

Financial Modelling for Energy Transitions: Hands-on Lecture 6: Terms of Finance

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Learning Outcomes

By the end of this exercise, you will be able to:

1. Use the MINFin Demo Data Publication Sheet to input terms of finance into MINFin
2. Use the MINFin Demo Projects Sheet to extract and input project data regarding the terms of finance committed to the Demo Project.
3. Understand how this is integrated with the Investment Needs data to produce projections of the Financing Requirements on the "High Level Dashboard"
4. Assess the visualisations of this data on the "Data Visualisation" tab.

In this Hands-On Exercise we will be looking at adding in information regarding the costs of capital associated with historic investments in the sector. These terms of financing include Rate (annual interest rates for debt and rates of return for equity), grace period, term (loan term for debt and project life for equity) and loan repayment structure. These parameters are used in MINFin to not include the burden of these debt obligations moving forwards, but to also help inform assumptions regarding the loan terms that may be experienced within the sector. Using this data, MINFin can translate "**Investment Needs**" into "**Financing**

Requirements” to assess how the sector is likely to perform, and how funding sources may be able to meet these financing requirements moving forwards.

To project this financing requirement within the sector, MINFin take terms of financing from each source (Conc_IFI, Conc_DPS, Comm_Dom and Comm_Intl) and applies this to investment costs projected by OSeMOSYS for each technology. The costs of repayments on these investments are then calculated in the High-Level Dashboard and presented in either local or foreign currency denominations to highlight these incremental costs.

1. Calibrating Financing Terms (Publication Sheet)

1. To input terms of finance into MINFin from the MINFin Demo Data Publication Sheet, once again navigate to the “Financing Baseline” tab of the data publication. If this has not already been downloaded, a link to this document can be found [here](#). Here we will be focusing on Columns P – T, these columns contain data on the terms of financing for each of the columns of data that we have already transferred across from this source. This includes

Column Header	Description
Rate of Return	The interest rate for loans, and for equity, the Expected Rate of Return (ERR).
Term	For a loan, the loan duration and; for equity, the project's lifespan.
Grace Period	The period from the issue year of a loan to the first repayment of principal.
Schedule	The schedule specifying the timing and amounts of interest and principal repayments required for a loan, which may be Equal Principal Payments (Equal principal repayments with declining interest), Annuity (Equal Principal and Interest repayments) and Lump Sum (repayment of principal at loan maturity)

2. Remembering that grey cells () contain formulas that should not be edited, whilst yellow cells () are our data input cells. Being careful to avoid the “Exchange Rate” and “Maturity” columns on either side in the MINFin Model, copy data from the Rate and Term columns in the MINFin Demo Data Publication Sheet into their respective columns in the MINFin Model as shown below:

	O	P	Q	R
1	Exchange Rate	Rate	Term	Grace period
2		1.96%	27.55	6.72
3		1.17%	24.85	7.42
4		9.31%	63.84	
5		7.56%	15.00	2.05
6		8.38%	15.00	1.50
7		18.00%	20.00	10.00
8		0.00%	20.00	0.00
9		15.99%	43.48	0.00
10		17.83%	25.00	0.00
11		2.39%	32.67	6.96
12		8.03%	15.00	1.50

	O	P	Q	R
48	Exchange Rate	Rate	Term	Maturity
49	1.0	1.96%	27.55	15.554
50	1.0	1.17%	24.85	12.846
51	1.0	9.31%	63.84	51.841
52		7.56%	15.00	4.000
53	1.0	8.38%	15.00	4.000
54	1.0	18.00%	20.00	9.000
55	1.0	0.00%	20.00	9.000
56	1.0	15.99%	43.48	32.478
57	1.0	17.83%	25.00	14.000
58	1.0	2.39%	32.67	22.668
59	1.0	8.03%	15.00	5.000
60	1.0	15.00%	15.00	10.000

- Next we can move onto the columns defining “Grace period” and “Schedule”. Here we must be careful of the “Maturity” and “Average Annual Payment” columns either side that again contain formulas.

	Q	R	S
1	Term	Grace period	Schedule
2	27.55	6.72	EPP with Grace Years for Principal
3	24.85	7.42	EPP with Grace Years for Principal
4	63.84	0.00	Equity
5	15.00	2.05	EPP with Grace Years for Principal
6	15.00	1.50	EPP with Grace Years for Principal
7	20.00	10.00	EPP with Grace Years for Principal
8	20.00	0.00	Equity
9	43.48	0.00	Equity
10	25.00	0.00	Equity
11	32.67	6.96	EPP with Grace Years for Principal
12	15.00	1.50	EPP with Grace Years for Principal

