MAGELLAN
ASSET MANAGEMENT LIMITED

Annual Investor Report

Magellan Infrastructure | June 2016

- Magellan Infrastructure Fund
- Magellan Infrastructure Fund (Unhedged)

Dear Investor,

I am pleased to write to you as an investor in the Magellan Infrastructure Fund (the 'Fund') for the year ended 30 June 2016.

For the year ended 30 June 2016, the Fund delivered a 17.8% return, net of fees, to unit holders. This was 12.6% better than the benchmark return of 5.2%. Magellan Asset Management Limited ('Magellan') also offers an unhedged version of the Fund. Over the 12 months to 30 June 2016, the Magellan Infrastructure Fund (Unhedged) returned 17.3%, net of fees, which is 11.2% better than the benchmark return of 6.1%.

In July 2016, the Fund paid a distribution of 8.1 cents per unit in respect of the year ended 30 June 2016. This takes the total distributions paid to unit holders in the Fund in respect of FY16 to 9.1 cents per unit.

Our underlying investment philosophy has not changed since we launched the Fund in mid-2007. We seek to buy and hold an investment portfolio of what we regard as outstanding infrastructure companies. We aim to invest in infrastructure and utility companies that possess solid fundamentals at prices that enable the Fund to achieve attractive risk-adjusted returns over a three-to five-year period.

Figure 1: Performance to 30 June 2016 in Australian dollars (after fees).

Yearly results to 30 June 2016	Magellan Infrastructure Fund (%)	Infrastructure Benchmark*	Difference
2007/08	-16.7	-0.4	-16.3
2008/09	-19.4	-26.3	6.9
2009/10	14.2	9.1	5.1
2010/11	33.8	17.1	16.7
2011/12	7.6	5.0	2.6
2012/13	17.7	14.4	3.3
2013/14	22.0	24.6	-2.6
2014/15	12.3	7.5	4.8
2015/16	17.8	5.2	12.6

Annual compound results (%) per annum			
1 Year	17.8	5.2	12.6
3 Year	17.3	12.1	5.2
5 Year	15.4	11.1	4.3
Since Inception (1 July 2007)	8.6	5.3	3.3

* S&P Global Infrastructure Index Net Total Return (hedged to AUD) spliced with UBS Developed Infrastructure and Utilities Net Total Return Index (hedged to AUD). Note: as the UBS Developed Infrastructure and Utilities Net Total Return Index (hedged to AUD) ceased to be published from 31 March 2015, it was replaced on 1 January 2015 with the S&P Global Infrastructure Index A$ Hedged Net Total Return.

Portfolio Strategy

Generally, infrastructure assets generate reliable earnings and cash flows from the provision of essential services to the community. Over time the stable, reliable earnings derived from infrastructure assets are expected to deliver a combination of income and capital growth for investors.

The universe of infrastructure assets that we consider for the Fund is made up of two main sectors:

- **Utilities**, including both regulated energy utilities and regulated water utilities. We estimate that utilities comprise approximately 60% of the potential investment universe for the Fund. Utilities are typically regulated by a government-sponsored entity. Such regulation requires the utility to efficiently provide an essential service to the community and, in return, the utility is able to earn a fair rate of return on the capital it has invested.

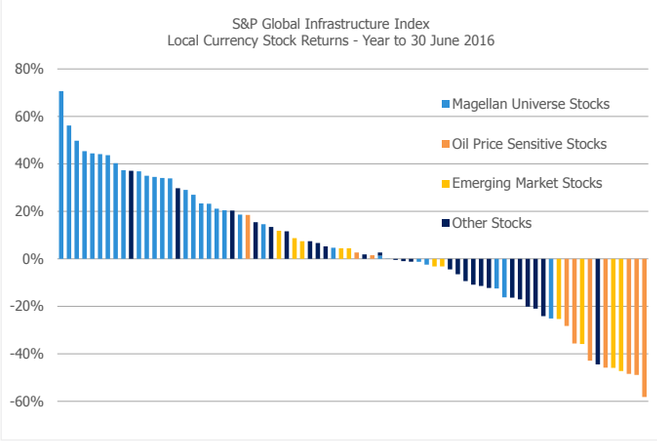
- **Infrastructure**, which includes airports, ports, railroads, toll roads, communications assets and energy infrastructure (oil and gas pipelines). Regulation of infrastructure companies is generally less intensive than for utilities and allows companies to accrue the benefits of volume growth. As economies develop, grow and become more interdependent, we expect the underlying levels of aviation, shipping and vehicle traffic to increase, as will demand for all forms of communications and energy.

