



NOVEMBER , 2017

# Microgrid for Mines

**ABB**

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# Agenda

- Overview of off-grid mining electricity operations
- How microgrids create value in mining
- Microgrid for mining business case
- Summary

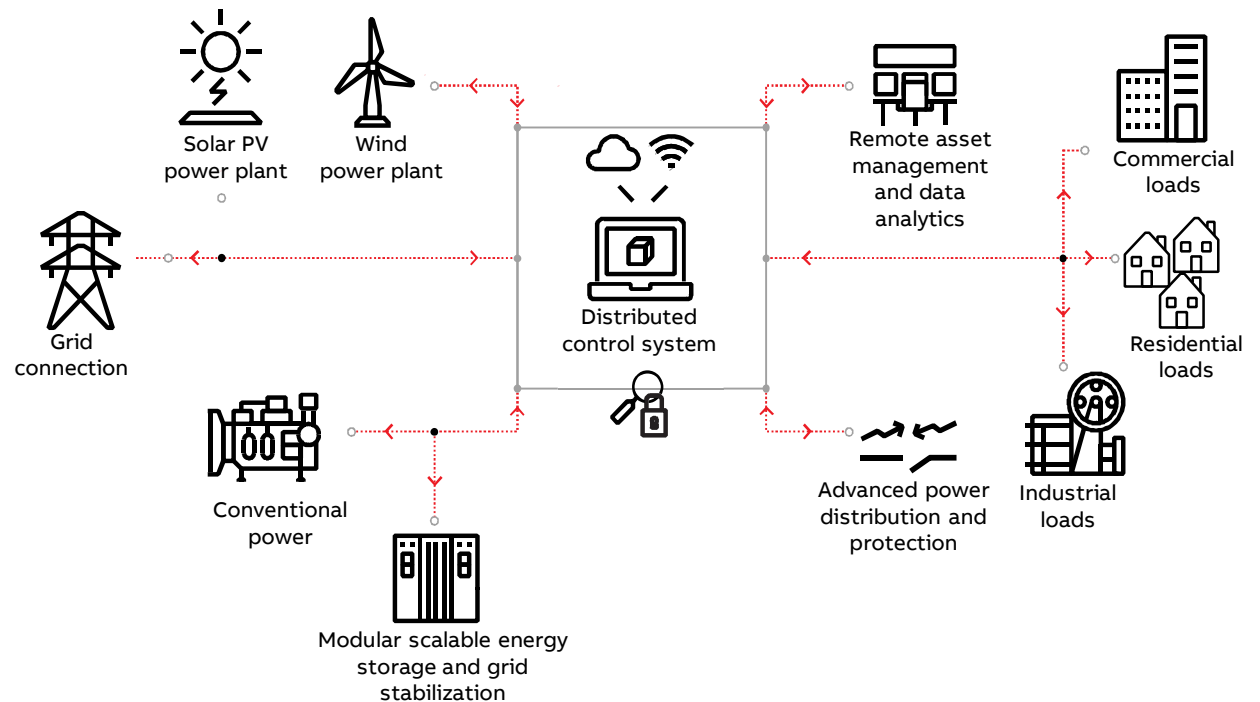
# Microgrid

Generation at the point of consumption and always available

## Microgrid definition

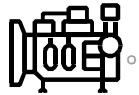
Distributed energy resources and loads that can be operated in a controlled, coordinated way either connected to the main power grid or in “islanded”\* mode.

*Microgrids are low or medium voltage grids without power transmission capabilities and are typically not geographically spread out.*



