The Economics and Financing of Distributed Generation Investment

Budapest, Hungary
November 17, 2016
Topics to Cover

How to Finance Distributed Generation Investments

1. Importance of financial aspects
2. Debt and equity
3. Key financial concepts (revenues, earning, cash flow, cost of capital, rate of return, LCOE)
4. Financial conditions of bankable projects
5. Key investment criteria
Importance of Financial Aspects

Financial aspects are critical for distributed generation

• Large amounts of capital required to cover the investment needs of distributed generation
• Sustainable economics and business models are required to ensure the sustained deployment of distributed generation
• Distributed generation will compete with other investments and projects for capital from investors and lenders
• All stakeholders and relevant parties need to speak the same language in order to negotiate
• Systematic approach to project evaluation and comparison of options
The Perspective of the Stakeholder impacts the economic evaluation

**CONSIDERATIONS**

- **Narrower Perspective**
  - Energy User
    - Costs
    - Reliability
    - Energy Availability
    - Growth
  - Asset Owner
    - Returns
    - Asset value
    - Asset life
  - Investor - Lender
    - Returns
    - Portfolio
    - Collaterals
  - System Operator
    - System investments
    - Balancing
    - System operating
  - Government
    - Tax implications
    - Budget impact

- **Broader Perspective**
  - Society
    - Health impacts
    - Environmental impacts
    - Equity and distribution of benefits
    - Energy security
Importance of finance - large amounts of capital are required to continue growth

Global Annual Distributed Renewable Capacity Installed Forecast, GW

Annual Distributed Renewable Investment, USD bn

Cumulative need for 1.9 - 2.5 tn USD by 2023

Source: Navigant, GTM Research, Infocast
2 Financial structuring – debt and equity

Definitions

**Equity:** A stock or any other security representing an ownership interest
**Debt:** An amount of money borrowed by one party from another

- Debt and equity are the two standard options for financing a project
- Debt typically has a higher priority to a cashflow than equity (lower risk)
- Debt financing can come in several forms (project or corporate financing)
- Typically equity has a higher cost than debt

There are a few reasons why debt can be preferrable over equity:
- Increase the returns to the equity holders
- Maintain ownership and control
- Allow larger investments to be made
Financial structuring – debt and equity

Debt versus equity

Advantages of debt
- debt does not dilute the ownership
- repayment of the agreed-upon principal and interest
- defined amounts which can be forecasted and planned for
- Interest on the debt can be deducted from taxes
- company is not required to comply with securities laws and regulations

Disadvantages of debt
- debt must at some point be repaid
- interest is a fixed cost which raises the company's break-even point
- debt payments have higher priority than payments to equity
- debt instruments may restrict some company activities
- high debt-equity ratio, the more risky the company is considered
- in case of missed payments, the lenders can take over the project / assets
## 2 Financial structuring – debt and equity

### Equity sources
- Private sponsors
- Corporate sponsors
- Employees (ESOP)
- Venture capitals
- Angel investors
- Specialise funds

### Debt sources
- Banks
- Vendor financing
- International financing organisations

- The equity and debt dynamics are defined by risk and reward
  - 100% equity means a complete exposure to risk for the investor
  - 100% debt means no financial participation by the owner
- Debt lenders typically require a certain level of equity participation in a given project
Distributed Generation Key Financial and Economic Concepts

Key Concepts

A) Revenue, Earnings, Cashflow
B) Cost of capital and Rate of return
C) Levelised Cost of Energy (LCOE)
Economics of renewable and microgrid projects

Benefits

• Main benefit from the systems is the energy delivered
• It is typically value relative to grid power (either wholesale or retail depending on project) or diesel generation

Secondary and related benefits and impacts can be difficult to value but important
• Lost production
• Quality of life
• Risks from supply interruption
• Avoided investment
• Environmental impacts and emissions
• Branding benefits

Costs

• Capex includes the equipment investment, development costs
• Opex includes operations and maintenance, repairs, administrative costs and taxes

Benefits

• Main benefit from the systems is the energy delivered
• It is typically value relative to grid power (either wholesale or retail depending on project) or diesel generation
Revenues, earnings and cashflow are very different