Both utilities and infrastructure companies provide an essential service, while facing limited (if any) competition, and, because the service is essential, the price charged for the service can be adjusted with limited impact on demand volumes. As a consequence, earnings are more reliable than those for a typical industrial company and generally enjoy inherent inflation protection.

Portfolio Summary

The past year has demonstrated the importance of how global listed infrastructure investors define their investment universe. As noted in previous investor letters, we apply a conservative definition of the infrastructure investment universe that is designed to provide investors with predictable, through-the-cycle, inflation-linked returns. This means that we exclude those stocks from the investable universe whose earnings are materially impacted by competition, sovereign risk and, importantly in the past year, changes in commodity prices. The Fund's outperformance over listed infrastructure and global equities benchmarks reflects its limited exposure to stocks impacted by falling energy prices and, to a lesser extent, emerging markets.

To illustrate this point, the following graph shows the total shareholder return (TSR) in local currency of the constituent stocks in the benchmark S&P Global Infrastructure Index for the 12 months ended 30 June 2016. Colour-coding is used to show those stocks in the benchmark index that Magellan includes in its defined infrastructure investment universe (shown in blue), with the remaining stocks that Magellan excludes split between those whose earnings are sensitive to commodity prices, those in emerging markets and other stocks that we exclude.



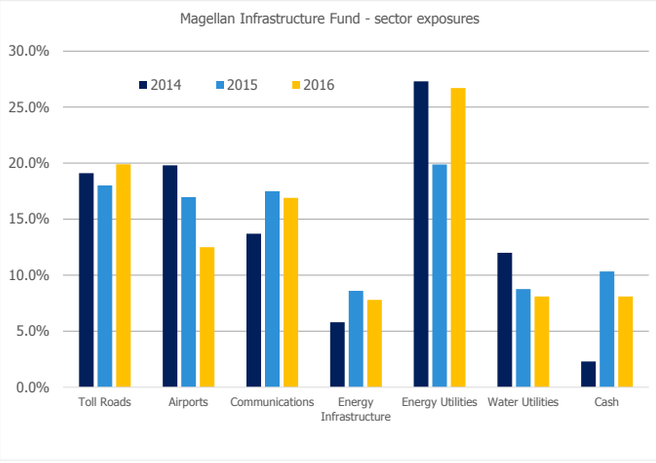
Source: Magellan Asset Management Limited.

The graph highlights a key reason why the Fund has outperformed over the period: it not only held stocks that performed well over that period but, just as importantly, it avoided stocks that performed poorly - in particular, stocks with earnings that are sensitive to commodity prices and stocks in emerging markets.

The Fund's investment portfolio has been constructed to reflect investment opportunities that meet our qualitative criteria and we assess as attractive, while also minimising the risk of permanent capital loss. As at 30 June 2016, the Fund's portfolio consisted of 29 investments (compared with 28 investments at 30 June 2015). The top 10 investments represented 49.4% of the portfolio at 30 June 2016, compared with 57.6% a year earlier.

The Fund also held approximately 13.8% in cash as at 30 June 2016, and 10.3% 12 months ago. The decision to continue to hold a large part of the portfolio in cash (a similar stance adopted by the Magellan Global Fund) reflects the view that accommodative monetary policy of recent years has affected global asset prices and that any unwinding of this policy could lead to increased investment market volatility. We expect to deploy the bulk of our cash holdings in the investment portfolio over the medium term.

The composition of the Fund by sector at 30 June 2014, 2015 and 2016 was as follows:



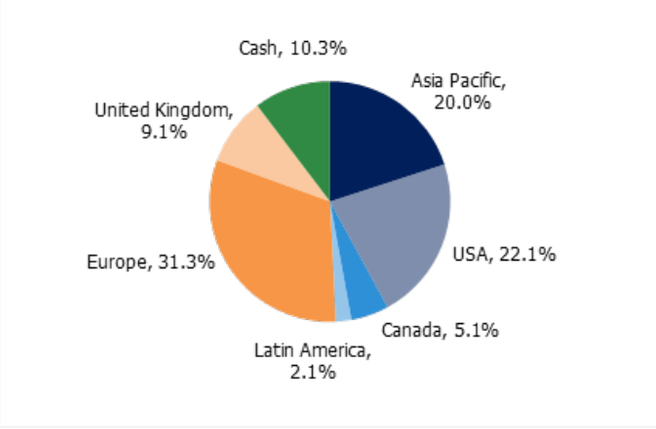
Source: Magellan Asset Management Limited.

The total share of the Fund held in the infrastructure sector, the regulated utilities sector and cash as at 30 June 2016 were 53.6%, 32.6% and 13.8% respectively.

