BEUMERGROUP

# CONVEYING VS. TRUCKING
# AN EASY ECONOMIC ANALYSIS TECHNIQUE

## INTRODUCTION

Most transport projects unilaterally utilize trucking because it is a known technology that provides flexibility. Long-distance conveying is often not contemplated because plants are unsure how to approach the economic analysis between trucking and conveying. This paper will explain how to easily compare the two technologies from both a technical and financial standpoint.

The economic benefit of conveying is easy to model. The way to look at this comparison of conveying vs. trucking is on an after-tax basis. In fact, the only logical way to look at it is on an after-tax basis. This allows the model to consider both capital and operating costs of each method in the equation which is crucial. The model spits out several key outputs. These are breakeven point, IRR, and cumulative after-tax cost over ten years. When all three are illustrated the results are enlightening.

The flexibility provided by trucking is truly valuable. But in some cases, it is too costly. The advantages of conveying by comparison are many and if analyzed properly they are easy to illustrate.

## A NEW TYPE OF CALCULATION

To properly evaluate a conveyor against trucking, it is important to identify all the variables that affect the calculation. This is a difficult task and is part of the reason that a complete analysis is rarely performed. The important variables are shown in table 1 below.

The key variables for any project are always the same – they include how many tons per year need to be moved and how far. This leads to the trucking cost per ton and the conveying cost per ton. The layout of the conveying route helps determine the capital cost of the conveyor. The three capital cost components are design/supply, civil works, and installation. For the trucks, the capital cost of the trucks and the operating cost per hour need to be identified. A critical calculation is the trucking cost per ton which can be a contractor all-in cost or a company owned truck cost per ton calculation. Either way it is important to identify the number of roundtrips per hour that can be achieved as this determines the trucking cost per ton moved.

| KEY VARIABLES | PARAMETERS | KEY VARIABLES 2 | PARAMETERS |
|---|---|---|---|
| Project Life | 20 years | Income Tax Rate | 30% |
| Depreciable Life | 10 years | Annual Volume to be Moved | Project Dependent |
| Type of Tax Depreciation | MACRS | Number of Trucks Required | Project Dependent |
| Cost per KHW for Power | 0.08 | Cost per ton for Road Maintenance | Project Dependent |
| Cost for Operations | $100,000 | Annual Inflation Rate | 3% |
| Cost for Maintenance | $100,000 | Conveyor Length | Project Dependent |
| Capital Cost of Conveyor | Calculated | Conveyor Capacity | Project Dependent |
| Design-Supply Cost | Calculated | Life of Trucks | Project Dependent |
| Civil and Foundation Cost | Calculated | Trucking Cost per Hour per Truck | Based on Size & Route |
| Mech and Elec Cost | Calculated | Roundtrips per Hour | Based on Route |
| Annual Inspection Cost | Based on Type of Inspection | Cost per Truck for New Trucks | Based on Size & Route |

*Table 1: Key variables for trucking vs. conveying analysis*

## KEY ADVANTAGE OF EACH METHOD

Trucking has the advantage of providing flexibility for the operation. In many cases this flexibility is so important that it thwarts the desire to investigate conveying. For plants where the future is uncertain or where haul distance is short, or where the volumes swing wildly from summer to winter, trucking is the logical solution.

The key advantage of conveying is the lower operating cost per ton which is predominantly a result of lower power cost and the ability to recoup the capital costs over time with accelerated tax depreciation. This adds up to a significant cumulative cost savings difference over time. If a plant is seeking O&M cost reductions by spending capital dollars, then the conveying option is worth modeling to see what the payback period for the investment is. If the payback period is short, then the cumulative after-tax savings difference also needs to be calculated. A short payback period is nice but a large cumulative after-tax savings over ten years is arguably even better.

If the plant operation is stable and will last for at least another ten years, then the breakeven point is usually well within this timeframe.

The "typical" project route to evaluate is usually over one-mile long. We pick this length range because projects where the destination is closer than one mile are typically trucked Conveying for these short routes usually does not pay out unless there are trucking problems.

## TRUCKING VS. CONVEYING CASE STUDY:

The specific project modeled herein is for a mine needing to transport coal 5 miles one way via transportation routes available. The annual volume is 5 MM tons. The trucks must be able to operate on public roads, so they are sized smaller to allow for the public road load limit. The type of conveyor is a curved trough conveyor as the terrain is not challenging and the curves eliminate the need for transfer towers. However, this analysis method is appropriate for any type of conveyor such as a pipe conveyor or conventional straight conveyors as well.