<table>
<thead>
<tr>
<th>Revenues</th>
<th>Earnings</th>
<th>Cashflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting measure of incoming money that is earned (and realisable)</td>
<td>Measure of the money remaining following costs (different measures will include depreciation and tax)</td>
<td>Measure of the money remaining following costs (different measures will include depreciation and tax)</td>
</tr>
<tr>
<td>DG examples</td>
<td>Examples</td>
<td>Examples</td>
</tr>
<tr>
<td>• Energy sold to network</td>
<td>• EBIT (earnings before income tax)</td>
<td>• EBIT (earnings before income tax)</td>
</tr>
<tr>
<td>• Savings from utility bill</td>
<td>• Net earnings (following all deductions)</td>
<td>• Net earnings (following all deductions)</td>
</tr>
<tr>
<td>• Heat sold or used</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Rooftop PV Example 100 kW

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td>Production MWh</td>
<td>150</td>
<td>149</td>
<td>149</td>
<td>148</td>
<td>147</td>
<td></td>
</tr>
</tbody>
</table>

#### Revenues

<table>
<thead>
<tr>
<th>Source</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced power costs</td>
<td>13,104</td>
</tr>
<tr>
<td>Sold to grid</td>
<td>3,744</td>
</tr>
<tr>
<td>Total revenues</td>
<td>16,848</td>
</tr>
<tr>
<td><strong>Total revenues</strong></td>
<td><strong>15,026</strong></td>
</tr>
</tbody>
</table>

#### Costs

<table>
<thead>
<tr>
<th>Category</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations and maintenance</td>
<td>1,560</td>
</tr>
<tr>
<td>Administration</td>
<td>520</td>
</tr>
<tr>
<td>Subtotal costs</td>
<td>2,080</td>
</tr>
<tr>
<td><strong>Subtotal costs</strong></td>
<td><strong>1,825</strong></td>
</tr>
<tr>
<td><strong>EBITDA</strong></td>
<td><strong>14,768</strong></td>
</tr>
<tr>
<td>Depreciation</td>
<td>13,333</td>
</tr>
<tr>
<td><strong>EBIT</strong></td>
<td><strong>1,435</strong></td>
</tr>
<tr>
<td><strong>Tax</strong></td>
<td><strong>359</strong></td>
</tr>
<tr>
<td><strong>Net earnings</strong></td>
<td><strong>1,076</strong></td>
</tr>
<tr>
<td><strong>Cashflow USD</strong></td>
<td><strong>-200,000</strong></td>
</tr>
</tbody>
</table>

**Revenue, earnings and cashflow example**
Costs profile of different technologies varies significantly

Costs over 20 year period per MW of capacity, USD 000s

Solar PV

Diesel
Comparison of systems

Costs over 20 year period to cover 1 MW load for 16 hrs /day, USD 000s

* Based on typical site conditions with adequate resource, diesel cost assumed at 1.3 USD / litre delivered at site, total PV capacity of ~2.0 MW
Cost of capital definition

- Rate charged for providing the capital for an investment (typically measured in percentage terms)
  - Cost of **equity** if the project is financed solely from equity
  - Cost of **debt** if the project is financed solely from debt
  - When combined equity and debt it is defined as the **WACC** (Weighted Average Cost of Capital)

Cost of capital depends on risks

- External risk (country, currency, social, etc.)
- Project risk (equipment, payment, operation, etc.)
Cost of equity calculation

- If the company finances a project out of equity, the rate is indicatively the minimum required returns from a project that the company requires.
- Considering the new activity has a similar risk exposure, the cost of capital will be defined by the potential returns from alternative investments.

From a theoretical perspective for the cost of capital calculation can be based on the CAPM (Capital Asset Pricing Model):

- CAPM = Risk free rate + Risk premium
Cost of capital

- Cost of debt is set by the lending institution consisting of fixed and variable terms, often based on widely used bases (e.g. LIBOR).

- The cost of capital represents a hurdle rate that a company must overcome before it can generate value.