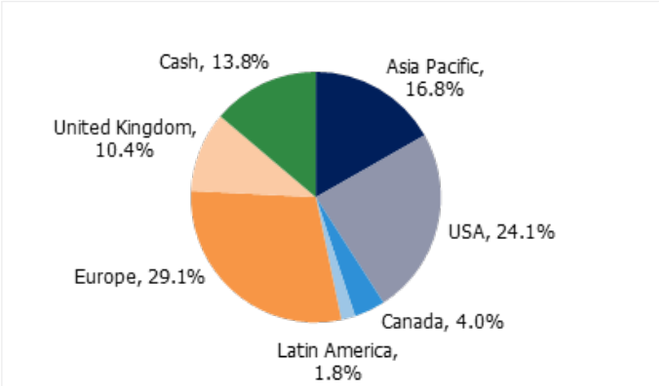
Accommodative global monetary conditions of recent years have led to significant increases in the prices of regulated utilities. In our assessment, regulated utilities in the better-performing economies of the world, effectively the most defensive infrastructure investment opportunities, have become progressively more expensive and we have found it increasingly difficult to identify regulated utilities that we assess as fairly priced. Accordingly, we have reduced the Fund's exposure to regulated utilities in the US and the UK, and increased the Fund's exposure to communications infrastructure stocks and European utilities. We have also reduced our exposure to the airports sector. The share prices of many airport stocks have increased by around 30% over the past year and are now trading materially above our assessed intrinsic value.

The composition of the portfolio by geography at 30 June 2015 and 30 June 2016 was as follows:

30 June 2015



30 June 2016



The Fund's holdings of regulated utilities generated superior investment returns (in local currency terms) during the year compared to the non-utility holdings, with regulated utilities delivering a weighted average return in excess of 24% while non-utilities delivered just over 11%. On a regional basis, Australia/NZ was the best-performing market with a weighted average return of almost 39%, while the Fund's US holdings delivered a weighted average return of over 27% for the year. In contrast, the Fund's Canadian and European exposures both generated negative returns on average.

The Fund's top-performing stocks for the year to June 2016 (in local currency terms) were Australian toll road company, Macquarie Atlas Roads (which delivered a TSR of +70.6%), US utilities stock, American Water Works (+76.7%), Atmos Energy (+62.2%) and ITC Holdings (+48.0%), and Sydney Airport (+45.4%).

The Fund's holdings in two European satellite companies, Eutelsat (-39.5%) and SES (-32.5%), were the major disappointments during the year. This was driven primarily by a reduced earnings outlook for the (non-infrastructure) data businesses, due partly to greater than expected pricing pressure from new, high-throughput satellite competition. In addition, the market appears increasingly concerned with the growth trajectory of the (infrastructure) TV broadcasting businesses, which represent the majority of revenues and earnings. We assess the infrastructure component of Eutelsat and SES as representing the dominant share of the business and believe that these business segments will continue to generate reliable returns over the long term. Accordingly, at the time of writing, the Fund continues to hold an interest in SES and Eutelsat.

Brexit

On 24 June, the UK voted to leave the European Union (EU) by a narrow margin (52% 'leave' to 48% 'remain') in a non-binding referendum. The result triggered volatility in investment markets, including a sharp depreciation of the British pound and falls

in the share prices of a range of UK and European companies. Despite this, there were limited signs of financial system stress and, in our view, the probability of a major global systemic risk event due to 'Brexit' in the short term is low.

In the aftermath of the Brexit vote, the Fund's investment portfolio experienced a short-term decline in market value but quickly recovered from the downturn. The companies in the Fund's investment portfolio provide essential services to their communities and accordingly, continue to derive reliable earnings for investors. While the economic impacts of a Brexit are uncertain, we believe the companies we invest in will continue to deliver strong operational performance and provide generally reliable earnings that are characteristic of the type of infrastructure companies within our area of interest.

Risk factors

In previous letters we have outlined our approach in applying a strict definition of infrastructure to determine whether an asset is considered investment-grade. Assets that are included in our defined listed infrastructure investment universe are assessed as delivering an essential service to a community and as generating reliable earnings and cash flows over the long term.

The stability of earnings is influenced by both competitive positioning and a range of risk factors. Key risk factors we consider are as follows:

- **Sovereign risk.** We avoid countries where political decisions can easily be made that undermine the contractual position or potential earnings of a company. Additionally, we only invest in countries where the judicial system and law are sound, so that contractual positions can be enforced as required.
- **Regulatory risk.** We avoid regulatory jurisdictions where regulatory processes are opaque or inconsistently applied.
- **Commodity price risk.** We do not invest in businesses that are materially reliant on the price of the product they transport. For example, many pipeline businesses and master limited partnerships (MLPs) in the US are excluded from our universe for this reason.
- **Leverage risk.** We avoid businesses with high leverage or where their ability to service their debt is tight relative to their earnings.

