

The Modern Energy Management value proposition

Modern Energy Management is unique in its focus on the financial success of our client's renewable energy projects. We deliver on this commitment through our real-world experience successfully developing, building and operating renewable energy plants in emerging markets globally. MEM's project management services are designed to provide project owners with measureable gains in the returns and valuations of projects.

Quantifying the Impact

MEM modelled the impact of 11 common problems encountered during the construction of wind projects. The impact of these problems can be grouped into three categories: project delays, cost overruns, and impaired performance. Delays also result in accumulated interest during construction (IDC) costs increasing debt principal. The 11 scenarios are designed to represent typical pre-operations problems caused by improper construction management. They are described in detail, and results of the modelling are shown, on the following page.

Assumptions

Project

MW	50	MW
# WTGs	20	
WTG capacity	2.5	MW
Capacity factor	35%	
Tariff rate	\$0.14	Per kWh
Operation	20	Years
Escalation	None	
CAPEX	\$90M	\$1.8M/ MW

Debt

Debt %	75%	
Interest rate	6.0%	Fixed
Repayment	10	Years
Grace period	1	Year

Taxes

Year 1-5	0%	
Year 6-10	15%	
Year 11-20	30%	

Base Case Results (Output)

EIRR	15%	
Equity NPV	\$16.1M	$k_e = 10\%$
Nom. total CF	\$136.6M	

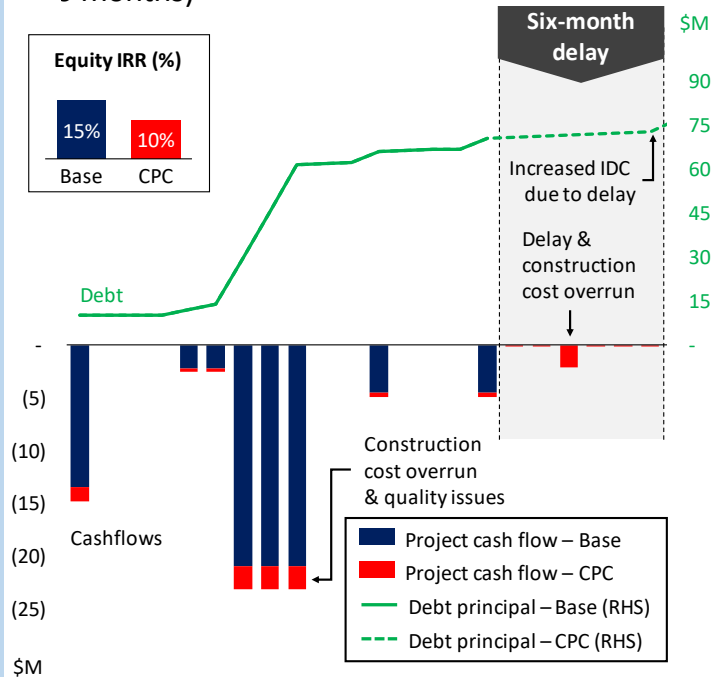
Wind Project Cash Flows

Base Case vs Construction Problems Case (CPC)

In our CPC, project problems cause an overall CAPEX overrun of 10%, a performance impairment of 2.5%, and a 6-month construction delay which incurs \$2.6M in additional costs.

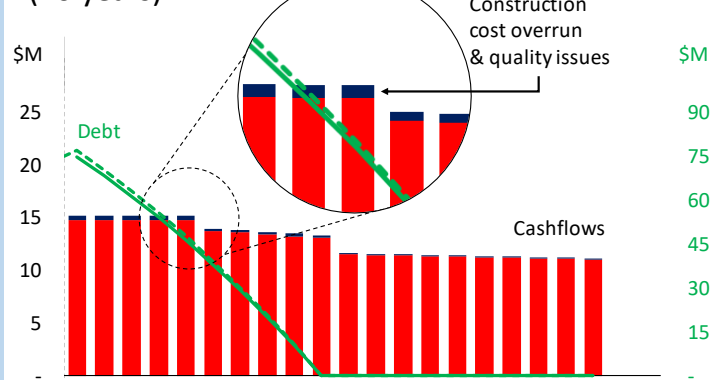
Construction Phase

(16 months)



Operation Phase

(20 years)



Financial Analysis and Valuation

The table below shows the 11 construction-related problems that we modelled and their impact on the typical Asian 50 MW wind project described on page 1. We have also created two Case Studies based on actual project examples that we have encountered. To value the impact of these problems, we analyzed EIRR, NPV (at a 10% cost of equity) and nominal cash flow. The table shows the reduction from Base Case results for these metrics caused by each problem.