*Horizontal Curve Trough Conveyor inside "Jumbo Covers". The covers eliminate any exposure to the environment and provide ability to maintain the system out of the elements. There is room for a maintenance buggy to drive alongside the conveyor inside the covers.*

| KEY VARIABLES | PARAMETERS | KEY VARIABLES 2 | PARAMETERS |
|---|---|---|---|
| Project Life | 20 years | Income Tax Rate | 30% |
| Depreciable Life | 10 years | Annual Volume to be Moved | 5 MM tons |
| Type of Tax Depreciation* | MACRS | Number of Trucks Required | 8 |
| Cost per KHW for Power | 0.08 | Cost per ton for Road Maintenance | $0.25 |
| Cost for Operations | $100,000 | Annual Inflation Rate | 3% |
| Cost for Maintenance | $100,000 | Conveyor Length | 23,000 ft |
| Capital Cost of Conveyor | $12,240,099 | Elevated Length | 11,500 ft |
| Design-Supply Cost | $7,758,287 | At Grade Length | 11,500 ft |
| Civil and Foundation Cost | $765,718 | Conveyor Capacity | 1,500 tph |
| Mech and Elec Cost | $3,716,094 | Conveyor Operation | 9.5 hrs per day |
| Cost per Truck for New Trucks | $939,000 | Life of Trucks | 6 years |
| Trucking Cost per Hour per Truck | $109 | Capacity of each Truck | 60 tons |
| Roundtrips per Hour | 2.5 | Conveyor Run Days | 262 |
| Annual Inspection Cost | $15,000 | | |

*Table 2: Conveyor Project variables*

**Note, the current Trump tax plan rule allows 100% of the capital investment to be taken as tax depreciation in year one but that was not assumed for this project.*

## CONVERTING THE VARIABLES INTO USEABLE MODEL PARAMETERS

The key variable is the cost of the conveyor. The capital costs of the conveyor are shown below broken down into civil costs, design/supply costs and installation costs.

The operating cost is figured by calculating the power cost per ton at average operating load, the maintenance cost per ton by dividing the dedicated maintenance costs by annual volume and the same for operations personnel costs. An annual inspection cost is also included assuming the client hires the OEM to perform an annual conveyor inspection which is prudent.

### Capital Cost Estimate:

Curved Trough Conveyor 42 inch with three horizontal curves:

| | |
|---|---|
| Design/supply cost | $7,758,287 |
| Client Engineering & project management cost | $550,000 |
| Civil works | $765,718 |
| Mechanical and Electrical Technician | $3,716,094 |
| **Total Capital Cost** | **$12,790,099** |

### Conveyor Operating Cost:

| | |
|---|---|
| Power cost | $0.096 |
| Maintenance | $0.067 |
| Operating labor | $0.033 |
| Outage inspection | $0.007 |
| **Total Operating Cost** | **$0.203** |

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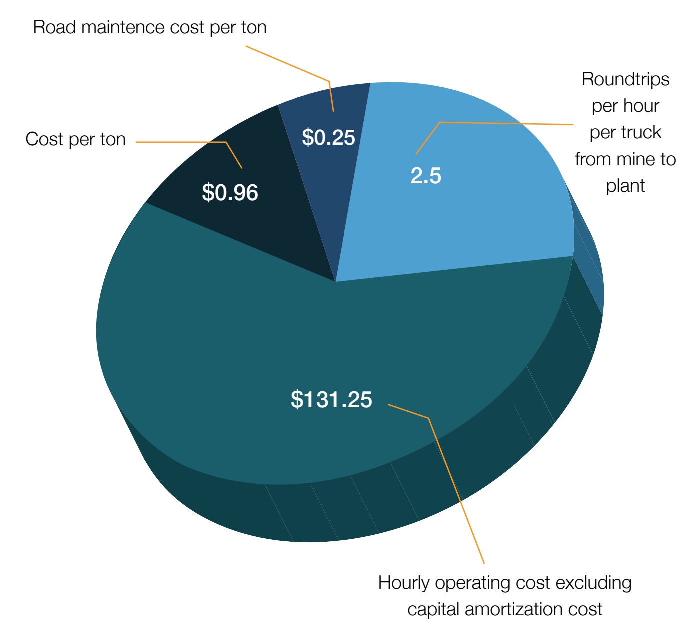
### Operating cost for 60-ton trucks:

### Total Trucking cost per ton: $1.21



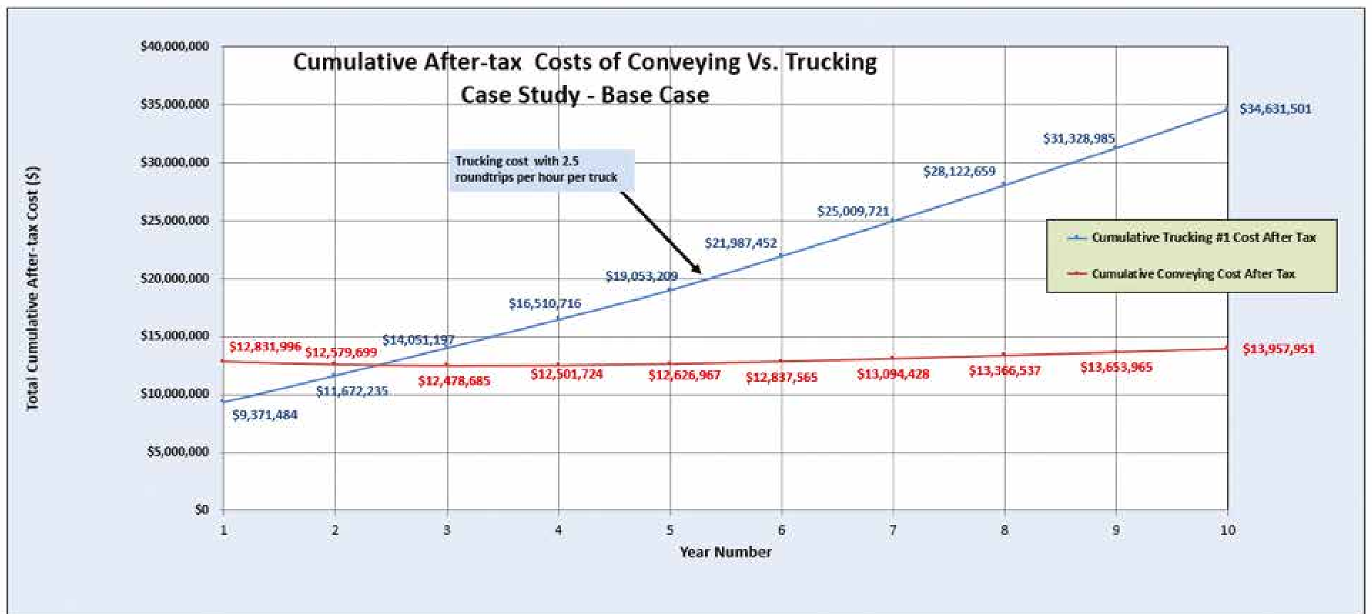
## Summary of Spreadsheet Variables

| | |
|---|---|
| Annual Volume: | 3,000,000 tons per year fixed |
| Conveying distance: | 5 miles, flat one way |
| Investment – all in: | $12,790,099 |
| Trucking cost per ton: | $1.21 year 1 |
| Conveyor cost per ton: | $.203 year 1 |
| Project life: | 20 years |
| IRS Depreciable life: | 10 years |
| Inflation rate for expenses: | 3% per year |
| Cost of capital (interest rate): | 8% |
| Corporate tax rate: | 30% |

| ECONOMICS RUN RESULTS | |
|---|---|
| Approx. Annual Pretax Savings for Conveying | $3,500,000 |
| Approx. Annual Net Cash Flow generated | $2,500,000 |
| IRR for 10-year Project Life | 42% |
| IRR for 5-year Project Life | 31.6% |
| Cumulative after-tax cost of trucking over ten-year project life | $34.6 Million |
| Cumulative after-tax cost of conveying over ten-year project life | $13.9 Million |
| Breakeven Point | Between year 2 and year 3 |

### RESULTS SHOWN ON GRAPH

When the after-tax cumulative net cash flows of each transportation method are plotted on a graph the results are easy to interpret. The key things to visualize on the graph are the difference in cumulative cost (net cash flow) in year 10 which is $20,673,550. This is a substantial cumulative difference in cost over the ten-year period. The breakeven point where the cumulative net cash flow becomes equal is between year 2 and 3. When coupled with the IRR for the capital for the conveyor of 31.6%, the economics are impressive even for a 5-year project life.