Impact of interest rates on infrastructure investment

We expect global monetary conditions to become less accommodative over the long term and, consequently, longer tenor rates to increase. As we have noted previously, there are two key areas we focus on when considering interest rates:

- **The impact on the businesses in which we invest.** We remain confident that the businesses that meet our investment-grade infrastructure criteria are well placed to continue to meet our investment expectations over the medium term and through a period of rising rates.
- **Impact on valuations and on debt and equity markets.** An increase in interest rates can be expected to lead to a higher cost of debt, and an increase in long-term discount rates. Our forecasts and valuations take these factors into account in our investment analysis. However, the history of financial markets leads us to expect increasing uncertainty as a consequence of a rising rate environment. Stocks that are regarded as 'defensive', including infrastructure and utilities, are often subject to negative sentiment during periods of interest rate increases as investors switch to higher-growth sectors. However, it is our experience that provided the businesses have solid fundamentals, their stock prices can be expected to revert to their longer-term trend which more closely reflects their underlying earnings profiles.

Notwithstanding equity market volatility, we expect the underlying earnings of infrastructure and utility companies in our defined investable universe to remain robust and to continue to reflect solid growth. Ultimately, the value of the companies in our investment portfolio reflects the future cash flows they are expected to generate and the risks associated with those cash flows. We believe that investment markets have not been pricing assets in the recent past to reflect prevailing interest rate levels, but rather are pricing in a higher, more 'normal' level of interest rates, when assessing the risks associated with future cash flows. This means that if interest rates increase over the medium term, we can expect the impact on asset prices to be somewhat muted because investors have already allowed for some level of increase.

Outlook

Magellan believes that infrastructure assets with requisite earnings reliability, that exhibit linkages to inflation, offer an attractive, long-term investment proposition. Furthermore, given the predictable nature of its earnings profile, the investment returns generated by infrastructure assets are different from standard asset classes and offer investors valuable diversification when included in an investment portfolio. In the current uncertain economic and investment climate, the reliable financial performance of infrastructure investments makes them particularly attractive and an investment in listed infrastructure can be expected to reward patient investors within a three-to five-year timeframe.

Notwithstanding the resilient nature of the stocks held in the Fund, as mentioned in previous newsletters, we expect to see volatility in equity markets, particularly when US interest rates start to rise. However, we are confident that any increase in interest rates will have a minimal negative impact on the underlying financial performance of the stocks in the portfolio.

An additional issue that we are often questioned about, and which Hamish Douglass has written about in his annual letter to investors, is the impact of technology disruption on infrastructure investment. While undoubtedly we will see technological progress lead to numerous changes in infrastructure investment, there are two key areas where this is apparent to us today. The first is the impact of the advent of driverless cars on toll roads, while the second relates to the continued progression of roof-top solar energy and battery technology and the impact on energy utilities. While the future will always be uncertain, we believe the prospects for both toll roads and electricity networks remain attractive. Our reasoning is detailed in the following discussion pieces written by my Infrastructure colleagues, Ben McVicar and Dennis Eagar.

Self driving cars: Implications for toll roads - Dennis Eagar

Since 2007, our infrastructure portfolios have held material positions in toll road companies. These companies have had exposure to toll roads in Europe, the US, Canada, Latin America and Australia. When valuing these roads, we distinguish between four different types of roads because of their inherently different traffic growth dynamics, including their sensitivity to economic conditions. These four types of toll roads are:

- Urban radial roads;
- Urban orbital roads;
- Urban High Occupancy Toll (HOT) lanes; and
- Inter-urban toll roads.

When valuing these roads, we build financial models that forecast traffic usage through to the end of the contracted concession period. In some cases, this can be more than 50 years. The advent of driverless cars therefore raises questions as to the impact of this rapidly developing technology on toll road traffic volumes.

The shift to driverless cars will clearly take some time to occur. While the basic technology for driverless cars already exists, there are a myriad social, regulatory and legal issues that need to be addressed before they become ubiquitous. In the meantime, the technology will develop and will inevitably impact toll road usage.

Based on our analysis, we expect the development of driverless cars to provide a boost to toll road traffic and earnings over the next 10-20 years. However, beyond that period the impact on usage of toll roads is difficult to predict and may even be negative. We explain our thinking in the following discussion.

