Assessing the Viability of Agriculture and Energy's Co-existence Model

A report for

By Angus Duddy

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Executive Summary

The author's intention is to determine how energy industries coexist when these companies seek to develop in highly productive agricultural areas.

The reason for the author's area of study is that the property that they reside on sits above one of the largest thermal coal and coal seam gas reserves on mainland Australia.

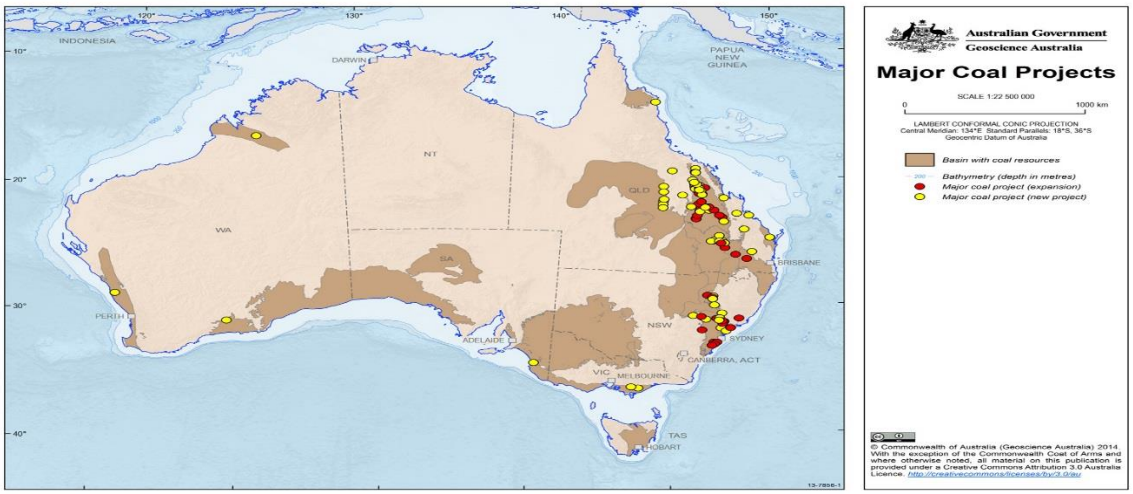

Figure 1: Australian Coal Assets (Source: Australian Government)

The basis for coexistence is that the development of the resource and the agricultural industries can operate within a region while maintaining or possible enhancing the condition of the environmental, social, cultural, human and asset within a region (Energy resources from a food bowl. Identifying and managing cumulative impacts of mining and agriculture, 2013).

The challenge for stakeholders is to manage the significant scientific, technological and social barriers while trying to achieve sustainable outcomes between agriculture and resource extraction.

The author suggests that the ultimate challenge is to initiate effective governance and adaptive management utilising a region-specific management technique.

The impact on Australian agriculture:

- Cumulative impacts unintended, often irreversible with regard to land and water.
- Disclosure and transparency with regard to the key process of strategic management strategies regarding the resource and natural assets.
- Providing positive contributions to both the regional areas, the resource companies and the local townships while managing the strategic agricultural lands in a sustainable manner.
- The differentiating factor across many sites visited was that the discussion needs to be transparent in nature and a strategic development of working relationships

between CBM, mining, oil, gas and agricultural industries would need to be enhanced to ensure sustainability of all the industries involved.

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Forward

I am a fourth-generation grain, cotton and beef producer on the Liverpool Plains of New South Wales (NSW). Although not a topic that applies to all Australian producers, the co-existence between extractive industries and agriculture is a topic of particular significance in concentrated areas within Australia.

The topic holds particular relevance to me as our family property 'Rossmar Park' lies across two NSW coal mining exploration licences: EL6505 and EL7223. These coal resources have been explored since 2006 and have proved to hold significant reserves of thermal coal with potential mine lives in excess of 50 years.

On 12 August 2016, while attending the Alberta Beef conference in Calgary, Alberta, the state government resumed EL6505 for a nominal sum of AUD $220 million. The state of New South Wales determined that a potential mine would pose too great a risk to the region's agricultural future, and its underground aquifers.

Much of the argument for the development of the mines on the Liverpool Plains has focused on the potential to provide employment and financial security to the region. Proponents of the mines also argue that the mining industry and the local agricultural sector can continue to operate within close proximity to each other.

This validity of this assumption has been questioned by much of the local broadacre farming community who are concerned that the vast reserves of water held in underground alluvial aquifers will be disrupted by mining activities. The farmers argue that it is this water, which provides a source for irrigation that sustains cropping activities and food production, that provides the real financial security of the region.

The Liverpool Plains is also well known for its extremely high-quality soils that are capable of storing large amounts of plant available water making the region a more reliable crop producing area than most other parts of the cropping belt. Crops grown on the Liverpool Plains include:

- Wheat
- Barley
- Sorghum
- Peas (chickpeas, field peas and edible peas)
- Beans (faba and mung)
- Corn (human consumption, gritting, silage and grain)
- Various forage crops including oats, lucerne, tropical grasses, perennials, annuals and pasture species.

The concentration and variety of grain grown in the area also supports three significant beef feed lotting yards as well as other intensive animal industries including poultry (meat and eggs) and turkeys. Excess grain is predominantly transported to Newcastle for export. As the Australian animal protein industry continues to grow, the soils (adjacent to these vertosol) that were once regarded as suboptimal are now being used in the production of animal proteins. Key production statistics are highlighted in Figures 2 and 3.

The region covers 99,100km^2 over twelve local government areas, with 78,030km^2 of productive agricultural land: ***that is 78.7% of the region***.

Ag, forestry and fishing accounts for 7% of total employed labour and the gross value of agricultural production was $2.5 billion, which makes up 20% of NSW total ag production (ABARE 2015)

Based on gross value, cotton is the most important commodity in the New England North West region, contributing $656 million in 2012-13, or 20% of the total of agricultural production in NSW.

Cattle and calves contributed $457 million in 2012-13, or 18% of the total.

Wheat contributed $451 million, or 18% of total.

Sorghum contributed $188 million, or 8% of total.

Barley contributed $124 million, or 5% of total.

In 2012-13, the New England North West Region accounted for 100% of the total value of NSW peanut production, 95% of the total value of sorghum, 53% of cotton and 35% of the total value of both barley and tomatoes.

Figure 2: Regional statistics of north west NSW (ABARES)

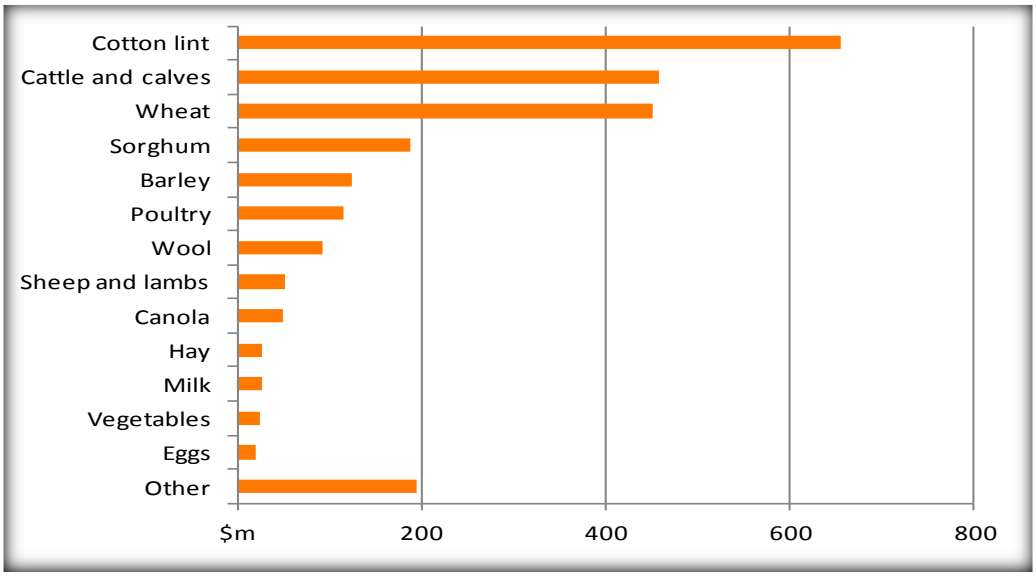

Figure 3: Total agricultural receipts relative to crop type in north west NSW (ABARES, 2015)

Initially, the proposed mining projects sought to create a symbiotic relationship between the producer and the coal mining entities. As these projects have moved through various levels of planning, potential impacts on the local environment and water reserves have become clearer. Some of the forecasts on the effects to groundwater in particular have raised

questions about the security and value of irrigation licenses and the flow on effects that diminished licenses would have on land values and associated mortgage securities.

Irrigation water entitlements within the Upper and Lower Namoi Valleys, both unregulated and regulated, amount to 880,838ML. This includes river water, bore water, and unregulated flood flow. Water entitlements including those from underground aquifers underpin the production of the agricultural industries which are so vital to the region. The extent of the water resources of the region can be seen in Figure 4, while Figure 5 illustrates the vastness of the coal resources.