# Typical off-grid power generation operations

Diesel or gas fired power stations with reciprocating engines or gas turbines



Conventional diesel power station

Power supply to mine



Industrial mining loads



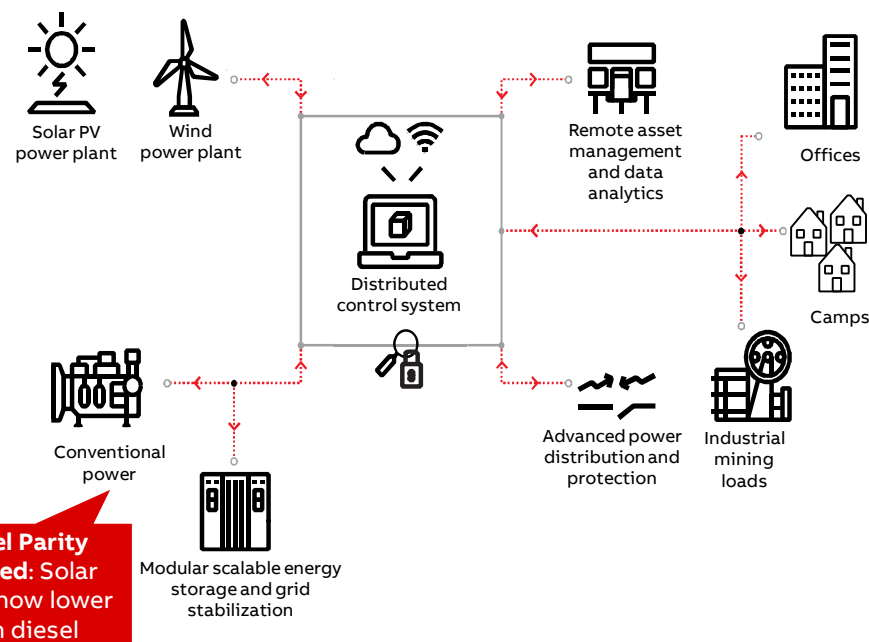
# How microgrids create value for off-grid

## Key drivers of value creation and cost savings

### Operational goals


























- **Providing essential off-grid quality power** with blackstart capability
- **Improving resiliency** by having storage, generation and loads optimally coordinated
- **Reducing reliance on diesel** and associated **supply chain risk** and **CO2 emissions**

Lower operating costs, higher up-times and higher gross margins for mines



# How microgrids create value for off-grid

Increasing renewable penetration requires enhanced microgrid control capabilities

Microgrid Integration Technologies	Controlled system	Energy contribution (Fuel reduction)	Power penetration (At peak solar/wind)
Limited control/ basic fuel saving No Renewables control, negative load		7-10%	20-30%
Power control and optimisation Controlling renewables + generator	 	10-15%	20-50%
Power control and forecasting Controlling renewables + generator	   	15-30%	50-70%
Power control and grid stabilisation Controlling renewables + generator + storage	    	25-40%	100%
Power control and load management Controlling renewables + generator + storage + load	     	60-80%	100%
Power control + energy storage Controlling renewables + storage + load	      	100%	100%

Broad range of technical solutions possible – design choice based mainly on economic criteria

# ABB microgrids deliver 30 to 50% fuel reduction

Future projects benefit from lower PV prices

ABB references already show 30 to 50% fuel reduction possible with subsidies



## Marble Bar & Nullagine, PowerStore/ PV/ Diesel

- Generates 1,048 MWh PV/ year
- Saves **35-40%** diesel consumption per year

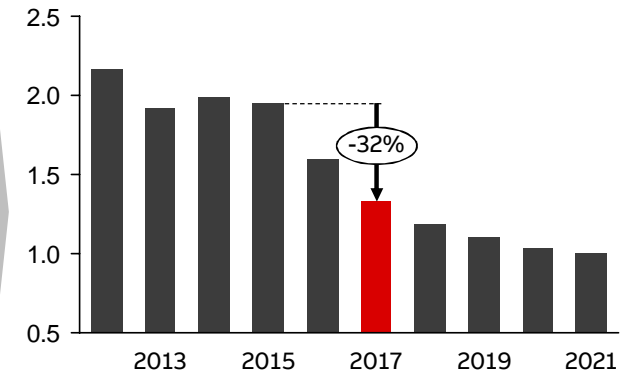


## Johannesburg, PowerStore/ PV/ Diesel

- **Up to 50%** reduction in electricity bills and fossil fuel consumption

## Decreasing Solar PV costs to improve future business cases

Global Large Commercial PV system prices (1 to 5MW) USD/ Wp



- PV prices have reduced over 30% in past 2 years and continue to fall globally
- Commercial and utility scale systems reducing faster than household solar with the \$1/Wp already reached for utility scale<sup>1</sup>

# Microgrid for Mining – Business Case

Various solar and storage scenarios tested using HOMER<sup>1</sup> optimization tool

## Example: remote brownfield gold mining operation

### Power System

- 5 MW average load
- 6.3 MW peak load
- 6 x 1.2 MW diesel generators

### Business Case

- Delivered Fuel Cost: \$1US/l
- Solar installed cost: \$2US/Wp
- Average cost of capital: 11%
- Subsidies: none