Autonomous vehicles

Cars are currently being produced that have Autonomous Vehicle ('AV') capability. This means they have the capability to allow the driver to relinquish complete control over the vehicle in certain circumstances and are smart enough to know when conditions do not allow that to occur, e.g. when lane markings are confusing or non-existent.

AVs are not driverless cars. Driving an AV allows the driver to hand over control of the vehicle but requires the driver to be ready to take back control of the car when needed. The vehicle will automatically keep a safe distance between itself and surrounding vehicles and, if needed, can change lanes. It will do all those functions more safely than a human – indeed road safety authorities are supportive of the adoption of AV technology because of the expected safety benefits.

So while the driver will still need to be behind the wheel and attentive to what is happening, the driving experience will generally be more relaxed, less stressful and safer than in non-AV vehicles.

While there are a raft of legal and regulatory issues that need to be solved before driverless cars become a reality, there are complex social/ethical issues that are even more important in the use of this technology. This is perhaps best illustrated when an AV is being used in a suburban street environment. In that situation, it is entirely possible that the vehicle would have to make a decision between running over a person that has moved into the path of the car or swerving into the path of a vehicle coming in the opposite direction, potentially putting the lives of the occupants of the AV at risk. Such "life and death" questions will take some sorting out!

In the context of such difficult issues, it is not surprising that the current thinking among road safety authorities is that AV usage is likely to be restricted only to motorways for some years to come. This is because:

- Generally motorways have better and more consistent road markings and signage; and very importantly,
- There is only very limited scope for an AV to be faced with situations that are difficult to predict in advance, e.g. a person running in front of the vehicle.

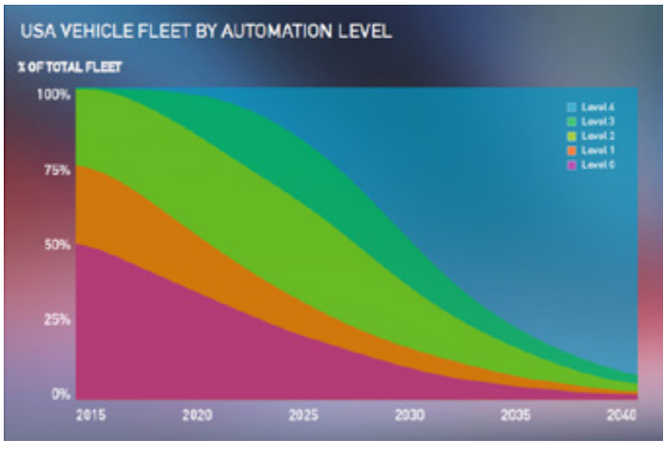
The future

So in the shorter term, we believe that the tolled motorways are likely to benefit from AV technology

because it will enhance the attractiveness to using the toll road over the free, non-motorway alternatives. Initially, that benefit will be marginal because relatively few cars will have AV capability. But over the next decade and beyond as AV technology is rolled out in more and more cars, it is likely to be material. As the following diagram illustrates, a recent University of Minnesota study forecast that within 15 years almost 60% of the USA vehicle fleet would have either complete or limited self-driving capability, rising to 90% by 2040.

Their forecasts are shown in the following graph which uses vehicle automation levels as defined by the National Highway Traffic Safety Administration of the USA being:

- Level 4 – Complete self-driving automation
- Level 3 – Limited self-driving automation (an AV)
- Level 2 – Combined function automation
- Level 1 – Function specific automation
- Level 0 – No automation.



Source: University of Minnesota, Levinson, The End of Traffic and the Future of Transport Funding (Aug 2015).

So, we do not see AV technology as being a disruptive technology that could have a negative impact on traffic growth on the toll roads in the next decade. Quite the opposite –for so long as its use is limited to motorway conditions, the toll roads are expected to be net beneficiaries.

The increasing usage of AV technology on motorways will also benefit toll roads in two other important ways:

- It will reduce traffic congestion on the toll roads because some congestion is caused by the poor behaviour of human drivers when changing lanes, breaking or accelerating. It will also reduce the number and severity of accidents – frequently a cause of severe congestion on the toll roads; and

- It will increase the capacity of the toll road, particularly in peak periods. Toll roads can currently handle around 2,200 vehicles per lane per hour. A recent study by the University of California concluded that full penetration of AV could see this capacity double. This is because vehicles will be able to travel much closer together at much higher speeds in much thinner lanes than is currently the case. A different study by Tientrakool et al[1] found that a 50% presence of AVs in the traffic mix can increase highway capacity by 80%. While these studies may prove to be optimistic, there is no doubt that the increase in capacity will be meaningful particularly for urban toll roads which are already capacity constrained during peak periods. This capacity benefit can be phased in over time by the creation of AV only lanes on the toll roads.