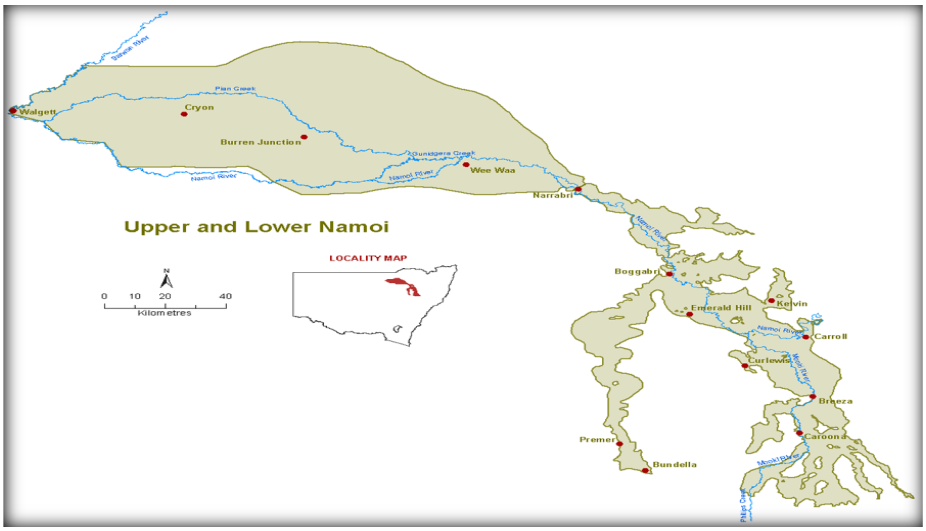

Figure 4: Spatial distribution of alluvial aquifer structure in the Upper and Lower Namoi Valleys (NSW Office of Water 2012)

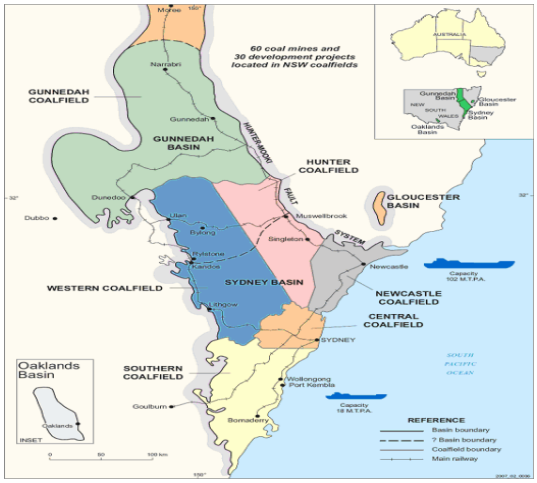

Figure 5: Coal resources (Resources and Energy Council Australia 2016)

Figure 6: Distribution of coal seam gas reserves in the Gunnedah Basin (NSW State Government bioregionalassessment.gov.au)

These figures highlight the colocation of water, gas and coal resources across north west NSW. The Gunnedah Basin has approximately 4% of the 2P (proved and probable) CSG reserves in Australia, approximately 1520 PetaJoules (Geoscience Australia and BREE, 2012).

Below are statements issued by the two companies who have purchased the rights to explore the coal reserves over the last decade:

- 'Shenhua Watermark currently holds the Watermark Exploration Licence (EL) 7223 covering an area of 195 km2, approximately 25 km south-east of Gunnedah. The Watermark deposit contains shallow resources of domestic and export quality thermal coal contained in the Hoskissons Coal and Melvilles Coal Member, ….. Shenhua Watermark proposes to extract up to 10 Mt/year of ROM coal from the Hoskissons and Melville seams for a 30-year period using a standard open-cut mining fleet of excavators and shovels, along with haul trucks, dozers, graders, drill rigs and water carts' (Shenua Watermark Coal, 2013).
- 'In April 2006, BHP Billiton commenced exploration activities in the Caroona Exploration Licence Area (ELA) 6505 (344km2), located approximately 40 km south-east of Gunnedah and 14 km west of Quirindi.

The Caroona deposit is estimated to contain more than 500 Mt of in situ potentially mineable underground coal that may produce a high quality exportable thermal coal' (SWS, 2011).

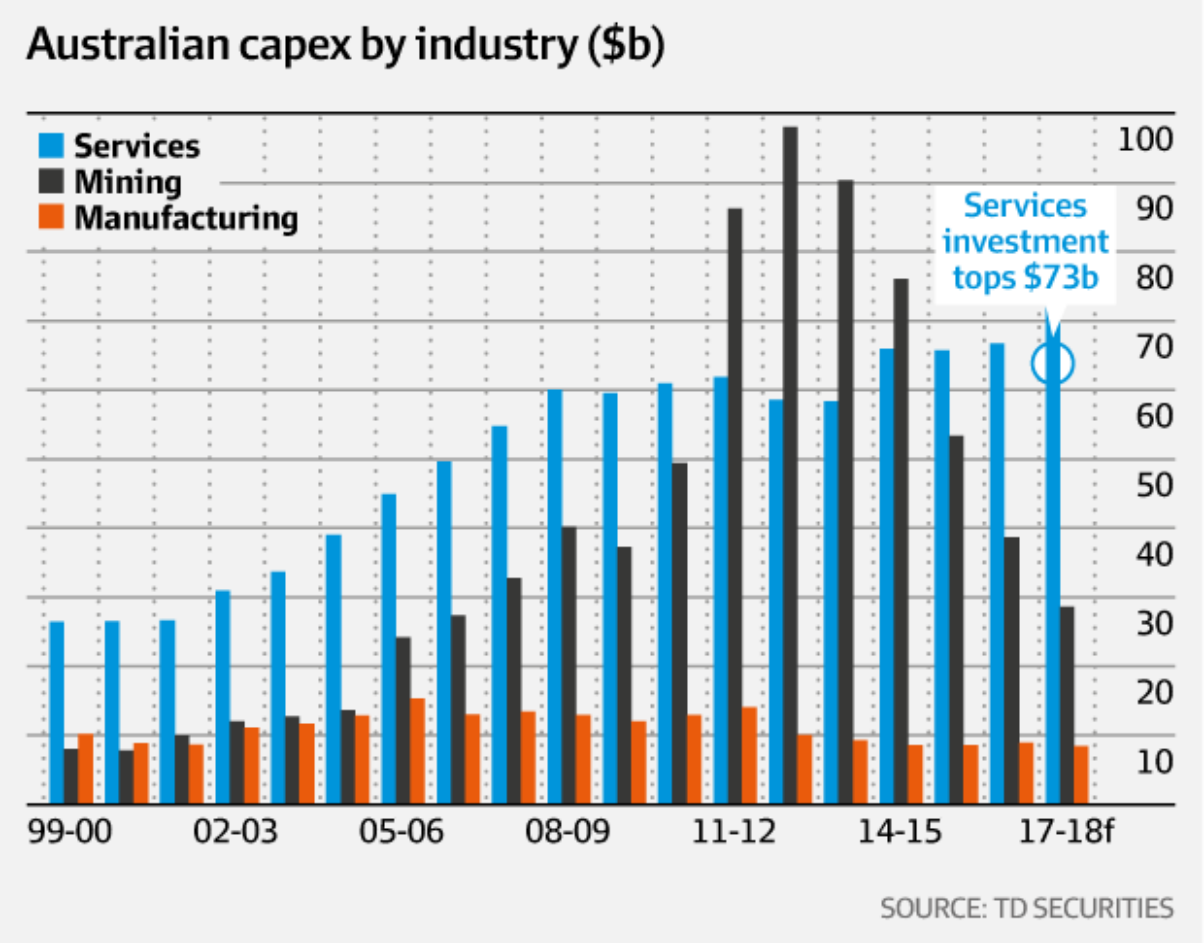

Figure 7: Australian Capex by Industry (TD Securities, 2017)

Figure 7 demonstrates the significance of mining, services and agriculture on Australia's capital expenditure to the year 2017.

The coexistence model is often challenged through the separate and conflicting interests and priorities of the associated stakeholders. The divisions become very clear between food producers, energy producers, government offices, and more often than not, neighbours.

Trust is the key word in relation to the process of energy development. The perception through observation is that the lack of trust and confidence in both government due process and companies developing the resource, have serious implications to the speed at which the resource is developed.

The key challenge is to manage the various interests amongst stake holders, to endeavour to achieve a suitable co-existence model.

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Bureau of Land Management, Casper, Wyoming, Kurt Triscori.

ConocoPhillips Canada Surmont No 2 KL(Gus) Lorenowicz 171 Conklin AB.

Shannon Anderson Powder River Basin Resource Council, Sheridan, Wyoming.

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Donnie Blankenberger, Evansville Indiana.

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Susan Speckert, Fayette Alliance, Lexington, Kentucky.

Dennis, Ross John Carnahan, Carnahan and Son farms, Vincennes, Indiana.