## Goal of the study

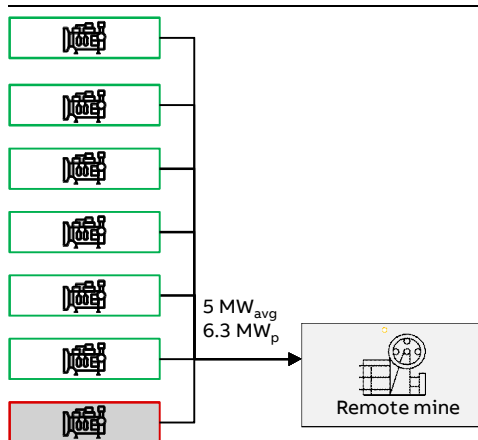
Determine when the Levelized Cost of Energy (LCOE) of 3 scenarios is lower than the diesel only base case

- Diesel & Storage
- Diesel & Solar PV
- Diesel & Solar PV & Storage

# Microgrid for Mining - Business Case

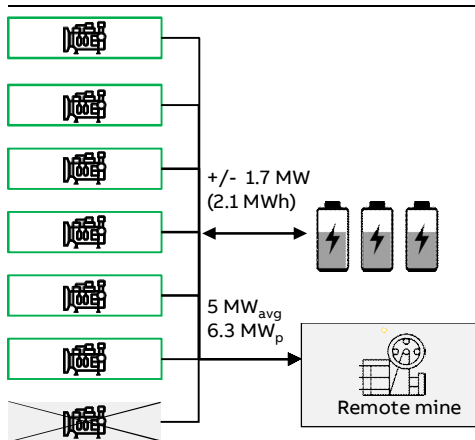
## Incremental hybridization options analyzed

### 1. Base case – Diesel



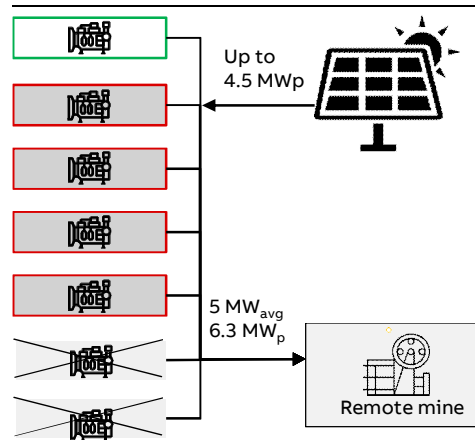
- 6 generator system (1.2 MW each)
- 1 generator equivalent required as operating reserve at all times
- All generators that are on typically operate at same level

### 2. Diesel + BESS



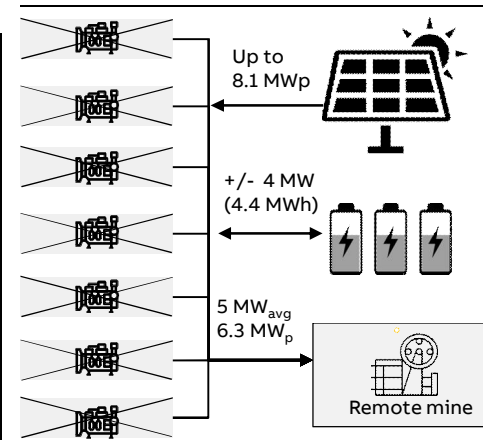
- BESS removes need for operating capacity
- BESS can also delay or remove need to start up a generator during short term peaks

### 3. Diesel + solar PV



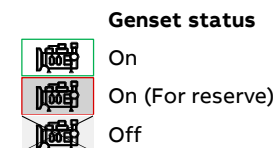
- Solar PV size limited in this case due to generator ramping limitation
- Additional generators must stay online in case of shading for 75% of solar production (potential reductions when using advanced forecasting)