The cumulative cost of conveying begins in year 1 with the total capital cost as the starting point so this starts out very high on the axis. After year 1 the cumulative cost of conveying starts going down each year because the tax savings afforded by the tax depreciation are larger than the operating costs for conveying. This allows the cumulative conveying costs to go down gradually every year while the cumulative trucking costs go up steeply each year.

For the sake of brevity, we have not shown sensitivities of this calculation. But it is important to note that this same model can be used to answer key questions such as the following:

- What kind of annual volume do we need to pay out a conveyor for this project?
- At a certain trucking cost and annual volume what does the cost of the conveyor have to be to payout economically?
- What is the sensitivity of the annual inflation rate?

The different types of sensitivities that can be modeled are nearly endless.

## Energy Efficiency and $CO_2$ Emissions

| | |
|---|---|
| Worldwide Power Production | 0.628 lbs/kWh $CO_2$ emisson |
| Burning of Diesel Fuel | 0.646 lbs/kWh $CO_2$ emisson |
| Specific Energy Consumption of Trucking[1] | 1.59 to 1.71 kWH/st*mi |
| Specific Energy Consumption of Belt Conveying[2] | 0.20 to 0.36 kWh/st*mi |
| Specific $CO_2$ Emission of Trucking | 1.065 lbs/st*mi |
| Specific $CO_2$ Emission of Belt Conveying | 0.177 lbs/st*mi |
| Specific $CO_2$ Emission Reduction Potential | 0.88 lbs/st*mi |

Source: TU Clausthal University

### OTHER CONSIDERATIONS

The breakeven graphs illustrate that most conveying projects possess similar characteristics such as a good payback period if sufficient volume exists and the long-term advantage of more cumulative after-tax savings. But there are other considerations over and above the cheaper operating cost of conveying.

These include:

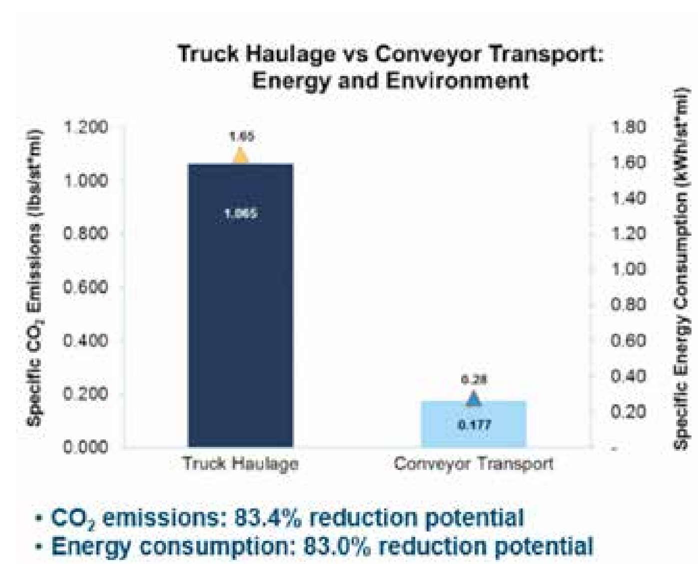
- Minimizing the carbon footprint of the transport system
- Improving plant safety, congestion, and noise
- Assuming the responsibility to operate and maintain the conveyor system

The benefits of conveying versus trucking are obvious. By reducing the burning of diesel fuel in the engines of the trucks there is an overall energy savings. The conveyor will utilize power from electric motors instead and the conveyor does not need substantial power just to move the vehicle as a truck does. The carbon footprint for burning diesel fuel is significant and many people don't realize that burning one gallon of diesel fuel creates 22.4 pounds of CO2. This is because the diesel ignition creates so many carbon atoms that must link with oxygen atoms. The energy for the electric motors must also come from a power plant ultimately but less emissions from the diesel are the result.