Doug, Mike, and Mark Anson, Anson Family Farms, Monroe City Indiana

John & Marlene Peacock.

Kallen Moore JBS Feedyard Brooks AB

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Abbreviations

ADR	Alberta Development Regulators
CBM	Coal Bed Methane
BLM	Bureau of Land Management Wyoming
DNR	Department of Natural Resources Indiana
EL	Exploration Licence
EIA	US Energy Information Administration
Ha	Hectares
LGP	Low Ground Pressure
ML	Megalitre (1000000 Litres)
SAGD	Steam Assisted Gravity Drainage
SG	Shale Gas
SUA	Surface Use Agreements
SMCRA	Surface Mining Control and Reclamation Act
US	United States

WILDCATTING The process of drilling for oil or natural gas in an unproven area, that has no concrete historic production records and has been unexplored as a site for potential oil and gas output.

WOGCC	Wyoming Oil and Gas Conservation Commission
WSEA	Wyoming Split Estate Act

Objectives

Firstly, it has been the authors intention to provide the reader with an objective view of how co-existence of mining and agriculture looks in other locations of the globe.

Secondly the demands placed upon local shire councils and communities with the influx of population, traffic, local service requirements and boom town type activities have not been fully investigated. It is the authors intention to provide insight into the assessment of the viability of an agriculture and energy extraction co-existence model.

This study has focused on the assessment of the key considerations and constraints in managing the impact of extractive energy industries and agriculture coexisting in close environmental proximity to each other.

The difference in the perception of environmental value indicate that the co-existence of energy and agriculture requires legislative framework manipulation that accounts for the environmental, social, economic and cultural values.

This paper will:

- Assess the government legislative process and its implementation.
- Measure the social and societal effects.
- Understand the true value of the agricultural and energy resources.
- Observe the cumulative effects of the process of extraction and regeneration.
- Discuss core objectives with regards to future energy and agricultural coexistence models.

This study has highlighted the emphasis and understanding that is required in relation to stakeholder's asset value, subjective perception with regard to what is valued and the emotive triggers when managing the co-existence of resource development and agriculture.

Chapter 1: Introduction

This paper focuses on the potential development of coal mining activities in an area in Australia called the Liverpool Plains. The area covers 1,200,000 hectares of various soil types.

Soils in this area are predominantly black vertosol soils that are deep in profile and have high water holding capacity. These soils are very well suited to growing various crops both during summer and winter. The region produces cotton, wheat, soyabean, sunflower, pulses, fruit, vegetables, beef, chicken and lamb.

With these rich natural environment attributes primary producers within the area are engaged in consistent reliable agricultural production when the weather permits.

In 2005 the NSW state government issued the licence to explore for coal under EL6505.

Upon its inception, the concept of being able to extract large tonnages of thermal coal from beneath alluvial flood plains has been met with considerable resistance from the local agricultural community and agricultural service businesses. This area hosts considerable underground alluvial and sandstone water formations that have been developed within agricultural businesses to enhance cash flow and bolster capital value. These water rights have licenses attached to them that are secured by financial institutions and often have funds lent against them to assist with further development.

Conflicts have begun to appear as the miners feel these rights are also their rights to the water and the security of this water can no longer be guaranteed. It poses a significant risk to banks' ability to lend money on a resource that potentially will only exist on paper.

Continually the miners have endeavoured to appease this conflict by stating that they would be able to coexist with agriculture and operate under current State and Federal legislation while ensuring the viability and longevity of the underground water reserves.

The coexistence model is often challenged through the separate and conflicting interests and priorities of the associated stakeholders. The divisions become very clear between food producers, energy producers, government offices, and more often than not, neighbours.

Trust is the key word in relation to the process of energy development. The perception through observation is that the lack of trust and confidence in both government due process and companies developing the resource, have serious implications to the speed at which the resource is developed.

The key challenge is to manage the various interests amongst stake holders, to endeavour to achieve a suitable co-existence model.

The author writes this whilst sitting on the tarmac at Vancouver International Airport. The sleep deprivation factor once again kicks in – something that becomes very familiar when undergoing a Nuffield Scholarship – having left Tamworth airport 18 hours ago with four more hours of travel to go.

Chapter 2: Lessons and Learnings from the United States and Canada

Government Legislative Framework in Wyoming and Environmental Pressures

United States (US) Department for Interior Bureau of Land Management Casper 2987, Prospector Dr, Casper, WY 82604, United States Wyoming Kurt Triscori. 20 August 2016

The state of Wyoming is heavily reliant on the coal, oil and gas industries. The Powder River Basin produced 363 million metric tonnes of coal in 2015. This coal is used to power US thermal power generation plants. In 2012, 21 of Wyoming's 23 counties had oil and gas production; 57,000,000 barrels of oil were produced and over 2 trillion cubic feet of gas. (US Department for Interior Bureau of Land Management Casper, 2016.)

The US Energy information administration states that Wyoming (WY) produces 39% of all the coal mined in the US (Figure 8). Furthermore, 33 US states are directly reliant on WY for their coal supplies for power generation with eight of these states receiving 90% of the coal they require from this state.

The scale and value of the Powder River Basin to the state of Wyoming is difficult to comprehend. To move 363,000,000t of coal per year requires 100 train loads per day. The net value of this to the state of Wyoming is $600,311,2501 (Figure 8).

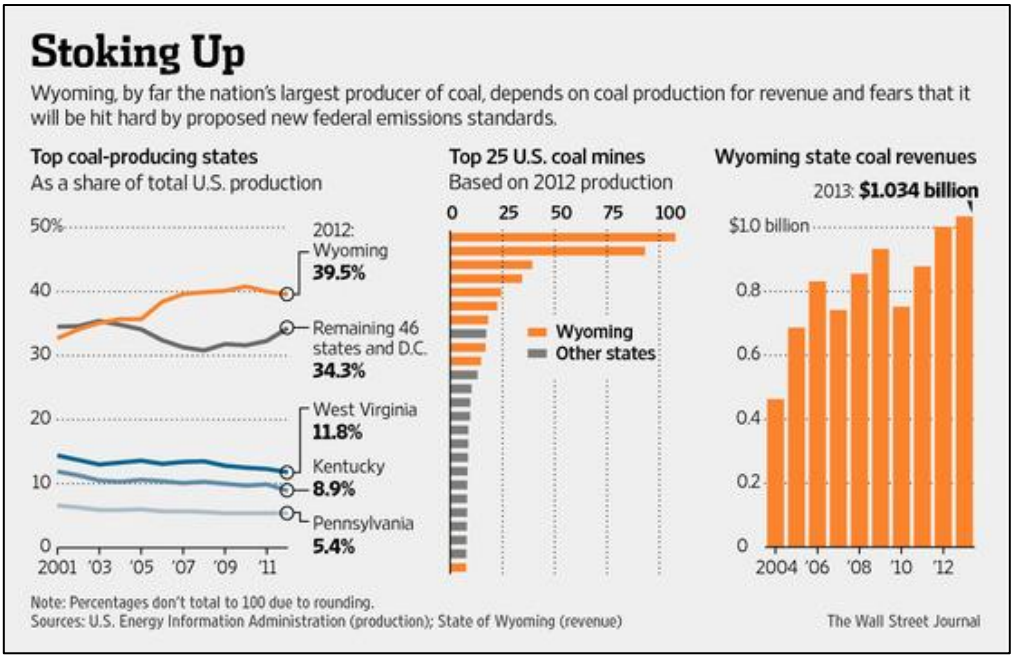

Figure 8: Relevance of coal to the state of Wyoming (Wall Street Journal)

[1] Value calculated at $13.23US per metric tonne (Impact of the Coal Economy on Wyoming, February 2015) and at 12.5% royalty which contributes $600,311,250 to the WY state purse.

In the US, the Surface Mining Control and Reclamation Act (SMCRA)1977 requires that coal mining areas be restored to 'a condition capable of supporting the uses which it was capable of supporting prior to any mining, or higher or better uses' (coal mine site reclamation, 2013).

The SMCRA requires mine operators to submit a mine reclamation plan prior to the release of any mining permits to commence extraction. The mining development operator must also post a performance bond prior to development to ensure that the funding will be available to complete the restoration.

The concept behind the environmental bond is to provide sufficient funding streams to finalise the reclamation, even if the mining company goes out of business. This environmental bond is not released to the mining operator until after the state or federal regulator office has concluded that the reclamation is successful.

Predominantly there are three types of environmental bonds held in the USA:

Corporate Surety Bond	A guarantee that the contractor will perform the obligation stated in the bond.
Collateral Bond	Short-term debt security (cash, letters of credit, federal, state, or municipal bonds).
Self Bond	Legally binding corporate promises available for those who meet certain financial tests conducted by the US State or Federal government. Not all US States allow self-bonding.

Bond release conditions occur after the regulatory authority deem the process of reclamation is acceptable. Often this process occurs in phases with sections of the bond being released at the conclusion of each phase. (Coal mine site reclamation. 2013. IEA Clean Coal Centre)

- Phase 1 - back-filling, regrading and drainage control.
- Phase 2 - topsoil replacement and vegetation establishment.
- Phase 3 - meeting the revegetation success standards.