### 4. Diesel + BESS + solar PV



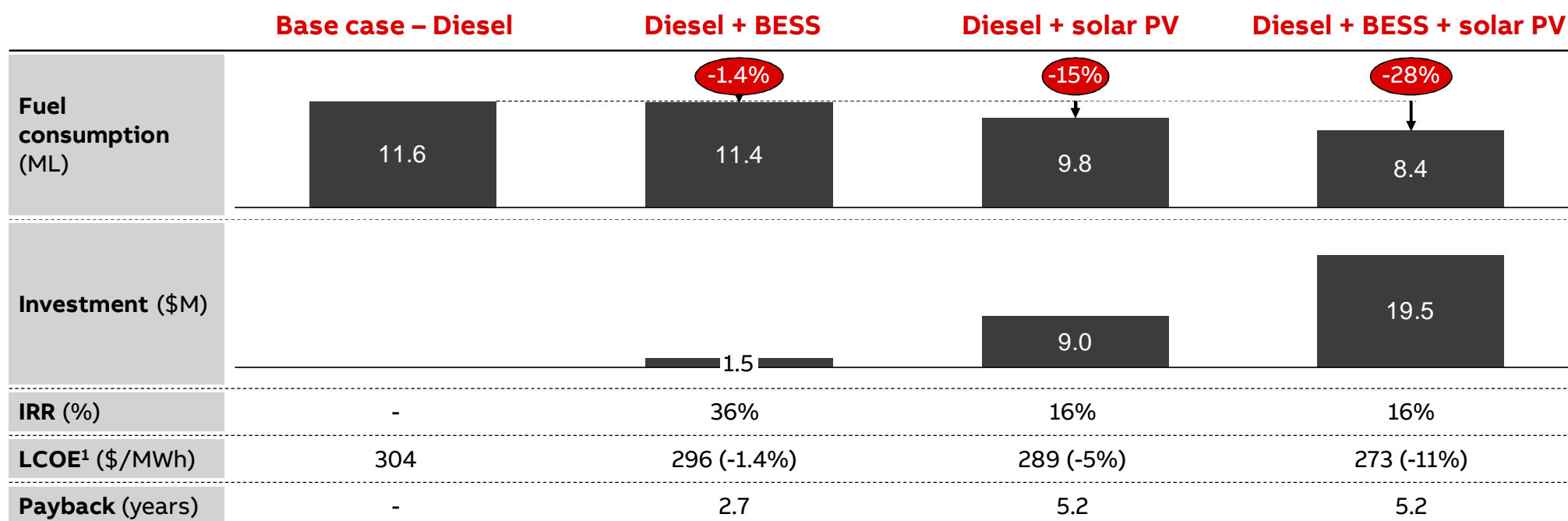
Generators can be off during daytime

- BESS provides required ramping
- During daylight hours all generators can be shut down completely