				EIRR (%)	NPV (\$M)	Nom. CF (\$M)	
Base Case				15.0%	16.1	136.6	
Problems During Construction Phase		Cost and Production Implications		Financial Impact			
Construction Phase	1 Wind delay during construction	<ul style="list-style-type: none"> Main crane charge Standby labor cost Equipment transportation cost 	<ul style="list-style-type: none"> \$0.33M / month \$0.05M / month \$0.02M / month 	3mo	-1.0%	-2.7	-2.3
				6mo	-1.9%	-5.3	-4.6
				9mo	-2.7%	-7.8	-6.9
	2 EPC contractor delay due to owner's risks	<ul style="list-style-type: none"> Labor carrying cost Storage and maintenance Bond renewal fee and insurance 	<ul style="list-style-type: none"> \$0.10M / month \$2.00M one-time cost (at 4th and 7th month) \$0.50M one-time cost (at 7th month) 	3mo	-1.3%	-3.6	-3.2
			6mo	-2.0%	-5.5	-4.8	
			9mo	-3.2%	-9.3	-8.4	
3 CAPEX increase	<ul style="list-style-type: none"> Increase in CAPEX 	<ul style="list-style-type: none"> 10% increase in CAPEX 		-3.0%	-8.0	-7.3	
Operation Phase	4 Improper allocation of WTG unavailability		<ul style="list-style-type: none"> 3% decrease in WTG availability 		-1.0%	-3.1	-8.0
	5 Incorrect adjustment of blades during construction		<ul style="list-style-type: none"> 2% reduction in energy yield 		-0.7%	-2.0	-5.2
	6 Construction quality defects and/or improper maintenance		<ul style="list-style-type: none"> 20% increase in OPEX 		-0.6%	-1.7	-3.6
	7 Construction quality defects		<ul style="list-style-type: none"> 15% decrease in energy yield in the first 2 years of operation 		-1.2%	-3.2	-4.9
	8 O&M team not adequately prepared		<ul style="list-style-type: none"> 5% decrease in energy yield in the first 2 years of operation 		-0.4%	-1.1	-1.6
	9 Manufacturing, construction quality defects and/or deferred maintenance		<ul style="list-style-type: none"> Project life from 20 to 15 years 		-1.4%	-7.0	-56.2
	10 Replacement of gearboxes at early year of operation due to serial defects	<ul style="list-style-type: none"> Gearbox, crane, transportation, and labor costs WTG downtime for repair 	<ul style="list-style-type: none"> Replace 50% gearboxes at year two Gearboxes \$6M, crane \$1.5M, transport \$0.6M, labor \$0.25M 15% decrease in energy yield in year two 		-2.9%	-8.7	-13.2
	11 Delay of commercial operation date increases debt Interest During Construction (IDC) and equity dividend timing		<ul style="list-style-type: none"> 3-9 months delay 	3mo	-0.6%	-1.7	-1.3
				6mo	-1.2%	-3.4	-2.6
				9mo	-1.7%	-4.9	-4.0

Case Study 1

BOP defects affect availability

Construction defects in civil and electrical works result in loss of wind turbine availability in first 2 years of operations (loss of grid during repair). EPC warranty guarantees repair only. Civil and electrical works issues are exclusions in wind turbine availability warranty. This results in 10% reduction of wind turbine availability in years 1 and 2.

EIRR	NPV	Nom. CF
-0.9%	\$ -2.3M	\$ -3.3M

Case Study 2

Layout constructability issues

The developer's preliminary design fails to account for permit restrictions and setback requirements which were discovered during construction. This results in a 3 months delay in construction and 10% CAPEX cost overrun to change design of civil and electrical works plus a 2% reduction in energy yield due to the change in wind turbine layout.

EIRR	NPV	Nom. CF
-3.9%	\$ -11.8M	\$ -13.8M