The US Federal government framework for the development of a coal mine is designed to allow the mining company to develop in a period of ten years, subject to conditions. This is summarised in Figure 9 below.

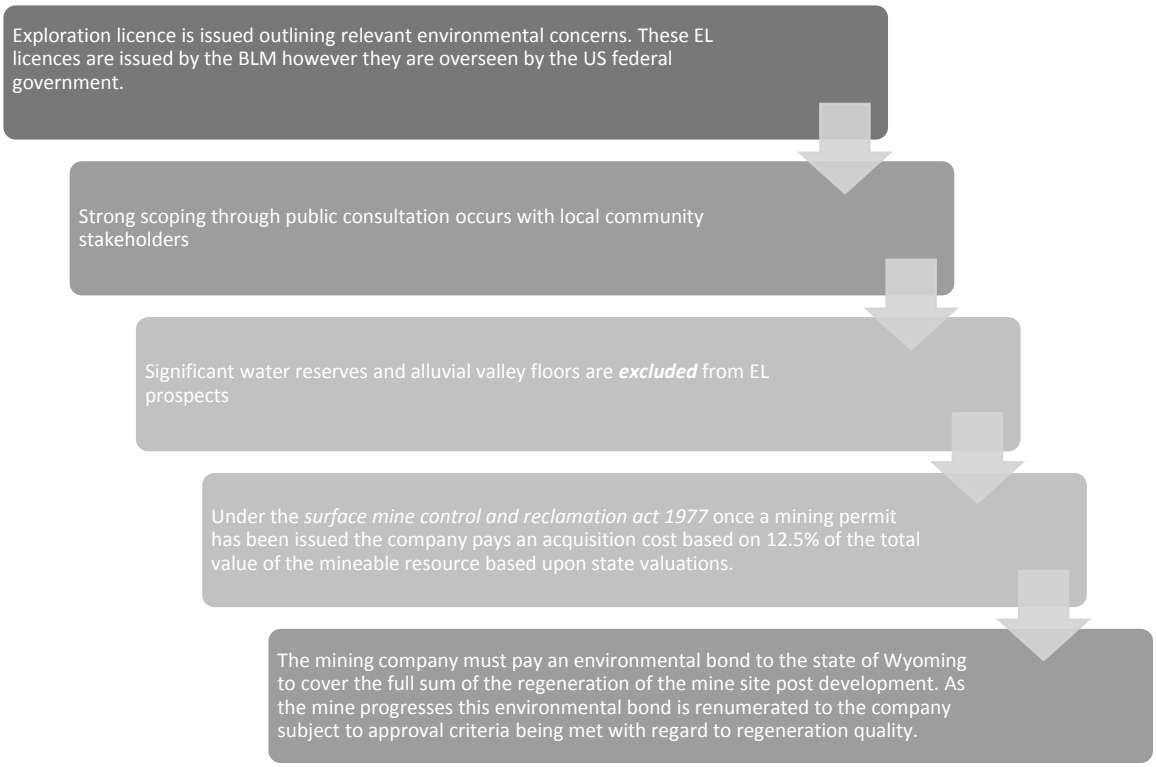

Figure 9: US Federal Government Frame Work for Mining Developments

The total value of agricultural production in the state of Wyoming in the year of 2012 was US$1,689,426,000. Of this, crops accounted for $438,968,000, while the remaining $1,250,458,000 was the result of livestock and poultry operations (Wyoming State Agriculture Overview, 2012).

The state of Wyoming has undergone significant development in the shale gas industry. Inadvertently, this has devalued the coal industry by supplying the US with a far cheaper source of energy in the current market climate. The process of shale gas extraction and coal bed methane (CBM) extraction has put significant pressures on the already scarce water resources in the state of Wyoming.

The stresses generated on the water resource occur through direct extraction of the CBM gas process, water loss into the deeper structures through gas depletion and sub artesian drainage or pollution through extraction.

Drilling in deep shale formation horizons and hydraulic fracturing requires 10-20ML per well. These water quantities are being drawn from the sub-artesian and artesian water resources (Garry Packard, 2016, Sheridan Wyoming, see chapter 3).

Gary S. Swindell, Powder River Basin Coalbed Methane Wells stated in 2007 that the eastern powder river basin was host to 20,000+ CBM wells with an annual growth rate of 2000 per annum.

Measuring social and societal effects

The author met Kent Britton and Jim McPherson of Stoney Mountain Waste Management in August 2016. This meeting outlined the issues that surround the instigation of a gold rush

type industry developing in an area that was based around agriculture. The oil sands of northern Alberta and Saskatchewan supply 32 states of the US with oil either via pipeline or shipped traditionally in twin hulled tankers by sea.

Politically, the debate is based on the issue of devaluing oil to such an extent that it starves other oil producing countries, disrupting their economies and affecting regional conflicts. Socially, as the cost of living goes up, the "oil patch" employee has a higher expectation of what their labour is valued at. Kent and Jim gave some sobering examples of people who refused to leave the house for under $90.00/hr.

The same issues seemed to be present in the oil sand regions as in the gas field areas. As the cost of living rises the employee expectation rises: many of the employees are sought from eastern Canada with a price tag in excess of CAD $200,000 per annum. A production supervisor at Exxon who observes the performance of their oil wells commands a salary of $275,000, and an employee to operate a truck in the oil sands hauling earth is typically paid $200,000.

The author met Kallen Moore, Feedlot Manager at JBS Processing Plant and Feedlot in Brooks, Alberta in July 2016. The town of Brooks has a population of approximately 13,500.

At JBS, the total yard capacity is 75,000 head, with 51,000 head capacity in July 2016. There is 3,500 hectares (ha) of associated farmland and 52 pivot irrigation systems managing the waste water from the yard and the processing facility. They have four steam flaked mills running.

The animal induction weight is 400kg and JBS ownership has exited since 2014. All stock work is done on horseback and there is a nil roping policy ex feed yard pen. Animals are 145 days on feed average throughout the yard.

The yard has no trouble finding machinery operators – as a direct result of the energy slowdown – but it does have trouble sourcing stockman.

A tension has developed in the local community. As traditional feed yard employees moved to the oil fields the labour void was filled with migrants and now the locals are out of work and the migrants have filled their positions. JBS Food Canada plant has 2,000 employees processing between 2,000-5,000 head (bovine) per day dependant on demand. The management structure is very autonomous with each of the associated areas of the business having a manager operating under the General Manager.

The "oil patch effect" means it has set a precedent on the expectations of the employee, many who have returned have been earning over US $45.00 per hour. The precedent has been set that this is now the going rate and to combat this outside labour has been sought to deliver a reliable supply of stockman labour.

Inadvertently, the result is that the lower skilled labour has been sought from overseas. Now the oil patch has slowed, much higher skilled operator labour is available. However very few of these workers are prepared to do the physical labour in the yard.

Following significant discussion surrounding the scale of oil sands and shale gas development in Canada, the author was encouraged to visit Fort McMurray to observe the extraction of oil under a process known as Steam Assisted Gravity Delineation (SAGD). The oil sands industry arose as a direct result of the improvement of available drilling technologies such as this.

Horizontal drilling spawned the development of the shale gas, shale oil, and oil sands industries. The oil sands were often deemed too inefficient at depth to extract the energy from. The resource sat at approximately 300-400m in depth, which would make the extraction process costly and inefficient. Conventional oil extraction works on the principals of sucking oil through a straw; as the resource depletes the oil is substituted for water. Although this process is efficient initially, the well becomes more inefficient as the age of the well increases.

Understanding the value of energy and agricultural resources

The author visited ConocoPhillips Surmont II site in Fort Mcmurray, Alberta.K L (Gus) Lorenowicz is the co-operator (from Stoney Mountain Waste Management). Due to the site protocols the opportunity to take photos was limited. However, to enlighten the reader with some understanding, the site has a total build value over US $10 billion. It has 30% of its resource developed which it is deemed stage 2. At 30% developed this site is producing 40,000 barrels per day. Between today and 2055 there are a further three stages to come into full production.