Of course, this improvement in capacity will also be experienced by the free roads running parallel to the toll road thereby reducing congestion on the free alternative and removing the incentive for drivers to use the toll road. So when AV technology is allowed to be used on non-motorways, there is likely to be a negative impact on toll road usage, at least until the free alternative roads become congested again.

Driverless cars

The ultimate form of AV is a driverless car. Such a vehicle is likely to be configured completely differently from today's vehicles. It would have no steering wheel or other controls and seats would be configured to best suit the needs of the occupants at the time. Driverless cars:

- Would allow the occupant to use the travel time productively or enjoy a greater range of entertainment experiences including video/TV/computers;

- Would allow greater interaction between occupants;

- Would provide enhanced mobility to those in our society currently incapable of driving a car, e.g. the old, infirm and young would be able to use the car without assistance.

Driverless cars will increase the capacity of both toll roads and their free alternatives as automotive networked intelligence results in optimising traffic flow, less accidents, and automatic rerouting. Ultimately roads may not even need traffic signals, lane markings or speed limits. The fact that a driverless car trip will be an opportunity to be entertained will also reduce the utility of the time saved by using a toll road, i.e. drivers will be less inclined to spend $5 or $10 on the toll road to save say 15 minutes. Alone these developments are negative for toll roads given that usage of a toll road is almost entirely dependent on the actual or perceived time and reliability benefits of using the toll road.

However, driverless cars will also increase the demand for trips by reducing reticence to taking trips, introducing empty trips, and taking share from other modes.

A study by Princeton University forecasts that vehicle

[1] Tientrakool, Patcharinee, Ho, Ya-Chi, and Maxemchuk, Nicolas M., 2011, "Highway Capacity Benefits from Using Vehicle-to-Vehicle Communication and Sensors for Collision Avoidance," Vehicular Technology Conference (VTC Fall) 2011 IEEE.

miles driven is likely to increase by between 5% and 20% when AVs reach 50% market penetration and when fleet penetration of driverless and AV cars reaches 95%, vehicle miles driven is expected to increase by 35%. The same study forecasts that this will be around 2040, well within the forecast period of toll roads in our investment universe.

The era of driverless cars is also likely to be associated with much lower levels of car ownership. It will simply be more economic to participate in some form of sharing arrangement that allows much greater utilisation of vehicles than to have a privately owned vehicle remaining idle. Again this is likely to lead to an increase in vehicle miles driven as it will decrease average trip costs.

Another study by academics at the University of Southern Florida showed that empty trips alone would increase total miles driven by at least 10%. These trips would arise because shared cars would drop off a passenger and drive empty to pick up the next occupant.

As an aside, it would appear that the clear losers of driverless cars would be the owners of parking stations and those making a living driving vehicles (at present, there are about 3.5 million truck drivers in the US, forming the largest job category in 29 states).

We believe there is significant potential for disruptive technologies to materially impact a range of industries. We know with certainty that none of the above quoted studies will be absolutely correct. We expect AV and driverless cars will generally be positive for the earnings of toll roads, and particularly urban toll roads, over the next 10 to 20 years but we have not changed any of our traffic forecasts to reflect this until we have greater certainty about how, and more importantly, when these developments will take place.

The long-term impact on toll roads will depend on the balance of the positive impact of the additional trips created by driverless cars and the negative impact of the additional capacity that is created on the free roads by the growth of driverless cars.

Utilities remain a bedrock of the Magellan Infrastructure Strategy - Ben McVicar

Electric utilities are a mainstay of our infrastructure portfolios. We often refer to utilities as providing the 'lead in the keel', or in other words, we expect these businesses will provide stable earnings, regardless of macroeconomic conditions. The stable earnings comes from both the reliable demand for energy and the application of strict price regulation to network fees. This means the utilities we invest in will continue to earn a modest but reliable return.

However, the individual economics of an 'electric utility' vary by company and need to be considered on a case-by-case basis. Our preferred part of the industry to invest in is transmission and distribution assets, i.e. the poles and wires, or more simply - the 'grid'. The grid benefits from being a natural monopoly and is therefore regulated to ensure it only earns a fair return on its investment. By comparison, companies that are operating in the power generation and retailing space typically struggle to deliver reliable returns. This is because their earnings profile is affected by dramatic swings in the electricity price that occurs through the course of the year. As a general rule, we limit the exposure of the portfolio to companies without sufficient stability of returns.

Source: Magellan Asset Management Limited.

