Department for
Business, Energy
& Industrial Strategy

HNDU Template Financial Model

Detailed Model Specification and Technical Guide

V010.001

Contents

HNDU Template Financial Model – detailed model specification and technical guide

Overview

The Heat Network Delivery Unit Template Financial Model (TFM) is designed to take key outputs from a techno-economic cash flow model (TEM) used for the appraisal of the development of a district energy network and enable the calculation of post-tax nominal investor returns derived from the pre-tax real project cash flows established in the TEM.

The TFM needs to be flexible enough to be able to effectively model the vast majority of district energy projects being developed in the UK without being overly cumbersome. Below is a list of the types of projects that are expected to be possible to model using the TFM (n.b. projects may combine heat/cooling/power):

- Heat networks with heat generating plant owned by the project;
- Heat networks with imported heat from a third party;
- Cooling networks with cooling generating plant owned by project;
- Cooling networks with imported cooling from a third party;
- Private wire electricity networks with electricity generating plant owned by the project; and
- Private wire electricity networks with electricity imported from a third party

The model also allows for the project to invest in energy efficiency measures for up to five energy off-takers allowing for analysis of how energy efficiency could be monetised in conjunction with the development of a district energy project.

In theory the model could also allow for other types of energy generation and transmission/distribution such as anaerobic digestion and subsequent export of the gas and/or onsite combustion; however, it would require some care as the feedstock would need to be expressed in kWh equivalent (where perhaps tonnes would be more typical).

Key calculations over-and-above the TEM

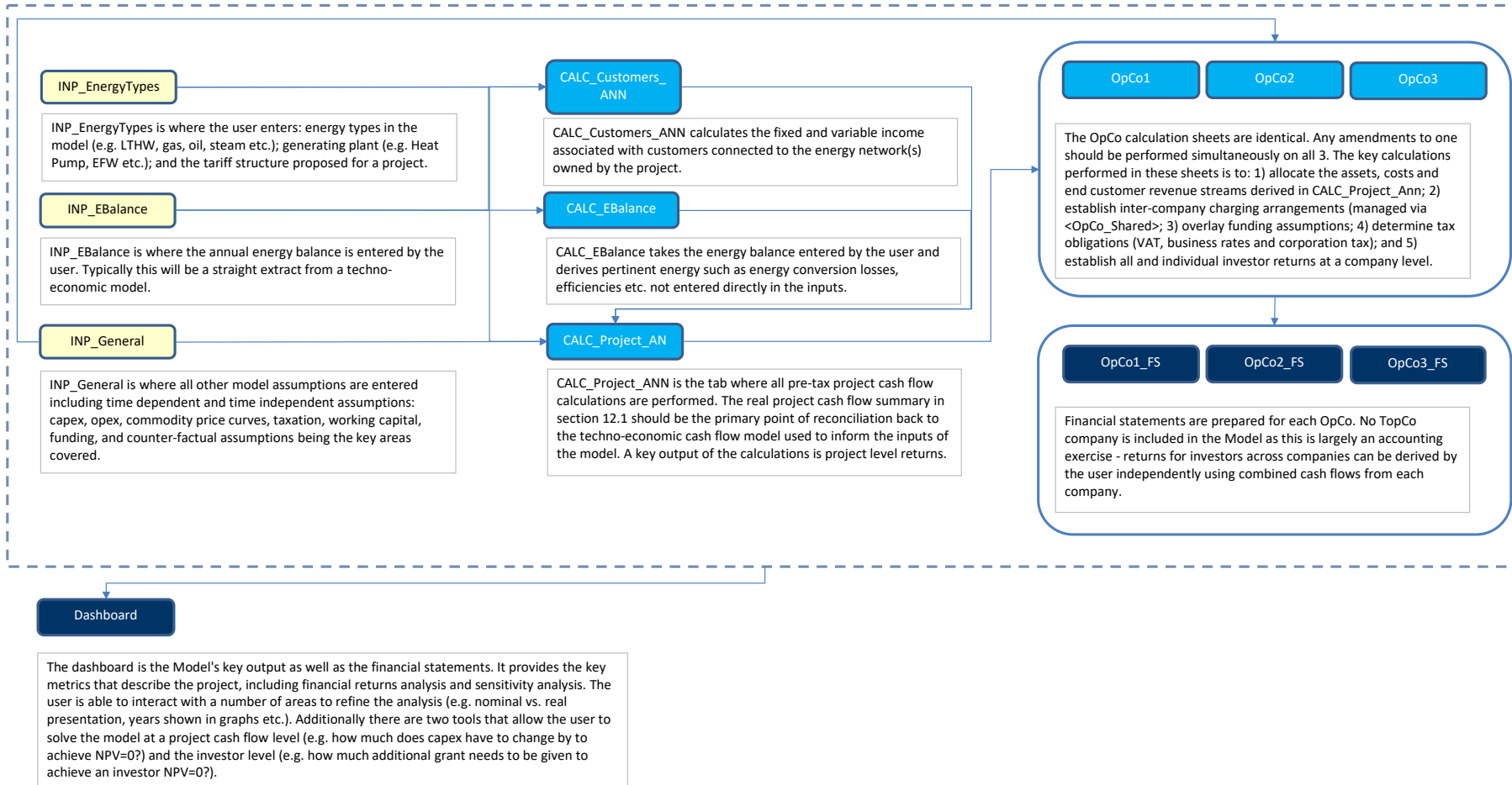The key additional calculations that the TFM undertakes, relative to the TEM, are as follows:

- Legal structuring (e.g. Generation Company vs. Distribution Company);
- Capital structuring (e.g. debt, equity, lease, overdrafts, restricted cash etc.);
- Tariff structure and financial risk management;
- Tax (VAT, corporation tax and business rates being key);

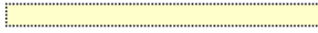- Working capital & bad debt; and
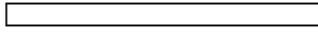- Inflation

Model Structure

1   KEY MODEL WORKSHEETS

INP_EnergyTypes

INP_EnergyTypes is where the user enters: energy types in the model (e.g. LTHW, gas, oil, steam etc.); generating plant (e.g. Heat Pump, EFW etc.); and the tariff structure proposed for a project.

INP_EBalance

INP_EBalance is where the annual energy balance is entered by the user. Typically this will be a straight extract from a techno-economic model.

INP_General

INP_General is where all other model assumptions are entered including time dependent and time independent assumptions: capex, opex, commodity price curves, taxation, working capital, funding, and counter-factual assumptions being the key areas covered.

CALC_Customers_ANN

CALC_Customers_ANN calculates the fixed and variable income associated with customers connected to the energy network(s) owned by the project.

CALC_EBalance

CALC_EBalance takes the energy balance entered by the user and derives pertinent energy such as energy conversion losses, efficiencies etc. not entered directly in the inputs.

CALC_Project_AN

CALC_Project_ANN is the tab where all pre-tax project cash flow calculations are performed. The real project cash flow summary in section 12.1 should be the primary point of reconciliation back to the techno-economic cash flow model used to inform the inputs of the model. A key output of the calculations is project level returns.

OpCo1   OpCo2   OpCo3

The OpCo calculation sheets are identical. Any amendments to one should be performed simultaneously on all 3. The key calculations performed in these sheets is to: 1) allocate the assets, costs and end customer revenue streams derived in CALC_Project_Ann; 2) establish inter-company charging arrangements (managed via <OpCo_Shared>; 3) overlay funding assumptions; 4) determine tax obligations (VAT, business rates and corporation tax); and 5) establish all and individual investor returns at a company level.

OpCo1_FS   OpCo2_FS   OpCo3_FS

Financial statements are prepared for each OpCo. No TopCo company is included in the Model as this is largely an accounting exercise - returns for investors across companies can be derived by the user independently using combined cash flows from each company.

Dashboard

The dashboard is the Model's key output as well as the financial statements. It provides the key metrics that describe the project, including financial returns analysis and sensitivity analysis. The user is able to interact with a number of areas to refine the analysis (e.g. nominal vs. real presentation, years shown in graphs etc.). Additionally there are two tools that allow the user to solve the model at a project cash flow level (e.g. how much does capex have to change by to achieve NPV=0?) and the investor level (e.g. how much additional grant needs to be given to achieve an investor NPV=0?).

Model cell style convention
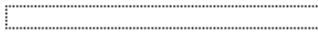
3	CELL CONVENTIONS	

	With the exception of the HNIP and HNDU templates, a cell with light yellow style and dotted border represents an unlocked input cell.
	A colourless cell, either with or without straight border, represents a calculation cells.
	A colourless cell, with dotted border, represents an input assumption call up.
	A green cell, with dotted border, will be a cell or range of cells that are populated by VBA.
	An orange cell, with dotted border, is only used in the HNIP and HNDU tabs and are to highlight cells, or ranges of cells, that require manual input.
	A light green cell, with dotted border, is only used in the HNIP and HNDU tabs are are used to highlight cells, or ranges of cells, that are required in the HNIP/HNDU templates and which are automatically populated by the Model.

Model Inputs

The TFM has three input sheets:

- INP_EnergyTypes
- INP_EBalance
- INP_General

Worksheet: INP_EnergyTypes

This input sheet is time independent and has two section:

1. Energy; and
2. Energy sales

1	ENERGY

ENERGY TYPES

Energy Name		Imp./Exp.	Grid Export	Type

Energy name is a free text entry that the user can specify. Up to 10 types of energy can be entered into the TFM. Examples might include:

- Heat
- Low Temperature Hot Water (LTHW)
- Steam
- Gas
- Oil
- Biomass
- Biomethane
- Electricity (import)
- Electricity (export)
- Electricity (day import)
- Electricity (night import)
- Electricity (day export)
- Electricity (night export)
- Etc.