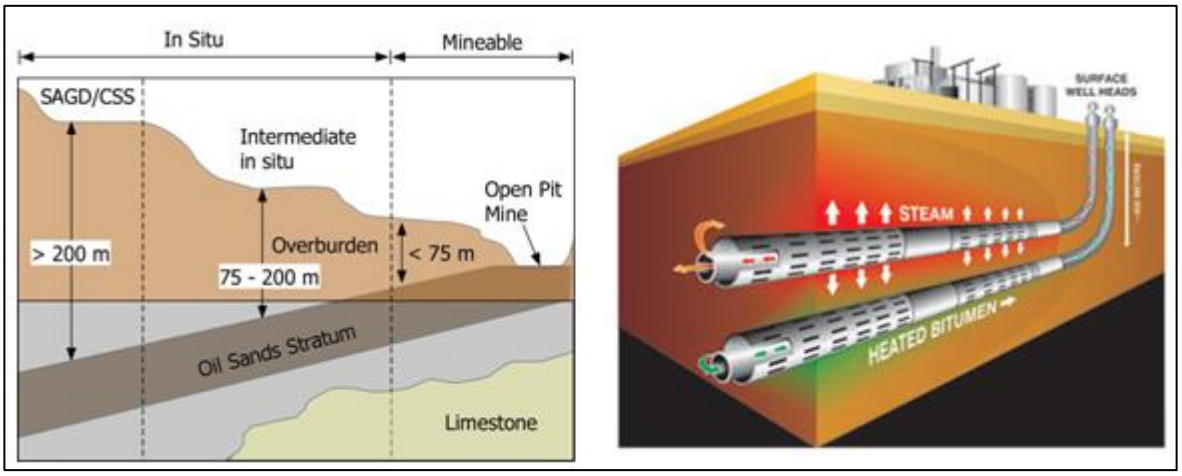

Figure 10: SAGD process Conoco Phillips Site

Surmont II Project site employees 15 people per 12-hour shift. The cost to extract a barrel of crude at ConocoPhillips is CAD $21.00, and once the plant ramps up production this will drop to $18.00. The issue for the Canadian Oil Sands industry is that to remain competitive with the Saudi Arabian and Middle Eastern oil its cost of production needs to reduce to US $4.00.

The total industry in Canada has available 172 billion barrels of oil of which 166 billion barrels are located in the oil sands (AER 2015 and Oil and Gas Journal, 2014).

The multi-billion dollar project is in Phase II in the construction of the Surmont in-situ oil sands production facility. The facility is designed to produce approximately 118,000 barrels of oil

per day over its 40-year production lifespan. Steam-Assisted Gravity Drainage (SAGD) is used to remove the oil from deep below the surface.

SAGD is the most commonly used method to recover oil in the Athabasca Oil Sands Region. Two horizontal wells are directionally drilled from a central well pad. In a nearby plant, steam generators powered by natural gas heat non-potable saline water and transform it into steam. The steam then travels through above-ground pipelines to the wells where it is injected into the ground via the top well where it heats the oil to a temperature at which it can flow by gravity into the producing well. This process of steam injection and oil production happens continuously and simultaneously. The resulting oil and condensed steam emulsion is piped from the producing well to the plant where it is separated and treated. Following this, the water is recycled for future steam generation and the oil is blended with dilbit, a lighter oil, and sent to a nearby pipeline for distribution. 90% of the water is recycled. In a process which uses 2.5 barrels of water to produce one barrel of oil, a 90% recycle rate is crucial to maintain environmental integrity. It was stated that ConocoPhillips is totally committed to the complete reclamation of the nearly one square mile of land that the project site resides on. It is not all good news, however. As stated by the Directorate General for Internal Polices Policy Department A: Economic and Scientific Policy in 2011:

> *'An unavoidable impact of shale gas and tight oil extraction is a high land occupation due to drilling pads, parking and manoeuvring areas for trucks, equipment, gas processing and transporting facilities as well as access roads. Major possible impacts are air emissions of pollutants, groundwater contamination due to uncontrolled gas or fluid flows due to blowouts or spills, leaking fracturing fluid and uncontrolled waste water discharge. Fracturing fluids contain hazardous substances, and flow-back in addition contains heavy metals and radioactive materials from the deposit. Experience from the USA shows that many accidents happen, which can be harmful to the environment and to human health'.*

Figure 11: Syncrude Fort McMurray, Alberta, Canada with elemental sulphur by-product in foreground

Figure 11 shows an aerial view of the Syncrude project. This helps gain some perspective of the true scale of the development of the oil sands of Alberta. This is one open cut site of eight in the region. It is a strange juxtaposition in Canada as a EPA environmental reportable spill of oil in Canada is 250ml.

The basis of a visit to Lexington, Kentucky, was to establish how the relationship between the landholder and the urban dweller could be developed while retaining the productive value of the agricultural lands. The principle behind this relationship development was to establish an understood value in the local people regarding the agricultural production that they inadvertently play a part in.

The author met with Dan Pride as part of a visit to Jonabell Farm in Lexington. Jonabell, through its affiliation with the Fayette Alliance, falls into an exclusion zone. The area is known as the Bluegrass county.

The basis of the program – and the role of the Alliance – is to sustainably grow the city of Lexington while promoting the anchor of the area, that being the high value lands that support agriculture and horse studs.

The Fayette Alliance recognises four pillars in its model:

- Quality of life.
- Economic growth generated by agriculture and the horse industry.
- Incomparable natural resources.
- Ideal environment.

The key point that Mr Pride emphasised was to understand the true value of what was trying to be protected.

In January 2013, the University of Kentucky was engaged to measure the influence of the agricultural cluster on the Fayette County economy. The paper found that historical nature of measuring agriculture in the county focused on production agriculture. However when the cluster was expanded to include the agricultural inputs, food processing, transport, communications, wholesale, retail and service industries the real value was discovered.

The findings were that one-in-nine jobs were directly linked to agriculture (16,676 in total) and that the cluster generated US $2.4 billion in output annually with a further $1.32 billion in additional income, profit and dividends. It was evaluated that $66 million in tax revenue is collected from state income tax and sales tax (Influence of the Agricultural Cluster on the Fayette County Economy, 2013). A further significant part of the attraction to the area of Lexington is that of the landscape.

> *'The landscape is fundamental to what we do. If the landscape and the horse farms disappeared, we would have no brand…one of our largest draws is our stunning and pristine landscape' (Influence of the Agricultural Cluster on the Fayette County Economy, 2013)*

The Vision: '*Lexington-Fayette County will be the model for sustainable growth, by balancing and connecting our vibrant city, with our productive and beautiful Bluegrass farmland*' (Fayette Alliance (2015) Annual report).

Key to this was that the thoroughbred industry, which is historically very private, open its doors to the community in an effort to educate them as to the value of that at their doorstep.

The Fayette Alliance conducted a survey that was conducted by a research group known as matrix. The result was that 48.2% of all respondents wanted an increase in locally grown and produced food products. (Fayette County Resident Opinion Survey, 2015.)

Critical to the success of the management of Lexington's bluegrass country is the Purchase of Development Rights Program. The program helps conserve the precious bluegrass landscape by purchasing conservation easements on 50,000 acres in the Rural Service Area to secure a critical mass of protected farmland for general agriculture, equine and tourism industries.

Essentially, a permanent agricultural land easement is created over the associated lands on a voluntary basis, whereby the landholder forgoes their right for development and leaves the land in agriculture for perpetuity.

Understanding the value of energy and agricultural resources

The author met with Sharon Anderson, Powder River Basin Resource Council in Wyoming. The Powder River Basin Resource Council's mission statement is:

> *The preservation and enrichment of Wyoming's agricultural heritage and rural lifestyle*
>
> *The conservation of Wyoming's unique land, mineral, water, and clean air resources consistent with responsible use of those resources to sustain the livelihood of present and future generations.*
>
> *The education and empowerment of Wyoming's citizens to raise a coherent voice in the decisions that will impact their environment and lifestyle.*

The Powder River Basin Resource Council was developed to assist landholders who were directly affected by energy development in Wyoming. Wyoming and Texas are somewhat unique as some landholders held their mineral rights as part of their original homesteading tenure, and holders can negotiate with coal and oil companies for the right for surface access arrangements through state process. The issue is that through a loophole there is provision for gas companies to access land without landholder consent. As the CBM industry developed, landholders felt they had lost their voice, and in some situations landholders were host to 200+ CBM wells of which they had no control over their development.

Wyoming's situation, although not isolated, is interesting as the social values that are held by the landholders are derived from a long history associated with early homesteading. The landholder is nearly always multigenerational with a strong intent to continue ranching into the future. Issues arise between the ranchers, the locals and the energy companies with the ranchers becoming the target of public and mining company campaigns that they are impeding the flow of mining royalties into the community. The local community receives monies from the federal government when the resource is released to a mining or petroleum

licence. 50% of all monies are returned to the state once the EL becomes a petroleum or gas licence, a further 12.5% returns back to the state on a profit share arrangement, a further 6.5-7.0% on top of that is paid as royalty. A slowdown in the demand of CBM and shale gas means the state's financial position becomes weaker.

A change in federal administration is placing significant pressures through carbon policy to attempt to grandfather coal power stations to natural gas. The ramifications of shutting down an industry that is mutigenerational has significant social implications. The locals have the view that without a republican nominee winning the US federal election their way of life will be threatened. The issue with all natural resources is that the market is global, meaning that no amount of state or federal legislation can determine the value of the natural commodity.

The take home message in Wyoming is that the coal industry implementing the available technologies that are available is '*the least worst industry available'*.

Federal policy is based on the reduction of carbon emissions through improvements of technologies in the design of replacement power plants. The issue is perceived to be in the wording of the policy to be implemented. Federal focus is on the limiting of carbon emissions. However, Sharon Anderson believes the main emphasis should be on that of capture and carbon sequestration in an effort to stimulate investment into sourcing more cost-effective ways sequester carbon.

