perth and Adelaide in order to serve future rail freight demand and stimulate growth for intercapital and regional/bulk rail freight.

II. Provide an increase in productivity that will benefit consumers through lower freight transport costs.

III. Provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor to deliver a freight rail service on the east coast that is competitive with road.

IV. Improve road safety, ease congestion and reduce environmental impacts by moving freight from road to rail.

V. Bypass bottlenecks on congested metropolitan rail networks on the east coast and free up train paths for other services on the coastal route.

VI. Act as an enabler for regional economic development along the Inland Rail corridor.

3 Inland Rail service offering

Extensive consultation with key market participants and other industry stakeholders was undertaken to develop the service offering and scope of Inland Rail to ensure it meets market needs. This ensured that Inland Rail's scope has a customer focus as opposed simply to having an infrastructure or engineering focus.

Four key service attributes have been identified as underpinning the market requirements for improved rail freight services in the corridor, namely reliability, transit time, price and availability. Table 1 summarises the relative advantages offered by Inland Rail for each service attribute in comparison with the existing coastal route.

Table 1 Comparison of Melbourne to Brisbane coastal route and Inland Rail

SERVICE OFFERING	COASTAL RAIL 2014-15	INLAND RAIL	IMPROVMENTS
Transit time (linehaul)	32-34 hours	Up to 24 hours	10 hours
Reliability	83%	98%	15%
Availability	61%	95%	34%
Relative price (to road)	85%	57-65%	20-28%

4 The importance of transit time and distance

As explained in some further detail in an accompanying Inland Rail Information Paper (*The Importance of Time and Distance for Inland Rail*), adopting a route that is as direct as possible has been a critical consideration in route selection. The length of the route and overall transit time between Melbourne and Brisbane drive key economic benefits that underpin the Business Case.

Transit time and distance drive rail operating costs (crew, rolling stock, fuel), which in turn determines not only the price that Inland Rail can offer against road transport but the overall competitiveness of rail compared with road for freight transport, without which there will not be the anticipated shift in freight from road to rail.

Lower transit time generates 'value of time' savings for freight customers: this relates to the value placed by freight customers on having time sensitive freight delivered earlier than delivery times offered by alternative options. Market consultation during both 2010 and 2014 that ultimately resulted in the Inland Rail Service Offering highlighted the need to offer a range of transit times to meet market needs, with a Melbourne-Brisbane transit time of less than 24 hours necessary to compete with road in the time sensitive express market for intercapital city freight.

Lower transit time is critical for improved reliability (allowing a buffer time between train arrival and the advertised pick-up time for freight by customers from the receiving terminal) and also improves freight availability (the range of feasible arrival and departure times for freight that meet market requirements).

5 Port connectivity

Inland Rail connects at both Acacia Ridge (Brisbane) and Tottenham (Melbourne) with existing rail links to the Port of Brisbane and to the Port of Melbourne respectively. Rail connectivity to both ports will continue to be provided from the commissioning of Inland Rail. It may be noted that that there have been significant upgrades to the link between the Port of Melbourne and Tottenham under ARTC's management.

It should be noted, however, that the major freight traffic on Inland Rail will be domestic intermodal freight (Melbourne-Brisbane, Brisbane-Adelaide / Perth), which is not destined for the ports. The Business Case forecast that by 2050, these interstate freight flows will make up 66% of the total freight carried on Inland Rail on a net tonne kilometres basis.

The Business Case forecast that only 34% of the freight task on Inland Rail by 2049-50 will be export traffic needing access to the ports (largely to the Port of Brisbane), comprising coal (accounting for 25%) and bulk goods (such as grain, cotton, chick peas etc) which either generally do not require double-stacking of containers or cannot be double-stacked (as in the case of coal). This export traffic will be able to utilise the existing rail connections for direct train access from regional areas to the ports and will not need to be transhipped at landside intermodal terminals.