	R	S	T
48	Maturity	Grace period	Schedule
49	15.554	6.72	EPP with Grace Years for Princip
50	12.846	7.42	EPP with Grace Years for Princip
51	51.841	0.00	Equity
52	4.000	2.05	EPP with Grace Years for Princip
53	4.000	1.50	EPP with Grace Years for Princip
54	9.000	10.00	EPP with Grace Years for Princip
55	9.000	0.00	Equity
56	32.478	0.00	Equity
57	14.000	0.00	Equity
58	22.668	6.96	EPP with Grace Years for Princip
59	5.000	1.50	EPP with Grace Years for Princip
60	10.000	0.00	Equity

2. Developing a new Financing Baseline

- This approach is required when there is a lack of data publication sheets available for the target country. As with the volumes of finance, the key to developing the terms of financing is establishing a comprehensive list of projects. Based on the work undertaken when assessing the volumes of financing, this should now also include a thorough breakdown of each project by financiers. In this section we will focus on determining the rates and terms of financing, as well as payment schedule.
- When research these loan parameters, it is important to understand the proper sources to search, as well as how to search. Four key sources of information are:
 - Project Reports** from large publicly financed development financial institutions aiding in the project either through direct investments, guarantees or other financial aid, such as the World Bank, African Development Bank, Asian Development Bank and Interamerican Development Bank among many

- b. **Financial Statements** from equity partners and developers who may state the loan repayments and terms in their balance book and annual statements
 - c. **Intergovernmental Organisation Publications** such as reports on costs of capital from IRENA, the IEA, CPI and SE4All among others
 - d. **Scientific Literature** reporting on costs of capital at the project or national level may provide insights into the terms of financing for power projects
3. Next it is important to be able to search databases properly, both on search engines and research databases. The use of quotation marks “” around words can exclude results that do not contain relevant information.
 4. Lastly to search efficiently through documents, use “Ctrl + F” to open the search, and input key words that are required for the baseline, words that are uncommon in other contexts such as “Grace” or “Maturity” are often helpful here, whilst searching for symbols such as “%” can also prove useful.

3. Adding missing terms from project documents

To help get a better understanding of collecting these terms from a project document, we once again turn to the MINFin Demo Projects Sheet used in Hands-On Exercise 3, if this has not already been downloaded, a link to this document can be found [here](#). Whilst this is a simplified insight into how to extract data from project sheets, it should help users identify what data they will need to search for and how it may be presented.

5. For this portion of the Financing Baseline, we will be looking at **Rates** of return, Financing **Term**, **Grace Period** and Financing **Schedule**. Firstly, we will look at interest rates, grace periods and loan terms for the debt financing portion of our demo project.

Debt Finance			
Co-Financier	Interest Rate	Term	Grace
MDB1 (AfDB)	0.82%	30.0	8.0
MDB2 (EIB)	2.39%	30.0	6.0
Bilateral Dev. (KfW / AFD)	2.50%	20.0	6.5
Climate Fund	4.96%	14.0	1.0
Commercial Banks	8.03%	15.0	1.5

6. Looking at this table at the end of our project proposal, the project appraisal report for “300MW Wind Project (Demo)” we can see that the terms of finance for our loan commitments is clearly highlighted. Not all reports will break down terms of finance in a table like this, and figures may appear in a paragraph, however they can be input in the same way.

Lastly for Debt repayments we need to make sure we input an appropriate loan schedule. We can see that at the top of the document, the loan from the AfDB (MDB1)

has the terms “*30-year term including 8 years’ Grace period on principal repayments*” from this we can determine grace on principal repayments only, whilst for infrastructure projects, we assume unless stated otherwise that repayments follow an Equal Principal repayments (EPP Schedule). Further in the document it states that loans in this project are “*...all under the same loan repayment schedule*”. As such we can label all loans as “**EPP with Grace Years on Principal**” in MINFin.

Transferring these inputs into our MINFin sheet, our project data should look like this:

48	Rate ▾	Term ▾	Maturity ▾	Grace period ▾	Schedule ▾
84	0.82%	30.000	20.000	8.00	EPP with Grace Years for Principal
85	2.39%	30.000	20.000	6.00	EPP with Grace Years for Principal
86	2.50%	20.000	10.000	6.50	EPP with Grace Years for Principal
87	4.96%	14.000	4.000	1.00	EPP with Grace Years for Principal
88	8.03%	15.000	5.000	1.50	EPP with Grace Years for Principal
89					
90					
91					
92					
93					

- Next we can move onto filling in data for our Equity terms of financing. For this we will be looking for Return on Equity (ROE) for the project, this may be presented with other project statistics, so it is important to ensure we select the correct variable. This will give us the **Rate** that we expect for equity investments in this project:

Economic Rate of Return (EIRR) on Project	12%
Expected Return on Equity (ROE) on Project	16%