They should be labelled so they are uniquely identifiable – there is an integrity check in the TFM to ensure this is adhered to.

The **Imp/Exp** field requires the user to set whether the energy type is an energy type that is imported or exported. Where a commodity is both imported and exported (typically electricity) then two instances should be entered into the TFM – one as the import and one as the export.

Grid Export refers to whether the commodity (if set to "Export") is capable of being exported to a wider network allowing for any energy spill to be sold in the wider traded market. For District Energy this will typically refer only to electricity; however, it is conceivable that there could be scenarios where other energy types such as excess heat, cooling, bio-methane production etc. could be sold in wider energy networks. If set to "TRUE" then the extent to which there is surplus generation (spill) then the export tariff set in <INP_General> section 1.2 will determine the income receivable.

Type for export this would be one of: heat, cooling or electricity; for an energy import this will only be "Fuel/input energy". If the user allocates an export to "Fuel/input energy" or an import to one of heat, cooling or electricity then an integrity error will appear. The purpose of this overarching allocation is to allow for analysis that combines the individual energy types entered by the user into the fundamental energy types of heat, cooling and electricity. For example, a project may need to distinguish tariffs supplying low temperature hot water, medium temperature hot water, high temperature hot water, steam and domestic hot water. All of these are forms of heat sales and as such requiring the user to allocate each to an overarching "heat" category allows for both individual analysis of each types of heat as well as combining them into a single energy category.

EMBEDDED GENERATION

Plant Name		FUEL INPUT			ENERGY OUTPUT TYPE			ENERGY OUTPUT kW			Maximum utilisation (run hours)
		Fuel Input 1	Fuel Input 2	Fuel Input 3	Energy Output 1	Energy Output 2	Energy Output 3	Output 1 Capacity	Output 2 Capacity	Output 3 Capacity	
Label	Primary?	Energy	Energy	Energy	Energy	Energy	Energy	kW	kW	kW	%
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

Embedded Generation refers to the energy generating plant that is proposed to be used over the project's life. Plant can have up to three *fuel input* types and up to three energy outputs. The reason for having multiple fuel inputs is twofold:

1. There are plenty of examples of co-fired power plants (e.g. biomass + gas) or plants that can take blended fuels (e.g. methane + hydrogen); and
2. Some plants may be planned to transition to an alternative future feedstock. For example, a natural gas fired CHP may plan to transition to hydrogen at a point when hydrogen can be sustainably and reliably manufactured and transported to the plant.

Equally with *energy outputs* it is perfectly possible for three separate energy types to be generated by a single plant. For example, a gas CHP plant could produce a variety of temperature outputs depending on the point of extraction (jacket vs. flue) as well as producing electricity. It was therefore considered safe to assume a maximum of three energy outputs. In the unlikely event of a single plant item producing four or more discrete energy types then this could be managed in the TFM by simply entering the plant twice and adjusting the fuel and output energy types to reflect the split.

Energy Output kW refers to the plant's energy generating capacity. The efficiency of the plant is derived on a profile basis within the TFM using the annual energy balance entered in <INP_EBalance>. As such it is not requested to be entered here.

Maximum utilisation refers to the number of hours of plant run time as a percentage of total hours in a year. No calculations are based of this value entered and it is solely used for dashboard presentation.

Checks are included in this section to ensure that no duplicate names of plant are entered by the user. There are some system calculations to categorise whether the energy output of the plant is heat, cooling and/or electricity. Generally calculations are aimed to be avoided in the inputs sheets.

ONSITE TARIFFS															

Base year		Year	2021												
Money Index		Index	CPI												
Allocate private network to:		select	Retail												

Tariff Name	Energy	Connection Point		Fixed	Variable	Connect. Charge	Indexation method	Fixed: Real PI fuel	Fixed: Real PI cost base	Fixed: Real PI unpegged	Variable: Real PI fuel	Variable: Real PI cost base	Variable: Real PI unpegged	Real price index	Check Peg	Check Entry
# Label	Type	Prim./Sec.		£/day/conn	p/kWh	£000	Select	%	%	%	%	%	%	Select		
1										100%			100%		OK	OK
2										100%			100%		OK	OK

This section establishes the tariffs (up to 30) for different energy types generated / on-sold by the party responsible for "retail" business to customer relations within the TFM. However, the user can change this preset assumption by amending "Allocate private network to:" from "Retail" to say "Generation" or "Distribution". Sales to a wider energy network (e.g. to a national electricity supplier via the National Grid) are managed through <INP_General> Section 1: "Tariffs for energy exported to National Grid".