- **Project financing** is typically structured such that cost of debt is lower than cost of equity (as debt takes on less risk and a p

- Using debt financing allows increased returns to the equity holders (as well as maintaining control over a project and allowing larger investment to be achieved with the same levels of equity). This is referred to as leverage.

- Lower cost of capital allows for more projects to be viable
Cost of capital example

- **Finance structure**
  - Will depend on all the factors mentioned
  - Market maturity
  - Risk appetite, comfortable and knowledge of finance institutions

- **Simplified project example (not including tax impacts)**
  - CapEx 100 (monetary units)
  - Equity 30  
    - Cost of equity 10% per year
  - Debt 70  
    - Cost of debt 5% per year
  - WACC = 30% x 10% + 70% x 5% = 6.5%
## Internal rate of return (IRR) – project and equity

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project cost</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue/Sales</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>O&amp;M + Management</td>
<td>-3</td>
<td>-3</td>
<td>-3</td>
<td>-3</td>
<td>-3</td>
<td>-3</td>
</tr>
<tr>
<td>Replacement cost</td>
<td></td>
<td></td>
<td></td>
<td>-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
<td>-3</td>
<td>-3</td>
<td>-13</td>
<td>-3</td>
<td>-3</td>
</tr>
<tr>
<td>Cash flow</td>
<td>-100</td>
<td>32</td>
<td>32</td>
<td>22</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Project IRR</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Internal rate of return (IRR) – project and equity

<table>
<thead>
<tr>
<th>Project cost</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financing structure</td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>30</td>
</tr>
<tr>
<td>Debt</td>
<td>70</td>
</tr>
<tr>
<td>Interest rate</td>
<td>5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue/Sales</th>
<th>Principal debt</th>
<th>Interest debt</th>
<th>Anuity debt</th>
<th>Total cost with I</th>
<th>Cash flow</th>
<th>Equity IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35</td>
<td>-14</td>
<td>-3.5</td>
<td>-17.5</td>
<td>-6.5</td>
<td>-30</td>
<td>36%</td>
</tr>
<tr>
<td>1</td>
<td>35</td>
<td>-14</td>
<td>-2.8</td>
<td>-16.8</td>
<td>-5.8</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>-14</td>
<td>-2.1</td>
<td>-16.1</td>
<td>-15.1</td>
<td>15.2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>-14</td>
<td>-1.4</td>
<td>-15.4</td>
<td>-4.4</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>-14</td>
<td>-0.7</td>
<td>-14.7</td>
<td>-3.7</td>
<td>16.6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>-14</td>
<td></td>
<td></td>
<td></td>
<td>17.3</td>
<td></td>
</tr>
</tbody>
</table>
Cost of capital needs to be below the project IRR

If the cost of debt (interest rate on debt) is lower than the project IRR, the equity IRR will improve

Scenarios can be important to determine the impact of changing interest rates or revenues
Levelised Cost of Energy (LCOE) is a theoretical payment value per unit of energy production that allows a project to recover all costs over an expected project life (including financing costs)

\[
\text{LCOE} = \frac{\sum_{n=0}^{N} \frac{C_n}{(1 + d)^n}}{\sum_{n=1}^{N} \frac{Q_n}{(1 + d)^n}}
\]

- \(N\) is the lifetime of the project
- \(C_n\) is the project cost in year \(n\)
- \(Q_n\) is the energy production in year \(n\)
- \(d\) is the discount rate of the project
Levelised Cost of Energy (LCOE) definition

Costs over lifetime

Production over lifetime

Levelised cost of energy

Single cost per unit of power (USD / MWh)
Levelised Cost of Energy (LCOE) factors

LCOE includes:

• Installation costs
• Financing costs
• Taxes
• Fuel costs
• Operation and maintenance costs
• Salvage value of equipment
• Quantity of electricity the system generates over its life

LCOE can be calculated in real or nominal terms
Levelised Cost Comparison uses and limitations

- LCOE is used to compare costs of different generating sources and projects.
- It indicates at what cost point a project will “break-even”
- Does not necessarily help in determining dispatching or selling price
- Limited from a system level perspective
Levelised Cost of Energy (LCOE) key factors

PV example

Variation by irradiation (kWh/kW)

Variation by cost of capital (%)