In Sharon's words: "*There are winners and losers in legislation, how do you decide?"*

The contribution of coal to the state of Wyoming is in excess of US $1 billion per annum. Agriculture in Wyoming is in the situation that the support generated by the general population is proportional to its contribution to state revenue. This makes it hard for agriculture to compete against the energy industry.

There seems to be a perceived imbalance regarding the ability of the department of the environment to get things done for the energy companies.

Observation of the cumulative effects of extraction and regeneration

The state of Indiana has suffered the same market adjustment as Wyoming regarding the coal industry. However, an interesting point of differentiation with the state of Indiana to Wyoming is that of the value of agriculture to the economy. Figure 12 below demonstrates the gross value of agriculture by commodity and Figure 13 highlights some of the key statistics of mining and agriculture.

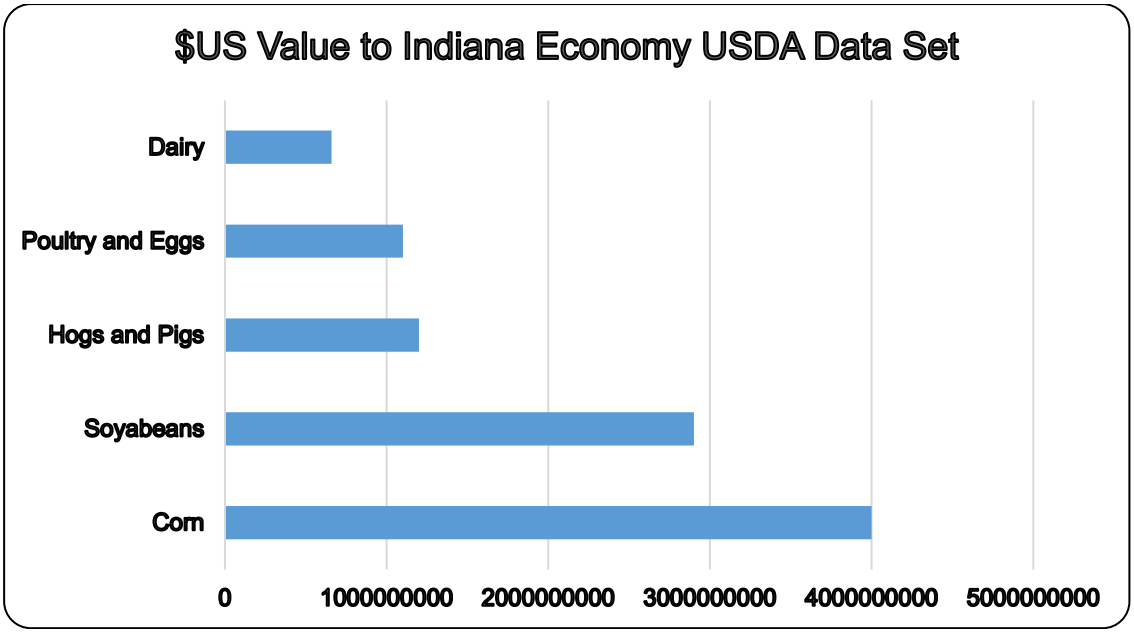

Figure 12: $US Value to the Indiana Economy, relative commodity value (Source: USDA)

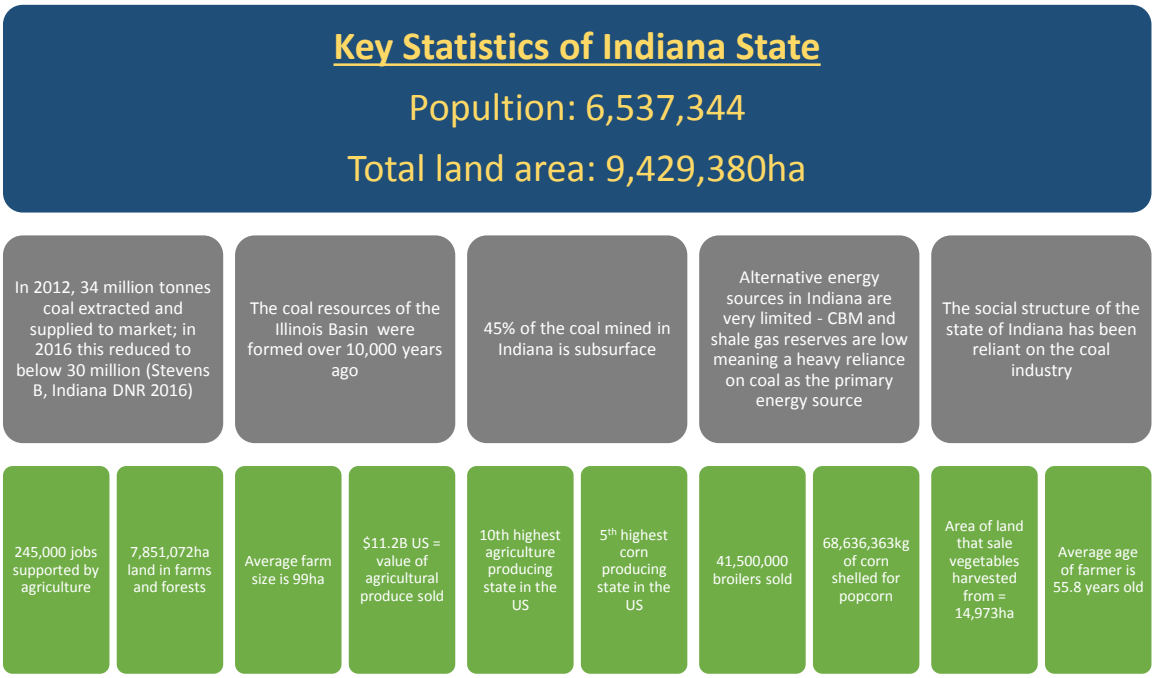

Figure 13: Comparative statistics for the state of Indiana (Source: USDA)

The author met Bruce Stevens Director of the Division of Reclamation from the Department of Natural Resources in Jasonville, Indiana. Their mission statement is:

> *'The Division of Reclamation, are dedicated to professional public service through effective administration of Indiana's mine reclamation laws. We are committed to ensuring optimum management of natural resources and public protection both during and after mining'.*

The state of Indiana prides itself on the process of extraction and sustainable regeneration. r Stevens suggested that the key to successful regeneration post extraction is to have a rigorous mine operations plan.

He also suggested that the key success factor in the regeneration of lands in the high rainfall and production areas of Indiana is not to compact the high clay soils. The mechanics of the process were the primary points of success. The soils are dumped on the regeneration sites after being loaded with hydraulic excavators, the dumped soils are then pushed with low ground pressure bulldozers (LGP), laser levelled and ripped 1250mm deep.

A Citizens Guide to Coal Mining and Reclamation in Indiana can be found on the Indiana Department of Natural Resources (DNR) website here: http://www.in.gov/dnr/reclamation/files/re-Guide_Coal__Mining_Reclamation.pdf. It includes an example of a Mine Operations Plan and an extract from this document is below.

"The Department of Natural Resources Indiana (DNR) must approve every aspect of the plan before mining can begin. The plan must include:

- description of mining area.
- information to demonstrate that reclamation can be accomplished.
- type of mining process and technique.
- direction of mining.
- access roads.
- facilities for coal processing.
- coal processing waste disposal sites.
- structures.
- water impoundments and land uses.
- stream diversions.
- water and air pollution control facilities.
- overburden and topsoil handling storage areas.

Topsoil Removal and Storage

Before mining begins, operators must plan for the replacement of topsoil after the coal has been removed. Details about the removal, storage, replacement and protection of the topsoil from wind and water erosion are listed in the mine operation plan. Topsoil, which is removed in a separate layer from areas to be mined, is immediately replaced or stored at approved locations.

A topsoil substitute or supplement may be used where it is determined that selected overburden materials are equal or more suitable chemically and physically for sustaining revegetation than the existing topsoil. Examples of using a topsoil substitute would be if prior to mining the topsoil had been contaminated or if erosion had lessened the quality of the soil. Topsoil depth before mining must be determined to ensure proper replacement depth for growing row crops and other vegetation.

To comply with these requirements, operators usually operate in the following manner. Before mining begins, scrapers or other machinery remove the topsoil and directly replace it on graded overburden or stockpile it for replacement after mining. Seeding and mulching protect the topsoil from wind and water erosion. Marking stockpiles as being topsoil and protecting them with a cover of vegetation prevents the soil from mixing with any other stored material.

Careful handling of the topsoil and subsoil is crucial for reclamation because this is the medium on which the success or failure of plant growth on the reclaimed site is determined. The combined depth of replaced topsoil and subsoil on areas designated as prime farmland must be a minimum of 1100mm deep."