In addition to Brisbane and Melbourne, by connecting into the existing interstate and regional rail networks, Inland Rail will also provide connections to multiple ports, including Newcastle, Port Botany, Port Kembla and Geelong.

Specific issues relating to access to the Port of Brisbane are discussed in an accompanying Information Paper (*Inland Rail Connection to the Port of Brisbane*).

INLAND RAIL

Inland Rail Business Case Briefing Paper No. 2

Business Case assumptions and key findings

August 2020

ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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This paper contains information drawn from Inland Rail's 2015 *Programme Business Case* (the Business Case). The Business Case, prepared for ARTC by PricewaterhouseCoopers, was published in 2015. Infrastructure Australia subsequently included Inland Rail as a Priority Project on the *Infrastructure Priority List*. The section in this short paper on the distinction between economic and financial analysis is taken from the report of the 2010 *Inland Rail Alignment Study* (2010 IRAS).

1 Key findings of the Business Case

Following are five key findings from the Business Case:

1. Demand: Potential for significant rail share uplift: Rail share of the Melbourne-Brisbane intercapital market increasing from 26% currently to 62% share by 2049-50 with significant volumes of grain and induced South-East Queensland coal.

2. Financial: Financial viability on an operations basis: access revenues sufficient to cover ongoing operations and maintenance costs and totalling $2.0 - $2.5bn Net Present Value (NPV) over 50 years of operation and 5.6% pre-tax, nominal discount rate – based on public sector comparator.

3. Economic appraisal: Positive net economic benefits over the long term: positive net economic benefits with Benefit Cost Ratio (BCR) of 2.62 (4% real discount rate). In other words, the benefits to society over the life of Inland Rail will be more than two-and-a-half times its costs.

The Business Case analysis found that Inland Rail will be resilient in terms of its economic value under a range of scenarios. These scenarios represent a full range of risks to the project.

The effects of changes in a variety of parameters were assessed: a package of upside scenarios including road pricing, a 10% reduction in capital costs and a high coal price brought the BCR to 4.06. Conversely, a package of downside scenarios including B-triple access on the Hume, Pacific or Newell Highway corridors, a 30% increase in capital costs and a low coal price (implying reduced coal haulage) resulted in a BCR of 1.37; in other words in this 'downside' situation the benefits of Inland Rail would still be 37% higher than its costs.

4. Economic impact: Driver of jobs and economic activity: Expected to generate $16bn in net Gross Domestic Product (GDP) over construction and first 50 years of operation, creating 16,000 jobs at the peak of construction and providing an additional average of 700 direct jobs per annum once operational.

5. Conclusion: The Business Case supports a firm, early commitment to proceed and deliver the project in its entirety so as to create an environment where the private sector can invest with sufficient certainty that the anticipated service outcomes will be realised in the committed timeframes. The finding that access revenues will be sufficient to cover ongoing operations and maintenance costs means that Inland Rail will be cash positive from the start of operations.

2 Inland Rail's demand forecasts

Detailed analysis of the demand for Inland Rail was a key to developing the Business Case. The work analysed separate markets of intercapital demand, regional demand, agricultural demand and coal demand. Intercapital demand is made up of manufactured and retail goods largely transported in containers.

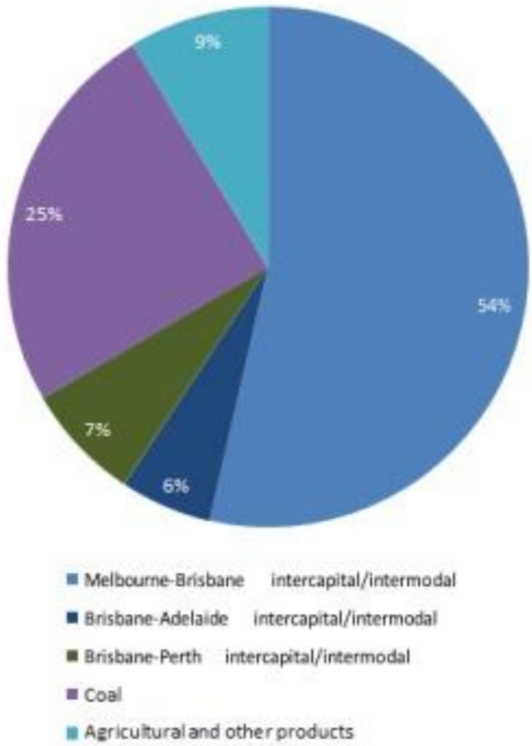
The resulting demand projections were used to:

- estimate the potential revenue of Inland Rail - access charges paid by train operators;
- assess the economic benefits arising from mode shift from road and from the coastal route to Inland Rail;
- determine the appropriate capacity of the railway; and

- determine appropriate service frequency and the impact of this service pattern on capacity utilisation and railway and train operating costs.

Figure 1 shows in percentage terms the combined Inland Rail northbound and southbound volumes by freight type in 2049-50 (net tonne kilometres)

Figure 1 Freight type volumes forecast for Inland Rail in 2049/50



Detailed analysis of the components of demand resulted in the forecasts of combined north and southbound volumes shown in Table1 and Table 2 following. Demand is shown in Table 1 on a net tonnage basis and in Table 2 on a net tonne-kilometres basis. (The net tonnage carried on a train is the payload only; the gross tonnage of a train includes the weight of the wagons.)

Table 1 Future freight demand (net tonnes)

		2024-25	2029-30	2039-40	2049-50
NET TONNES (000)					
Intercapital/intermodal	Melbourne to Brisbane	3195	4008	5674	7906
	Brisbane to Adelaide	560	690	997	1412
	Brisbane to Perth	878	1034	1398	1815
Regional	Coal (SEQ-Port of Brisbane)	12 900	19 500	19 500	19 500
	Agricultural products	6750	7129	7954	8873
Total		**24 283**	**32 361**	**35 523**	**39 507**

Table 2 Future freight demand (net tonne-kilometres)

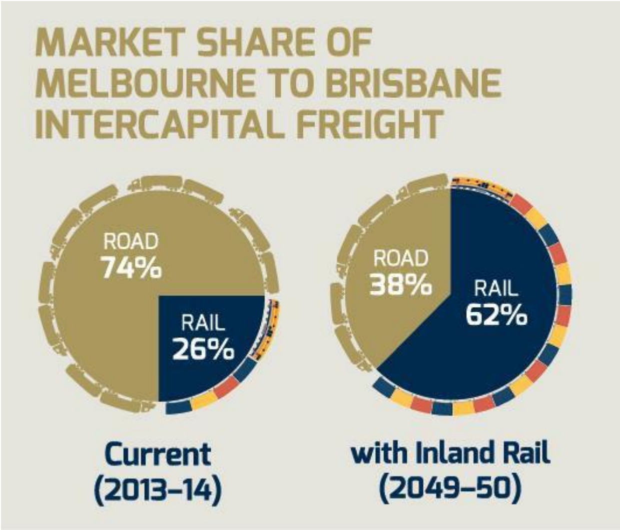
		2024-25	2029-30	2039-40	2049-50
NET TONNE KILOMETRES (MILLIONS)					
Intercapital/intermodal	Melbourne to Brisbane	5527	6934	9817	13 677
	Brisbane to Adelaide	573	707	1021	1447
	Brisbane to Perth	900	1059	1432	1860
Regional	Coal (SEQ-Port of Brisbane)	3873	6292	6292	6292
	Agricultural products	1687	1782	1988	2218
Total		**12 660**	**16 774**	**20 550**	**25 494**

The demand assessment found there would be strong market appetite to leverage the enhanced capabilities of Inland Rail with a significant uplift in rail market share.

Rail's share of the Melbourne to Brisbane market is projected to increase by 36 percentage points to a total of 7.9 million tonnes in 2049–50 [see Table 1], which represents an additional 3.1 million tonnes of freight on rail between Melbourne and Brisbane compared to a future without Inland Rail (which would see total volume in 2049-50 of only 4.8 million tonnes).