However, in recent years the price of both roof-top solar power generation and batteries has come down dramatically, begging the question as to whether these technologies will disrupt this reliable earnings profile of the grid. In this note, we consider if the arrival of more-affordable roof-top solar and batteries undermines the investment case in the sector.

The first electric grids were developed over 100 years ago. Since then, the level of complexity has increased as the scale of the operations have grown. However, compared to a century ago, the underlying principle of how electricity is supplied to consumers is largely unchanged: electricity is generated in a remote location and delivered to a household or business through a series of wires and transformers.

In the developed world, access to power provided by the grid is considered an essential service and underpins the modern economy. Investment in electric grids has generally provided a stable, low-risk return.

Despite new technologies, we do not expect the investment fundamentals to change in the coming years.

Batteries

Batteries are the first piece of the puzzle. For context, the use of batteries in electricity grids is still in its early days. For large-scale batteries ('utility scale'), grid operators are largely at the trial phase in developing knowledge and capabilities to harness the technology. Meanwhile, the home-installation of batteries is a similar story, with consumer uptake still in its infancy. However, in the long-term, we expect batteries to play an important role in the grid. Why? Because unlike other commodities, electricity needs to be produced

[2] We note that batteries also have the potential to reduce the amount of 'wasted' energy that disappears as heat due to the resistance of the wiring used in electrical equipment. This heat loss is worst in the peak period, therefore using batteries to "flatten" the demand profile of the grid has significant implications for grid efficiency.

concurrent with consumption. This requires the construction of 'surplus' capacity to deal with the periods of peak demand. This 'surplus' capacity sits idle for the majority of the day (or even year) until there is a surge in demand. Batteries solve this by allowing electricity to be generated in off-peak periods[2] such as during overnight hours, for storage until needed. In turn, this reduces the need for excess capacity, which is a win for both the utilities companies and their customers. And importantly, the grid's role in all this is largely unchanged because energy will still need to be delivered to the batteries.

Solar power

The impact of renewable generation on the grid is more complex. Some renewables are being installed at the residential level, typically as roof-top solar, while others are being developed as larger 'utility scale' projects. These are typically developed on solar and wind-farms.

In assessing the impact to grids, it is worthwhile to initially analyse the implications of small-scale applications. In our view, utility scale solar or wind changes nothing for the owner of the grid. This is because the generation from the power station will still need to be transported to its customers. The dramatic decline in prices in wind and solar have made these technologies far more cost competitive with the more emissions intensive technologies. In recent years, global expenditure on utility scale renewables has outpaced expenditure on thermal power stations. As costs continue to decline, we expect this trend to continue, with the electric grid providing a key link for this renewable energy to reach its customers.

Connecting large scale renewables to the grid is likely to be an important source of capital expenditure for the high-voltage 'transmission' network that transports the output back to population centres. However, the shift to renewables at the transmission level is not without challenges. Unlike existing thermal power stations, which have a reliable production output, renewables tend to be more unpredictable and 'intermittent' in their power output and vary with changes in wind and clouds. Managing this variation in output requires operators of the grid to use reserve generators (often gas turbines) to balance the output from the renewables with the load or consumption of the customers on the grid. The difficulty for the operator of balancing this increases as the proportion of renewables increases. According to the US National Renewable Energy Laboratory, this additional cost on the grid of managing this variable output of renewable energy is often not thought about when considering the cost of renewables.

Where the renewables discussion gets more complex is roof-top solar. This is known as 'distributed' generation because it's no longer 'centralised' at a large scale generator. Theoretically, it does solve one of the problems of electricity supply – i.e. that electricity needs to be transported a long-distance from the generator to the household. The long distances involved have been unfortunate as the further the electricity is transported, the more that gets lost as heat.

When roof-top solar is combined with a battery, it begs the question, why do customers even need to be connected to a grid? Our short answer is, (1) building a reliable, disconnected system is prohibitively costly; (2) being connected to the grid provides enormous redundancy with numerous generators and electric lines that ensure the power stays on for consumers – especially in weeks when the sun isn't shining; and (3) not everyone in the community has the ability to self-generate.

The current installed cost for a reasonably sized solar and Tesla battery package is approximately AU$20,000 (US$15,000). Except for households with extremely low electricity consumption, this system would only act as an offset and would not allow for a full grid disconnection. This is because the system would not be able to supply enough power to meet most household's requirements in all conditions. For example, the new 7kWh Tesla battery is rated to deliver 2 kilowatts of continuous power (3.3 kilowatts at peak). A kettle and toaster can require over 2.5 kilowatts, which when combined with a hairdryer, can easily pass 4.5 kilowatts of "load", exceeding the peak capacity of a single battery.