Figure 14: Visiting a regeneration site at Jacksonville, Indiana, planted to sorghum and mined by Peabody Energy, 2009 (Source: Author)

Cumulative effects of the process of extraction and regeneration on Agriculture

The author met Doug, Mike, and Mark Anson in Indiana in August 2016. Anson Family Farms is a 8,000ha operation based in Lawrence County, Indiana. The Anson brothers' grandfather started the business with 10ha. Today the business operates across nine counties.

The business produces corn, soybean, storage, turkeys and cover cropping. There are three 24-meter John Deere precision corn planters, four John Deere S series combines, three 4045 John Deere self-propelled sprayers and multiple John Deere tractors. They have a full zero tillage system operating in conjunction with a cover cropping program.

In addition, multiple acres have been reclaimed from pillar and block and open cast mining. The land reclaimed from the coal mines is assessed for regeneration bond performance and reimbursement in three stages.

- Phase 1- Contractor receives first phase once 60% is reclaimed and planted.
- Phase 2- Economic proof that two viable crops have been planted and combined at least meeting the county average yield.
- Phase 3- Once all requirements have been fulfilled and productivity proof is met the remaining 15% is paid.

Environmental quality incentive program- pay portion of cost to introduce cover crops into any lands that are suitable (highly erodible).

Doug Anson took the author to a site that had been reclaimed from a strip-mined site as shown in Figure 15. The site had been reclaimed using the most current methods of regeneration. In addition, the use of turkey manure had been used to assist in feeding the microbial activity in the cover cropping biomass breakdown.

Figure 15: Soyabean sown into cereal rye and crimson clover covercrop on reclaimed lands from bed and pillar mining (Source: Author)

The results were outstanding. It was stressed by Mark Anson that the imperative source of success was to source high-quality pure seed so as to not put pressure on chemical groups when burning the cover crop down. The timeliness of cover cropping operations on lands – either reclaimed or not – is critical for the success of the emerging grain crop. When dealing with the soils reclaimed from mining activities, Doug's opinion was that the root biomass that accompanies a solid stand of rye is critical to support root microbial organisms.

The significant difference in this business with regard to the reclaimed soils was the speed at which soils have been regenerated after open-cast mining activities. Although not scientifically proven yet, the Anson family are using cover cropping regimes in a positive fashion to reinvigorate ex mining soils into a healthy balanced state.

John and Marlene Peacock have a small cattle property in the Ponoka County in middle Alberta, Canada, which the author visited in July 2016.

When dealing with oil and gas, the legislation that these companies operate under offer the landholders a very different experience to those whom were visited in Wyoming.

At a glance:

- Fracked oil well pad 400 meters from the Peacock's house.
- True well vertical depth 1629M and a further 2735M horizontal length.
- The pad was built in September 2015 to host to three deep well oil deposits.
- In September 2015, the property's main spring supply was intercepted, resulting in a total loss of property water supply.
- Post oil well fracking the water smells like H2S. The water that supplies the stock and family home relies on underground aquifer structure for supply.

During this visit, it was noted that the water that the Peacock's are drinking from the underground reserves also has bubbles in it. A nasal test suggests high levels of H2S in the drinking water.

The visit yielded some interesting information when related to that of the cumulative effects of the resources of agriculture. Tamarack drilling built a fracked oil well pad in September 2015. During pad construction it seems as if the supply for the property spring water was intercepted resulting in the loss of the water supply to the property. This spring water supply was then pumped into a holding pool during January-February 2016.

Figure 13. Tamarack Drilling Site, 2016. Fracking supply water holding tank right, incepted water supply foreground left, with pump in it. (Source: Author).

The author would suggest this property sits in a hub of fracked oil and gas wells that populate the county.

The fracked site sits on public crown owned lands. Although the access to the site passes through Mr & Mrs Peacocks property, it is in the interests of the crown so as a result no access agreement has been sought between the oil company and the co-operators. As a co-operator, land access sub-surface lease arrangements are usually sought between the oil company and the landholder. The oil and gas industries do not host a non-partisan regulator, which from the landholder's point of view results in the Alberta Development Regulators (ADR) very rarely engaging in mediation during dispute resolution.

Basic well economics

- New oil well after fracking yields 300-400m3 crude oil per day.
- One cubic meter of oil is the equivalent to 6.6 barrels of oil. For the purpose of calculation, value the oil at US $40.00 per barrel.
- Average 350m3 per day at US $40.00 = 2,310 barrels per day.
- Total value per well $92,400 per day.
- Total per annum US $33,726,000.

The Peacocks case study was interesting. However, the author suggests it is definitely not an isolated case, following further investigation. In summary, in this situation a dispute arose as a result of the landholders losing their properties water supply. The landholders need seemed reasonable. All they required was that the flow of the spring water supply be returned to normal. It seems as if this was not the outcome the oil company was prepared to appease the Peacocks with the promise of compensation.

Chapter 3: Experiences in North America regarding water contamination

Avenues for water contamination include:

- Spills of drilling mud, flowback and brine, from tailings or storage tanks causing water contamination and salinisation.
- Leaks or accidents from surface activities, e.g. leaking fluid or waste water pipes or ponds, unprofessional handling or old equipment.
- Leaks from inadequate cementing of the wells.
- Leaks through geological structures, either through natural or through artificial cracks or pathways.

Policy department A 2011 states that "*most of the complaints against hydraulic fracturing are because of possible groundwater contamination*".

Cumulative effects of extraction and regeneration on agriculture

The author visited Gary Packard at Buffalo, Wyoming, and Bill and Marg West, at Arvada, Wyoming in August 2016.

In summary, Garry Packard's great grandfather settled in the fall of 1876, after walking cattle from Texas. The operation received total rainfall of 250mm per annum.

In the 1970s, there was a large amount of exploration drilling and Garry found himself between a father that despised drilling companies and a mother who welcomed them. The Powder River Resource Council was formed in a barn on Garry's property.

This visit outlined the importance of the issues that the land holder's perception of what is important to them during the process of development. Gas company 'Wildcatting' drilled 21 Coal Bed Methane (CBM) wells dewatered artesian aquifer and did not yield gas. The result was complete decimation of his stock water supply.

Bill & Marg West's story was also an interesting one. CBM was being produced from a 30m seam of soft coal. Artesian aquifer dewatered to make gas available.

In Marg's words: 'The water is far more valuable than the gas'.

Four companies held the rights for the CBM on their property. CBM wells initially US $200,000 to the landholder per developed well but now the value has dropped to $2,000. Surface rights agreements have been signed between gas companies and the West family. There are approximately 1500 wells inhabit the immediate area

The authors experience in rural Wyoming was that of a situation where a gas and oil resource had been developed by resource companies with complete disregard for the environment and the landholder. The first-hand accounts of how companies gained access to lands under

Federal Government legislation left many of the co-operators with little security neither for land title or water title.

The effects of what a resource boom and bust cycle entails are being lived in the Powder River basin on a daily basis. The author suggests that the introduction of the 'split estate law' was the states effort to equalise the balance between the state, the resource companies and the landholder.

Split estate refers to the situation where one particular party owns the surface and another company/identity owns the subsurface mineral rights. In 2005, Wyoming Governor Freudenthal signed the Wyoming split estate act to encompass oil and gas exploration.

The issue in the state of Wyoming is that the Federal Government has ownership of the minerals and the petroleum resources. The statute developed under the split estate lands act applies to:

- Seismic and other forms of CBM exploration activities.
- CBM development and all associated infrastructure.
- Deep gas tight sands operations and all associated infrastructure.
- Oil development wells including secondary and tertiary operations.
- Oil shale operations and associated infrastructure.

Source: A Landowner guide to the Wyoming Split Estate Statute, 2005.

The introduction of the split estate laws to petroleum resources has meant that a permit for extraction cannot be issued without a bond to secure the payment for damages to the surface, the crops and forage, and to any tangible improvements that a surface owner posses'.

It also allows for any loss or disruption of the surface owners operation with regards to damages. There is argument that such legislation has allowed for more timely development of resource activities as they can operate in a more stable environment (Source: A Landowner guide to the Wyoming Split Estate Statute 2005).

Conclusion

This study has focused on the assessment of the key considerations and constraints in managing the impact of extractive energy industries and agriculture coexisting in close environmental proximity to each other.

The author suggests that it is essential for agriculture and energy to coexist to achieve a balanced approach. This objective observation is derived from the necessity for the associated industries to support all the key stakeholders who share in the resources. A 'lock the gate' policy does not allow for the energy industry stakeholders to explore nor develop resources even if the development of resource extraction is found to have minimal natural resource impact.

The difference in the perception of environmental value indicates that the co-existence of energy and agriculture requires a legislative framework that accounts for the environmental, social, economic and cultural values. For example:

- Assess the government legislative process and its implementation.
- Measure the social and societal effects.
- Understand the true value of the agricultural and energy resources.
- Observe the cumulative effects of the process of extraction and regeneration.
- Discuss core objectives with regards to future energy and agricultural coexistence models.

As previously mentioned, the point of differentiation here in Australia – compared to other countries – is that of the overarching government framework. The environmental bond policy stipulation puts the necessary economic deterrents in place for mineral and petroleum companies to instigate best practice.