An additional two million tonnes of agricultural freight would be attracted from road to rail, particularly grain and cotton from New England, and grain from the Darling Downs.

Significant volumes of existing grain movements (approximately 5.8 million tonnes in 2049–50) to east coast ports would use Inland Rail for part of their journey.



The accompanying graphic shows the projected increase in rail's market share of Melbourne – Brisbane intercapital freight achieved by Inland Rail by 2049-50.

3 Capital cost summary

The Business Case includes detailed estimates of the capital and operating costs of Inland Rail. Table 3 summarises the estimated Inland Rail capital costs (P50 and P90 estimates).

It should be noted that the estimates were not based on any reference design (or subsequent detailed design) that give greater certainty as to construction costs nor could the Business Case foresee changed market conditions that affect forecast costs.

Table 3 2015 Business Case Cost Estimates for Inland Rail

ITEM	P50 COST ESTIMATE ($MILLION)	P90 COST ESTIMATE ($ MILLION)
Base costs (Real 2015)	6926	6926
Contingency (P50-26%, P90-36%)	1811	2490
Escalation component	1152	1241
Total out turn cost	9889	10 657

The base cost estimate includes an allocation for property acquisition.

4 Operating costs

These were estimated both for 'below rail' activities (i.e. costs which are the responsibility of the track owner, such as ARTC) and for 'above rail' (i.e. costs to be incurred by train operating companies). Below rail costs are a component of Inland Rail's financial analysis; knowledge of above rail costs is essential in assessing the impact of use of Inland Rail for customers.

Below rail operating and maintenance costs are shown in Table 4 below expressed as dollars per kilometre for both 10 million gross tonnes and 100 million gross tonnes.

Table 4 Below rail operating and maintenance costs (dollars per kilometre)

ITEM	At 10 MGT ($'000 PER KM)	At 100 MGT ($'000 PER KM)
Operations (Real)	5.70	9.58
Reactive Maintenance (Real)	8.00	31.95
Major Periodic Maintenance (Real)	11.84	81.41

5 The distinction between economic and financial analysis

Investment evaluations conducted from the wider economy or community's perspective are termed economic evaluations whereas those evaluations conducted from the producer's perspective only (e.g. the track operator) are known as financial evaluations. This is an important distinction as the outputs have varying purposes.

5.1 Financial appraisal

Financial appraisals assess the financial viability of a project from the perspective of owners/operators (e.g. in this case, the track owner and operator of the inland railway). Financial appraisals are concerned only with the financial returns delivered to operator stakeholders and do not take into account the costs or benefits derived by other parties and the wider community. Financial costs and revenues include capital, operating and maintenance costs; and operation. In the case of Inland Rail, these will include track access charges for the track operator (assuming separate track and train operations).

The aim of the financial appraisal in the case of Inland Rail is to enable assessment of whether it is viable from the perspective of a single commercial entity, based on financial revenues and costs. The conclusion of the Business Case is that Inland Rail is viable. Excluding capital charges, Inland Rail will be cash flow positive from commencement of operations with access revenues sufficient to cover ongoing operations and maintenance costs plus a margin.

5.2 Economic appraisal

The Business Case included two complementary forms of economic appraisal:

a) a conventional economic Cost Benefit Analysis (that was used to assess the direct costs and benefits of Inland Rail, as summarised in the Benefit Cost Ratio); and
b) an assessment of the broader economic impacts flowing from the construction and ongoing operation of Inland Rail, in terms of the impacts on Gross Domestic Product and employment.

Cost Benefit Analysis

The Cost Benefit Analysis (CBA) assesses the total costs and benefits of a project to the community. As such, the CBA encompass the costs and benefits accrued and incurred by many different stakeholders, including the project proponents, users, government and the community in general. A CBA takes into account costs and benefits that are not necessarily derived directly from market-based transactions including, in the case of Inland Rail: value of freight travel time, reliability, accidents and congestion costs.