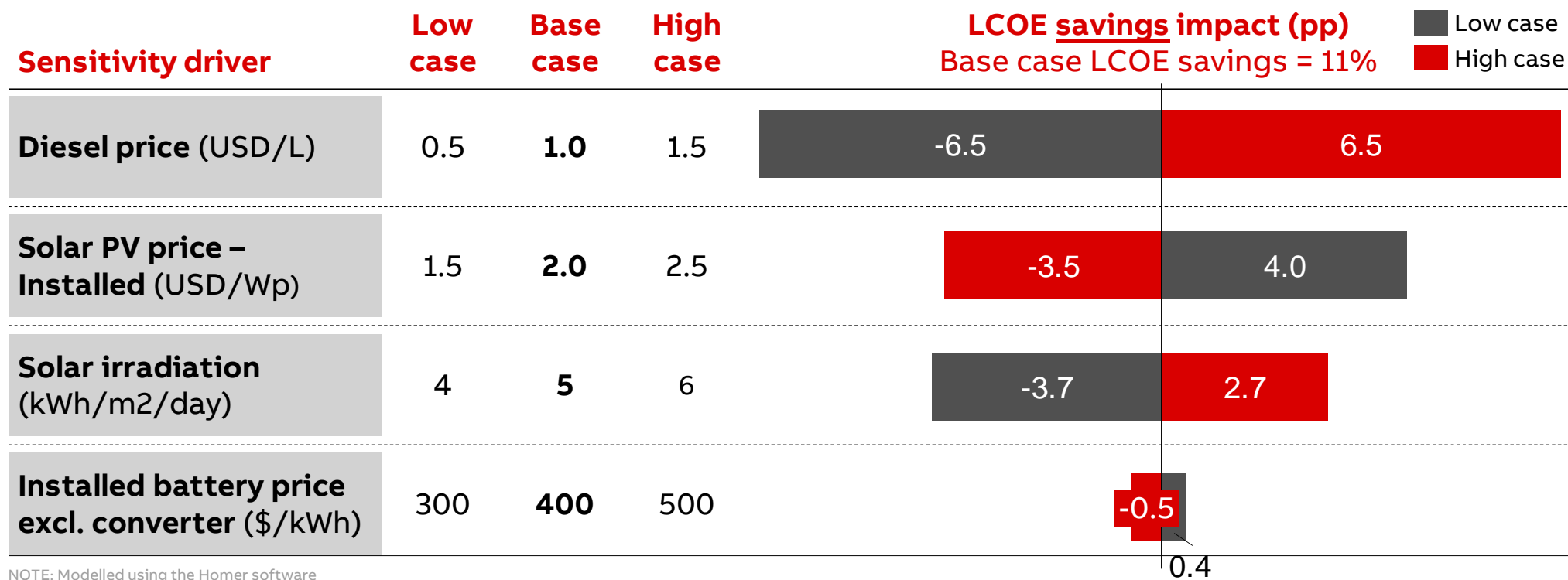
## Microgrid for Mining - Business Case

Up to 28% reduction in fuel and CO2 possible when combining diesel with BESS and solar PV



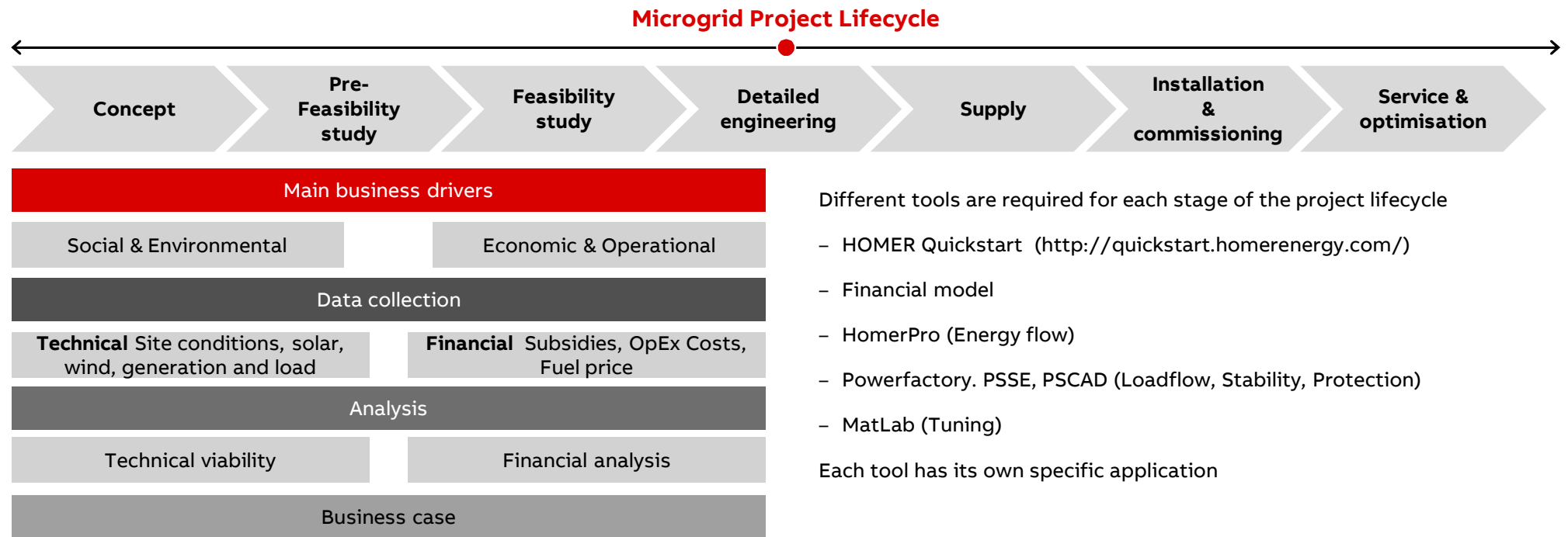
## Sensitivity analysis – Key driver of LCOE saving

Diesel price the largest single driver of LCOE savings, followed by solar PV price



# Developing a microgrid project from concept to commission

## The project lifecycle



# Microgrid for Mining and Island Utility

## Key takeaways

### Benefit from microgrids

- Fuel saving (and associated reduction in CO2 emissions & maintenance costs)
- Reduced Levelized Cost of Electricity (LCOE)
- Attractive Internal Rate of Return on investments (IRR)
- Improved power quality



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## Get in touch with us

### ABB Microgrids

To know more about our solutions, please visit: [www.abb.com/microgrids](http://www.abb.com/microgrids)

If you've any specific questions about our microgrid solutions, please write to me at [sandipsinha@in.abb.com](mailto:sandipsinha@in.abb.com)



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