This scholarship experience has highlighted the importance that needs to be placed on stakeholder's asset value, subjective perception and emotive triggers when managing the co-existence of resource development and agriculture.

This report demonstrates how water and energy are closely interconnected, the choices and actions made in one domain greatly affecting the other; the author's intention was to addresses a wide range of key issues, including agriculture, cities, industry, infrastructure and the environment.

As UN Secretary-General Ban Ki-moon stated in his message for World Water Day 2011:

> *"As the world charts a more sustainable future, the crucial interplay among water, food and energy is one of the most formidable challenges we face. Without water there is no dignity and no escape from poverty."*

The development of energy and the environment are obviously heavily interconnected. All sources of energy production require the use of water throughout the process:

- Extracting the raw materials.
- Cooling during the thermal process.

- Irrigation and chemical application in the production of crops for biofuels.
- Powering turbines.

Energy is required to make water available for human use and subsequent associated production through pumping, transportation, treatment and desalination. The development of the management of water, the environment and energy is a process that is being refined over time. It is critical that integration of policy and effective policy direction allow energy, water and the environment to develop a strategic plan that does not dissociate one sector from the other.

As described by the International Decade for Action 'Water for Life':

> *"Energy availability is the pillar for social and economic progress in a society. Water holds the key to development of energy infrastructures and remains fundamental throughout the lifecycle of energy infrastructure and resource development, from extraction of raw materials, purification, washing and treatment of raw materials to coolants in nuclear or thermal power plants to being a fuel for hydropower plants."*

Achieving water, energy and food security for all is one of the greatest challenges facing humankind. Already today, nearly one billion people lack access to safe drinking water, one billion people suffer from hunger and 2.5 billion people do not have access to modern forms of energy. These challenges will intensify in the future.

The OECD Environmental Outlook to 2050 projects that global demand for energy and water will increase by 80% and 55% by 2050 respectively. In addition, the FAO estimates a 60% increase in food demand over the same period. Population growth, economic development and climate change will accelerate competition for food, water and energy.

As for the future of the Caroona development which was the underlying issue that fortunately initiated the author to invest the time in a Nuffield Scholarship, common sense prevailed and the rights for BHP Billiton to explore for coal were resumed by the state of NSW.

As said by NSW Premier Mike Baird via the Australian Financial Review, 12/08/16, page 1:

> *"This decision guarantees the future of the state's most productive and fertile farming land, providing confidence for local farmers to invest in an industry that has the potential to be one of the food bowls of the world"*

Recommendations

The author suggests that the co-existence model performance relates directly to the landholder's perception of value and conflict with regard to their environmental and social assets.

The relationship and attachment of farmers to their land and water resource are not well understood by mining, gas, mineral and oil companies.

The main findings are:

- The values that farmers hold with regard to the impact of the landscape as it changes during the development are not well communicated by the landholders to the extraction companies who have financial interests in the natural environment for their resources.

- Fair and equitable compensatory processes could be established between resource companies and landholders if they had a better understanding of the perception of value by the landowner.

- Examples overseas that have hosted good community consultation and transparency operating and developing projects have led to positive outcomes for all the involved stakeholders.

- Negative measurable impacts to ground and surface water sources should negate any development proposal no matter its size nor economic value.

- The author supports the Canadian and US method of environmental bonding with relation to the objective methods of resource extraction. This environmental bond and associated federal government legislation is critical to produce positive outcomes with regard to sustainable energy extraction.

- As part of this environmental bonding – enforced by federal government – it is crucial that the implications of environmental default are such that the financial viability of the operation would be jeopardised by a company's incompetence.

- For the purpose of suitable legislative development, it would be a requirement for government, agriculture, mining and science industries to work closely and transparently to achieve equitable outcomes with regards to emerging issues and timely strategy development.

- The author supports the concept of the identification and total exclusion of energy related activities from strategic cropping lands and natural environmental assets.

Finally, as stated by Sharon Anderson Powder River Basin Resource Council:

> *'There are winners and losers in legislation……how do you decide?'*

References

A Landowner Guide to the Wyoming Split Estate Statute. 2005. Powder River Basin Resource Council. Sheridan. Wyoming.

ABARES 2014, *Catchment scale land use of Australia – update March 2014*. Department of Agriculture. http://data.daff.gov.au/anrdl/metadata_files/pb_luausg9abll20140506_11a.xml

ABS 2014c, *Value of Agricultural Commodities Produced, Australia, 2012–13*, cat. no. 7503.0, Australian Bureau Statistics, Canberra.

Australian Minerals Council Statistics 2012. Minerals.org.au

Australian Bureau of Agricultural and Resource Economics-Bureau of Rural Sciences 2010, *Land use of Australia 2005-06*, Version 4, Department of Agriculture, Fisheries and Forestry, Canberra.

Citizens Guide to Coal Mining and Reclamation in Indiana.

Indiana Department of Natural Resources Division of Reclamation 14619 W State Road 48 Jasonville IN 47438-9517

www.in.gov/dnr/reclamation/files/re-Guide_Coal_Mining_Reclamation.pdf

Department of Infrastructure Planning and Natural Resources 2004, A Guide to the Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources. September 2004. Accessed online 17/11/2009, http://www.water.nsw.gov.au/Water-Management/Water-sharing/plans_commenced/default.aspx

Department of Infrastructure Planning and Natural Resources 2005, A Guide to the Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources. April 2005. Accessed online 17/11/2009, http://www.water.nsw.gov.au/Water-Management/Water-sharing/plans_commenced/default.aspx

Department of Water and Energy 2009, Water sharing in the major inland alluvial aquifers. Progress report 2006 to 2008. NSW Department of Water and Energy, Sydney, May 2009. Accessed online 18/11/2009, http://www.water.nsw.gov.au/Water-Management/Water-sharing/plans_commenced/default.aspx

Energy resources from the food bowl: an uneasy co-existence. Identifying and managing cumulative impacts of mining and agriculture. September 2013

Centre for Social Responsibility in Mining Sustainable Minerals Institute, The University of Queensland, Australia csrm@smi.uq.edu.au

www.csrm.uq.edu.au

Directorate General for Internal Polices

Policy Department A: Economic and Scientific Policy. 2011. Impacts of shale gas and shale oil extraction on the environment and on human health

Study. europarl.europa.eu

Fayette Alliance annual report 2015.

The Influence of the Agricultural Cluster on the Fayette County Economy. January 2013. A Davis, L Garkovich, L Maynard, J Allen, S Burney & T Dunaway. University of Kentucky, College of Agriculture.

Fayette County Resident Opinion Survey 2105. The Matrix Group.

Impact of the Coal Economy on Wyoming, February 2015 Wyoming Infrastructure Authority Robert Godby Roger Coupal David Taylor Tim Considine

Center for Energy Economics and Public Policy Department of Economics and Finance University of Wyoming, Laramie, Wyoming

International Decade for Action 'Water for Life' 2005-2015. United Nations Department of Economic and Social Affairs (UNDESA). Un.org

Wyoming State Agriculture Overview 2012 nass.usda.gov

Powder River Basin Coalbed Methane Wells – Reserves and Rates

Gary S. Swindell, SPE gswindell.com

Plain English Compendium Summary

Project Title:	Assessing the Viability of Agriculture and Energy's Co-existence Model
Nuffield Australia Project No.:	1607
Scholar:	Angus Duddy
Organisation:	929 Rossmar Park Road Quirindi New South Wales AUSTRALIA 2343
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Objectives	The core objectives of this research paper are to: • Assess the government legislative process and its implementation • Measure the social and societal effects • Understand the true value of the agricultural and energy resources • Observe the cumulative effects of the process of extraction and regeneration • Discuss core objectives with regards to future energy and agricultural coexistence models
Background	The coexistence model is often challenged through the separate and conflicting interests and priorities of the associated stakeholders. The divisions become very clear between food producers, energy producers, government offices, and more often than not neighbours
Research	The authors intention to provide the reader with an objective view of how co-existence of mining and agriculture looks in other locations of the globe.
Outcomes	The values that farmers hold with regard to the impact of the landscape as it changes during the development are not well communicated by the landholders to the extraction companies who have financial interests in the natural environment for their resources. Examples overseas that have hosted good community consultation and transparency operating and developing projects have led to positive outcomes for all the involved stakeholders Negative measurable impacts to ground and surface water sources should negate any development proposal no matter its size nor economic value. The author supports the Canadian and USA method of environmental bonding with relation to the objective methods of resource extraction. It is crucial that the implications of environmental default are such that the financial viability of the operation would be jeopardised by a company's incompetence. The author supports the concept of the identification and total exclusion of energy related activities from strategic cropping lands and natural environmental assets.
Implications	For the purpose of suitable legislative development, it would be a requirement for government, agriculture, mining and science industries to work closely and transparently to achieve equitable outcomes with regards to emerging issues and timely strategy development.
Publications	Nuffield National Conference verbal presentation – Darwin, NT, September 2017