The direct benefits of Inland Rail captured and measured in the CBA include:

- Improved productivity and economic efficiency as a result of operating cost savings, shorter transit times, improved reliability, improved availability, avoided improved redundancy and resilience to incidents on the coastal route.
- Safety benefits for the community as a result of removing heavy vehicles from the road network.
- Sustainability benefits for the community from removing heavy vehicles off the road network and reducing the distance travelled for rail freight resulting in reduced road traffic congestion, fewer emissions of carbon/pollution and less noise.
- Improved customer outcomes for rail passengers in Sydney and Brisbane because unused freight paths on the coastal route are returned to passenger services, and the increased frequency of services reduces average wait time.
- Reduced lifecycle costs for infrastructure owners/operators on the rail coastal route and road network as a result of lower freight volumes which reduce maintenance costs and enable investments in capacity to be avoided or deferred.

Economic Impact Assessment

In addition to the CBA, the Business Case included a broader economic impact assessment of the impacts of Inland Rail on Gross Domestic Product and employment.

These broader economic impacts were estimated by consultants PricewaterhouseCoopers (PwC) using a methodology called Computable General Equilibrium (CGE) modelling, which is an economic impact analysis tool for simulating the economy wide effects of projects or policies. The economic benefits were simulated using PwC's version of the Monash Multi Regional Forecasting Model (MMRF) model, originally developed at Monash University and widely used by the Australian Government (including the Productivity Commission and the Australian Treasury) to quantify impacts of policy changes and proposed projects on the Australian economy.

The key measures reported in the CGE economic impact assessment are:

- value of production – net value of goods and services in the national, state and regional economies, generally referred to as Gross Domestic, State and Regional Product (GDP, GSP, GRP); and
- employment – the number of additional full-time equivalent jobs in the economy.

CGE analysis is a useful complementary analysis to CBA because it explores the possible wider economy implications by considering how the direct impacts of Inland Rail will provide flow-on impacts to sectors and regions.

6 Economic results

Cost Benefit Analysis

The results of the Cost Benefit Analysis of Inland Rail are given in Table 5 below. It should be noted that the figures below are based on real 2014-15 dollars at 4% discount, and hence do not equate to the P50 and P90 estimate figures provided in Table 3 above.

Table 5 Cost Benefit Analysis summary

Economic appraisal results (incremental to base case, discounted, real 2014-15 dollars)

COST AND BENEFITS	PV@ 4% DR
COST	
Capital costs (excluding escalation)	7650
Operating costs	133
Maintenance costs	793
Total costs	**8575**
BENEFITS	
Freight user benefits	10 525
Induced freight benefits	1090
Improved outcomes for rail passengers	32
Improved safety for the community	1828
Reduced infrastructure lifecycle cost	1106
Residual value of assets (future stream)	7921
Total benefits	**22 503**

RESULTS	PV@ 4% DR
RESULTS	
Net present value of costs and benefits	**13 928**
Benefit cost ratio	**2.62**

CGE Economic Impact Assessment

The CGE analysis estimates that the Inland Rail Program will have a net positive impact of $16 billion[1] on GDP over the 10-year construction and 50-year operating appraisal period and generate an additional 16,000 direct and indirect jobs at the peak of construction (early 2020s). During construction of Inland Rail, direct capital expenditure has a stimulatory impact on the economy as the construction works stimulates the construction sector in each region of Inland Rail. The expansion in the construction sector supports additional flow on demand in the economy through the construction industry supply chain and additional spending on consumer orientated products by the construction workforce.