An Australian Think Tank, the Grattan Institute, put out a research paper in 2015 that addressed the cost of building a system capable of full grid disconnection. For a typical Sydney household, to fully disconnect from the grid would require a system worth AU$34,200 (US$25,600). However, this system would only be 95% reliable, i.e. the house would be without power in 1-in-20 days, on average. To be 99% reliable, the cost goes up to AU$52,200 (US$39,150). For 99.9% reliability, i.e. still below the level achieved by a grid – the price jumps to AU$72,200 (US$54,150). The same analysis highlights that using this disconnected system would cost the household over 5.5 times more than if it had simply opted to draw power from the grid.

Other studies in different markets have estimated the cost of a disconnected system to be eight times higher than simply drawing power from the grid. Even expected declines in technology costs are unlikely to save this, with an 80% reduction in the solar and battery costs still leading to a system that is 2.5 times the current cost of sourcing power from the grid.

While the cost of installing the system may come down in the future, there are still significant barriers to mass adoption. Many homes will have insufficient

space available for all the requisite equipment to be installed – whether it's garage space for batteries or roof-top square-metres to install the solar panels. Some disconnected systems can include a back-up generator, however, in a relatively densely-populated neighbourhood, neighbours may have complaints about the sound of an engine running at full-tilt when sitting down to relax in the evening. Then there are apartment owners without space for panels, or even home-owners with roofs facing in the wrong direction, or with shadows from trees and other buildings. Future growth in population density is only likely to exacerbate this issue. And what about renters? They won't want to pay to have equipment installed and owners may be reluctant to spend the money, given it's typically the renter that makes the saving from the energy generated by the system.

Even for those households with adequate roof-top space and large solar/battery-systems, there is still a benefit in staying connected to the grid, being that it allows excess electricity to be exported back to the grid - an example being when the owners are away on holidays or even out for the evening. This leads to a future where the grid's role becomes a facilitator of trading between household 'generators', rather than as a pure delivery mechanism.

For the reasons above, we believe that for the foreseeable future, disconnecting from the grid will remain a poor financial decision for many customers. Furthermore, there will be a significant number of customers that can't disconnect at all. That's not to say we don't expect there will be continued growth in roof-top solar and batteries, but we do expect to see these customers using the technologies as a complement to the existing network. In turn, this will require regulators to review network pricing models. The grids themselves will need to work to adapt the network to deal with the changing flow patterns of electricity.

When things change, it is rare for all stakeholders to be winners. In our view, the worst impacted part of the energy supply chain will be the utility-scale scale thermal generators – gas, coal and nuclear power - as their economics are damaged by ongoing growth in renewable generation. While we expect many of these fuels to have a place in the fuel mix in coming decades, the transition to an increased renewables share in the market is likely to be problematic for them.

Fundamentally, the grid will continue to be an important piece of infrastructure in the community. At the present time we expect regulated utilities to remain a reliable investment and we remain confident in the outlook for the sector. As a rule, we exclude from our investment universe those companies who derive more than 25% of their earnings from unregulated power generation and/or power retailing. Hence, the companies most negatively impacted by these newer technologies fall outside our scope. While we remain aware of their disruptive potential, we believe that solar, wind and battery storage technologies are unlikely to materially impact the stocks in our investment universe. Where they do, the impact will be spread over many years and decades.

Yours sincerely,

Gerald Stack
Head of Investments and Portfolio Manager

The other 'green' technology - electric cars

Discussion of the impact of technology on the grid is typically centred on the potential for disruption. In this note we have outlined why we believe this is an unlikely scenario. However, there are other technology changes that have the potential to dramatically increase the demand for energy from the grid, namely electric cars. Transport is one of the largest categories of global energy demand and if electric cars begin to take market share, the potential to create much greater on-grid demand for energy is significant. Households would see a large increase in electricity demand and more charging outlets would be required in cities. Interestingly, this growth in electricity demand would make it even more difficult for households to install solar and battery systems large enough to allow for complete grid disconnection.

Placing this observation in context, a three person household in Sydney is expected to consume 6.9MWh of electricity each year, while an average car typically drives in the order of 14,600km per year. Based on Tesla's guidance, the Tesla Model S would require around 11.1KWh per day to recharge or 4.1MWh per year. So for a typical household, this car would increase power demand by approximately 60%.

Contact Details

Magellan Asset Management Limited ABN 31 120 593 946, AFS Licence No. 304301
MLC Centre, Level 36, 19 Martin Place, Sydney, NSW 2000 Australia.
www.magellangroup.com.au


+61 2 9235 4888


info@magellangroup.com.au

Please note: From June 2016, Magellan Asset Management Limited will be producing this Investor Letter on an annual basis.