In a large transport operation such as the case study there are many extraneous costs that can be eliminated such as dust suppression and road maintenance. In the plant represented by the case study they have a full-time dust suppression truck adding water to the roads to keep dust down. But some dust is generated despite that and during hot summer days the dust is far more difficult to control. With the conveyor system the truck dust is eliminated.

Reducing the number of trucks and drivers improves the plant congestion and improves overall plant safety. Any plant manager is going to appreciate having fewer drivers on his site which creates uncertainty and significant training requirements. Additionally, the noise and congestion of the site with too many trucks is disquieting.

Finally, on the flip side, after installing an overland conveyor the operator must operate and maintain the conveyor system responsibly. We assumed in our operating cost projections that a certain number of people will be assigned directly to the conveyor and their costs are recognized as part of the conveyor operating costs. The conveyor operation is more technically advanced; at least there is more at stake when not operating or maintaining the conveyor properly. So, there is a group that must focus on this to assure the conveyor is maintained at peak efficiency so that the economic value shown in this paper can be realized.



*Horizontal curve overland conveyors and pipe conveyors can eliminate the need for transfer towers, saving capital costs and reducing maintenance.*

## CONCLUSION

Using an after tax cumulative cost comparison of trucking versus conveying costs, including operating and capital costs, provides a way to combine all costs to see the breakeven point in time where the cumulative cost of trucking starts to exceed the cumulative cost of conveying. If the volumes are too low relative to the required capital costs to justify conveying, the intersection of the lines on the graph will be too far to out in years to merit further study of a conveying system. If the intersection (breakeven) is less than 5 years from time zero, the plant should investigate conveying to generate more earnings for the operation. The interesting conclusion is that some low volume projects show a short time to break even using this method because the capital costs are not as significant. The economic analysis needed to do this is fast and easy.

# References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# Appendix

IRS DEPRECIABLE LIFE FOR TAXATION TABLE

Table B-2. **Table of Class Lives and Recovery Periods**

| Asset class | Description of assets included | Class Life (in years) | Recovery Periods (in years) GDS (MACRS) | ADS |
|---|---|---|---|---|
| | *DEPRECIABLE ASSETS USED IN THE FOLLOWING ACTIVITIES:* | | | |
| 01.1 | **Agriculture:** Includes machinery and equipment, grain bins, and fences but no other land improvements, that are used in the production of crops or plants, vines, and trees; livestock; the operation of farm dairies, nurseries, greenhouses, sod farms, mushroom cellars, cranberry bogs, apiaries, and fur farms; the performance of agriculture, animal husbandry, and horticultural services. | 10 | 7 | 10 |
| 01.11 | **Cotton Ginning Assets** | 12 | 7 | 12 |
| 01.21 | **Cattle, Breeding or Dairy** | 7 | 5 | 7 |
| 01.221 | **Any breeding or work horse that is 12 years old or less at the time it is placed in service**** | 10 | 7 | 10 |
| 01.222 | **Any breeding or work horse that is more than 12 years old at the time it is placed in service**** | 10 | 3 | 10 |
| 01.223 | **Any race horse that is more than 2 years old at the time it is placed in service**** | * | 3 | 12 |
| 01.224 | **Any horse that is more than 12 years old at the time it is placed in service and that is neither a race horse nor a horse described in class 01.222**** | * | 3 | 12 |
| 01.225 | **Any horse not described in classes 01.221, 01.222, 01.223, or 01.224** | * | 7 | 12 |
| 01.23 | **Hogs, Breeding** | 3 | 3 | 3 |
| 01.24 | **Sheep and Goats, Breeding** | 5 | 5 | 5 |
| 01.3 | **Farm buildings except structures included in Class 01.4** | 25 | 20 | 25 |
| 01.4 | **Single purpose agricultural or horticultural structures (within the meaning of section 168(i)(13) of the Code)** | 15 | 10*** | 15 |
| 10.0 | **Mining:** Includes assets used in the mining and quarrying of metallic and nonmetallic minerals (including sand, gravel, stone, and clay) and the milling, beneficiation and other primary preparation of such materials. | 10 | 7 | 10 |
| 13.0 | **Offshore Drilling:** Includes assets used in offshore drilling for oil and gas such as floating, self-propelled and other drilling vessels, barges, platforms, and drilling equipment and support vessels such as | 7.5 | 5 | 7.5 |

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