- In the Project document, under general project information we can see that the ERR for this project is 16%, now we need the Term and Grace period. In MINFin the term of equity investments is estimated to match the lifespan of the project. In this project document we are told that the project has a “*projected operational lifespan of 30 years*”, so we assume that the term of these equity investments will be 30 years. In projects where we do not know the exact lifespan of the projects, assumptions can be used based on standard regional technology lifespans used in OSeMOSYS which can be found [here](#) which is based on the [NREL Transforming Energy Database](#). Regarding grace period, we assume no grace period between construction/operation and equity returns, so this is by default set to 0. Lastly the repayment schedule is set to “**Equity**” in MINFin. Inputting this data in the MINFin model, the sheet should now look like this:

48	Rate	Term	Maturity	Grace period	Schedule
84	0.82%	30.00	20.00	8.00	EPP with Grace Years for Principal
85	2.39%	30.00	20.00	6.00	EPP with Grace Years for Principal
86	2.50%	20.00	10.00	6.50	EPP with Grace Years for Principal
87	4.96%	14.00	4.00	1.00	EPP with Grace Years for Principal
88	8.03%	15.00	5.00	1.50	EPP with Grace Years for Principal
89	16.00%	30.00	20.00	0.00	Equity
90	16.00%	30.00	20.00	0.00	Equity
91	16.00%	30.00	20.00	0.00	Equity
92	16.00%	30.00	20.00	0.00	Equity
93	16.00%	30.00	20.00	0.00	Equity

9. This completes the data inputs for the “300MW Wind Project (Demo)” project, and these results should be included in our modelling.

4. Visualising Historic Financing Terms in MINFin

Navigating again to the “Visualisation Dashboard” tab in the MINFin Model and selecting the visualizations under the “Historic Financing” heading, we can view a visualization of many of the characteristics our historic financing baseline:

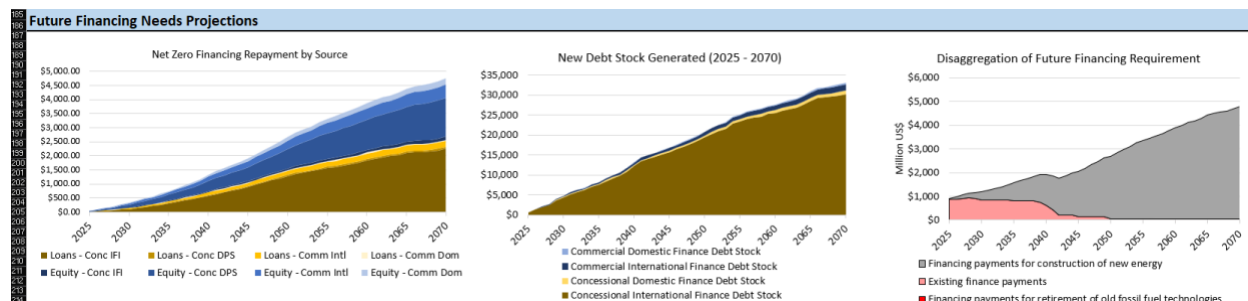


Looking at the measures of Grant and Market element (as covered in previous lectures), we can see that finance from Multilateral sources constitutes the not only the largest volume of financing in this sectoral baseline, but also carries some of the most concessional terms, with a market element of a little over 20%.

Disaggregating by source of financing tells a similar story with large volumes of Concessional international Debt (Conc_IFI) carrying loan terms marginally higher than that of Concessional Domestic Debt (Conc_DPS), but in far larger volumes.

From a technology perspective, we can see that Transmission and Distribution technologies, despite relatively high returns on equity have relatively low weighted average costs of capital (WACCs), in part due to their large proportions of concessional debt financing. Solar and Hydro both carry relatively low WACCs due to lower equity rates of return, whilst wind also benefits from higher amounts of concessional debt financing.

We can see that despite high IRR for equity commitments, low interest rates and large portions of debt financing in Wind technologies leads to low WACCs, with Hydro and Solar following closely. Geothermal carries large amounts of equity investments in this example baseline and has a far higher WACC than other technologies. Biomass, Geothermal and Battery technologies carry higher portions of equity financing, with battery 100% equity financed in the historic baseline, and due to high equity rates of return also carry high WACCs. Lastly we can see that non-renewables including Oil carry the highest WACC at nearly 10%.



Now we can also move on to look at changes in future financing needs, here we must find the heading “Future Financing Needs Projections” on the “Visualisation Dashboard” tab in Rows 185–215. Here we can see how the burden of repaying the financing requirements of the transition is distributed between debt and equity, as well as between sources of financing, with Concessional International Loans, and Concessional Domestic Equity constituting the largest shares of this repayment cost. Here we can also see how New Debt stocks (outstanding debt obligations) are accumulated over the modelling period and are distributed between sources. In this instance the vast majority of debt stock will be against Concessional International sources of financing. Lastly here we can see the financing requirements by source, disaggregated between repayment of existing financing obligations from our “Historic Baseline”, costs of fossil fuel retirement, and the financing requirements of constricting new energy capacity as projected by OSeMOSYS.