In the operations phase, Inland Rail is forecast to stimulate further economic activity as the direct benefits of Inland Rail begin to accrue and drive cost savings and user efficiencies, and these directly and indirectly benefit freight operators, consumers and industry. The economic modelling estimates a positive impact on employment of an average of 700 full-time equivalent jobs each year for 50 years from commencement of full operations. Further details of the regional and sector-based economic impacts estimated in the CGE analysis were included in Appendix A to ARTC's submission to the Senate Inquiry (November 2019)

[1] Present value at 4% discount rate

Inland Rail Business Case Briefing Paper No. 3

Technical and operational parameters

August 2020

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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Appendices

Introduction

This paper contains information drawn from Inland Rail's 2015 *Programme Business Case* (the Business Case). The Business Case, prepared for ARTC by PricewaterhouseCoopers, was published in 2015. Infrastructure Australia subsequently included Inland Rail as a Priority Project on the *Infrastructure Priority List*. Additional information is drawn from Inland Rail's service offering, and from answers provided to Questions on Notice arising from the Senate Committee Inquiry into Inland Rail. Some of these answers provide updated information based on work undertaken during Inland Rail's continuing development.

The paper includes information under six headings:

1. Key technical specifications
2. Minimum design standards
3. Future proofing
4. Reference train
5. Operational specification
6. Additional technical and operational information

1 Key technical specifications

Information on Inland Rail's technical and operational specifications is given in Appendices A and B to the 2015 Inland Rail *Programme Business Case* (the Business Case). These specifications underpin the four key characteristics of the Inland Rail Service Offering: reliability, price, transit time and availability.

Train Length: 1,800m with future proofing for ultimate 3,600m train length

Axle Load / Maximum Speed: 21 tonnes @ 115km/h, 25 tonnes @ 80km/h, with future proofing for 30 tonnes @ 80km/h

Double Stacking: 7.1m clearances for double stack operation

Interoperability: Full interoperability with the interstate mainline standard gauge network. Dual-gauging in Queensland to provide for connectivity to the Queensland narrow gauge regional network. Connections to the NSW Country Regional Network to provide for standard gauge connections to the ports of Melbourne, Port Kembla, Sydney, Newcastle, Brisbane, Adelaide and Perth.

2 Minimum design standards

General alignment standards:

Design speed	115km/h
Maximum grade	1:100 target, 1:80 maximum (compensated)
	1:200 maximum at arrival or departure points at loops
Curve radius	1,200m target, 800m minimum
Cant / cant deficiency[1]	Set for intermodal reference train

[1] **Cant / Cant deficiency:** Trains operating in curves experience a lateral force (centrifugal force) to the outside of the curve that is a function of speed. Cant refers to the degree of superelevation of the track (i.e. raising the outside rail in curves, similar to banking a road) to partially compensate for the centrifugal (sidewise) force when travelling through the curve, allowing trains to travel safely at higher speeds

Medium speed alignment standards (mountainous terrain):

Design speed	80km/h minimum
Maximum grade	1:100 target, 1:50 maximum (compensated) 1:200 maximum at arrival or departure points at loops
Curve radius	800m target, 400m minimum
Cant	Set for coal reference train
Corridor width	40m minimum
Rail	Minimum 53kg/m on existing track; 60kg/m on new or upgraded track
Concrete sleepers	Rated @ 30 tonne axle load
Sleeper spacing	667mm spacing (1,500/km) - existing track 600mm (1,666/km) - new corridors / track or re-sleepering existing track
Turnouts	Tangential, rated at track speed on the straight and 80km/h entry / exit on the diverging track
Crossing loops (initial)	1,800m (clearance point to clearance point) plus signalling overlap No level crossing across loops or within road vehicle sighting distance from loops

3 Future proofing

Train length	To provide for future extension of maximum train length to 3,600m
New structures	Capable of 30 tonne axle load @ 80km/h minimum
Formation	Formation on new track suitable for 30 tonne axle load @ 80km/h
Crossing loops	Loops designed and located to allow future extension for 3,600m trains

4 Reference train

Intermodal	21 tonne axle load, 115km/h maximum speed, 1,800m length (initial), 2.7hp/tonne power:weight ratio
Coal / bulk	25 tonne axle load (initial), 80km/h maximum speed, length determined by customer requirements within maximum train length