Variation by investment cost (USD 000s /MW)
LCOE evolution of PV

PV LCOE evolution over 10 years*

* Based on irradiation range of 1200-1700 kWh/kW and 10% cost of capital
## Levelised Cost Comparison across technologies

### Typical levelised energy cost range across technologies* (USD / MWh)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Levelised unit cost of power (USD / MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel*</td>
<td>195 - 530</td>
</tr>
<tr>
<td>Stand-alone PV</td>
<td>85 - 190</td>
</tr>
<tr>
<td>PV + Battery</td>
<td>130 - 360</td>
</tr>
<tr>
<td>Micro-wind</td>
<td>90 - 190</td>
</tr>
</tbody>
</table>

* Based on typical site conditions with adequate resource, diesel cost assumed at 0.7-1.4 USD / litre delivered at site.
In general, there are two main business models for distributed generation:

**Host Ownership**
- The user of the power and the building invests and owns the assets.
- The investment can be financed with debt financing.
- Financing costs may be lower but often will require guarantees and recourse to the assets and real-estate.

**Third-party ownership**
- The investment for the DG assets is made by a company.
- The equipment is owned by the company and operations are typically handled by the company.
- The energy user signs a long term contract (typically a PPA or equipment leasing).
- The payments are made based on the cost savings or revenues generated by the assets.
Financial conditions of bankable projects (1/2)

**Involved Parties**
- The energy user should typically have a history of profitable operations
- A prior relation with financial institutions is beneficial

**Technical aspects**
- Renewable resource should be sufficient
- Project planning and evaluation should be professional
- Equipment selection should be appropriate and from reputable suppliers

**Duration**
- Asset and contract durations in line with the lending term
- Loans may have a maximum duration and will have much shorter life than the equipment

**Economics**
- The benefits of the project sufficient to repay the investment and required returns (cost of capital)
- Costs should be covered by the expected cashflows
Financial conditions of bankable projects (2/2)

**Contract**
- Contract terms may include:
  - Required insurance
  - Operations and maintenance requirements
  - Financial covenants (minimum DSCR, restrictions to shareholder payments)

**Risks**
- Overall risks need to be manageable and include
  - Regulatory
  - Market
  - Currency

**Financial Guarantees**
- Borrower may need to provide guarantees
- Constructor will need to ensure performance for initial period (1-2 years) and provide a bond
- Equipment manufacturers will need to provide equipment warranties
Key investment criteria

- Investment risk-return profile meets investor requirements
- Project Owner / Energy Off-taker
  - Credit worthiness of the off-taker
  - Bankability of the Project Owner
- Energy resource
- Equipment and constructor requirements
  - Top-tier
  - Performance guarantees and product warranties
- Risks
  - Power system sustainability and stability
  - Regulatory regime and potential for changes
  - Recoverable assets
  - Guarantees
Good projects can create a virtuous circle

- Strong project economics and good project characteristics drives financing interest
- Access to financing and low financing costs drives stronger project economics
Unaccounted for system costs leads to future problems and risks

California “duck curve”
Additional economic considerations for DG projects

Potential additional benefits
- Avoided system costs and investment
- Reduced losses in transmission and distribution
- Greater resilience in emergencies
- Lower emissions and pollution

Potential additional drawbacks
- “Duck curve” – higher system costs to manage
- Stranded assets for current owners
- Lower efficiencies for central generation
Key point recap

- Financing critical to moving distributed generation forward
- Systematic approach to evaluate and compare projects required
- Some important financial concepts
  - Debt and equity define the financing structure
  - Rate of return on a project must exceed the cost of capital for it to be economical (and typically to be implemented)
  - LCOE is useful for comparing technologies and projects but has its limitations
- Key investment criteria will impact which project receive finance – goal should be to create a virtuous circle of economically strong projects
- Risks need to be taken into account to make the investments sustainable
Thank you - Contact Details

Gommyr provides expert business, financial and economic advisory and investment support on distributed generation, renewable microgrids, and energy storage projects

Contact or follow us:

www.gommyr.com

arnaud@gommyr.com

www.linkedin.com/company/gommyr-power-networks-ltd

www.gommyr.com/blog.html