5 Operational specification

Freight train transit time (terminal to terminal)	Target driven by a range of customer preferences and less than 24 hours Melbourne terminal - Brisbane terminal for the intermodal reference train. Flexibility to provide for faster (higher power:weight ratio) and slower (lower power:weight ratio) services to meet market requirements
Gauge	Standard (1,435mm) with dual standard / narrow (1,067mm) gauge in appropriate Queensland sections
Maximum freight operating speed	115km/h @ 21 tonne axle load
Maximum axle loads (initial)	21 tonnes @ 115km/h 23 tonnes @ 90km/h 25 tonnes @ 80km/h
Clearance (terminal to terminal)	As per ARTC Plate F for double stacking (7.1 m above rail)
Maximum train length (initial)	1,800m
Braking curve	G40 for intermodal reference train
Reliability and availability	Competitive with road

6 Additional technical and operational information

Number of crossing loops between Melbourne and Brisbane: There will be 54 crossing loops (also known as passing loops) which are sections of track that allow a slower or non-priority train to wait off the main line while a faster or priority train continues unimpeded - or allow trains running in opposite directions to pass. The sections from Seymour to Albury/Wodonga and from Junee to Illabo have no crossing loops as the sections have double track and these sections total 221km or some 13% of the 1700km route.

The number and spacing of crossing loops are determined in order to accommodate more reliably the capacity, Service Offering and anticipated train plan (timetabling) requirements for Inland Rail. Crossing loops are not evenly spaced given that the capacity requirement varies over the network.

Crossing loops determine capacity but are also intrinsically linked to the Service Offering, both in terms of transit time (fewer loops = longer transit time as trains spend longer waiting in loops for passing or opposing trains to arrive) and reliability (fewer loops = lower reliability due to the longer average transit time).

How long does a train spend in a crossing loop: Typically, a train would spend in the order of 10-20 minutes in a crossing loop if required to utilise one although about 50% of trains will run through with no requirement to stop in a loop.

The average speed for a 24-hour transit from Melbourne to Brisbane is just over 70 km/h. This accounts for a range of factors including time spent in crossing loops (minimised by efficient train control), and track curvatures and gradients which slow trains below the design speed achieved on straight and level sections.

Number of level crossings and waiting times: Current planning for Inland Rail includes 391 public road-rail interfaces between Tottenham in Melbourne and Acacia Ridge in Brisbane. This includes 62 road-over-rail or rail-over-road grade separations, 173 public level crossings with fully active protection (signal lights, gates and bells) and 156 with passive protection (signs).

There are also 209 private level crossings providing access from a private property to a road or between parcels of a severed property, three of which will have active protection and 206 with passive protection.

The above figures are at the reference design stage. The final number of level crossings will be determined through approval processes following the preparation of Environmental Impact Statements.

It is estimated that the waiting time for road traffic for a 1,800m freight train travelling through a level crossing will be up to approximately 2 ½ minutes, inclusive of the length of time between boom gate warning lights signalling “stop” and signalling “all clear” once the train has passed.

Trains stopping at regional centres: It is expected that terminals in regional centres will likely be served by origin-destination specific trains and, in general, Melbourne-Brisbane trains will not stop to service these terminals. However, these decisions will be made by train operating companies depending on market requirements which will evolve over the course of the 100-year operating life of Inland Rail.

Number of trains per day: The attached map from the Business Case shows the expected number of trains per day on various sections of Inland Rail. Bromelton (13km south of Kagaru) has been added as a terminal in Brisbane since this map was prepared in 2015 due to the development of the SCT terminal there in 2017. Other adjustments to the route have also been made; for example, it no longer passes through Oakey or Kingsthorpe. Note that train numbers increase through to 2039/40 then drop following the assumed increase in some trains’ length to 3600 metres, anticipated to occur in about 2039. The additional capacity of each longer train from that time will initially mean a reduction in train numbers, after which the number will again gradually increase.

Appendix 1 Expected train movements per day – 2015, 2025 and 2040