Each tariff requires a name "Tariff Name". This could be "Heat sales tariff", "Domestic heat sales tariff", "[City X] Town Hall specific private wire tariff" etc. The key is that each tariff can only supply a single energy type. Where commercial negotiations with customers are for bundled energy supply (e.g. heating + private wire) in a single energy supply contract (ESA), the user of the TFM can simply separate out the energy types embedded within the ESA and split the fixed charge across the three or in proportion to underlying costs.

The *Energy* field provides an abbreviated list derived from the "Energy Types" inputs section to show only those energy types that have been set by the user to be "export".

The *Connection Point* field describes the point at which connection is made to the customer from an invoicing perspective. In heat sales, primary connection would refer to where heat is supplied directly to a building heat exchange and metered at that point for invoicing purposes. Secondary connection would be where heat is supplied to end customer Heat Interface Units (HIUs) and the internal riser and lateral pipework losses are managed by the system operator.

Fixed: this is the pound per day per connection fixed charge that customers connected pay from the year they are connected to the end of the project appraisal period. This value is expressed in the money of the year terms of the "Base Year" entered.

Variable: this is the p/kWh consumption charge for the energy type being sold. This value is expressed in the money of the year terms of the "Base Year" entered.

Connection charge: this is the one-off charge **expressed in £ thousand** for each customer connection of a given tariff type. This value is expressed in the money of the year terms of the "Base Year" entered.

Indexation Method: there are three methods for escalating a given tariff in real terms (money escalation is managed through the general "Money Index" assumption adopted by the user for tariffs.

1. Weighted cost
   If selected then both fixed and variable will escalate in line with the weighted average real price escalation of the project's cost base (fuel & O&M). This might reflect where a project is adopting a not-for-profit model but has a straight pass through of costs to the customer.

2. Allocated

Tariff Name	Energy	Connection Point	In CCA scheme for CCL?	Fixed	Variable	Connect. Charge	Indexation method	Fixed: Real PI fuel	Fixed: Real PI cost base	Fixed: Real PI unpegged	Variable: Real PI fuel	Variable: Real PI cost base	Variable: Real PI unpegged	Real price index	Check Peg	Check Entry
Label	*Type*	*Prim./Sec.*	*T/F*	*£/day/conn*	*p/kWh*	*£000*	*Select*	*%*	*%*	*%*	*%*	*%*	*%*	*Select*		
Phase 1 tariff	LTHW	Primary dis	FALSE	0.13	6.00	0.30	Allocated			100%	100.00%		0%	Zero real inf	OK	OK
Subsequent phase tariff	LTHW	Primary dis	FALSE	0.13	6.00	0.30	Allocated			100%	100.00%		0%	Zero real inf	OK	OK
Hospital tariff	LTHW	Primary dis	FALSE	0.13	6.00	0.30	Allocated			100%	100.00%		0%	Zero real inf	OK	OK
										100%			100%		OK	OK

If "Allocated" is selected then the user can adjust the proportion of fixed and variable tariff components that are escalated in line with a real price index (e.g. fuel) set in column labelled "Real price index", O&M or not pegged for real price escalation.

For example, a tariff may want to keep the fixed tariff unchanged in real terms and as such allocate 100% of the escalation method to "Fixed: Real % unpegged". However, they may want 100% of the variable tariff to inflate with the marginal cost of underlying primary fuel used by the project (e.g. electricity for a heat pump) or else peg it to an altogether different fuel which may be that customer's current (for retrofit schemes) or counter-factual (for new build) fuel.

3. Real Price Index
   Both the fixed and variable tariffs will be escalated in real terms in line with the marginal cost of user selected "Real price index".

In the current UK District Energy sector "Allocated" is the most likely selection to be made as projects typically are wary of escalating fixed tariffs in real terms.

Integrity checks are provided to ensure that if a tariff is entered that all relevant fields are completed and that if "Allocated" is selected that a % greater than 100% is not entered by the user.

Worksheet: INP_EBalance

DH FFM - 004.007		Sheet Integrity checks:			Financial Year	2020	2021
INP_EBalance		Sheet Warnings:			Year	2020	2021
No Integrity Errors					Period Start Date	01/01/2020	01/01/2021
No Warnings					Period End Date	31/12/2020	31/12/2021
All Macros Run			**CALCUALTE**		Annual Period	1	2

	Units	Call	Calc.	Check	Warning	Total

1 ENERGY DEMAND & ENERGY EFFICIENCY

PRE-ENERGY EFFICIENCY (IF E.F. MEASURES MET BY ESCO) DEMAND

	Customer		Tariff	Type	Existing?	Sub-class	Energy	Check		
1	Town hall	kWh	Phase 1 tariff	Non-Domestic	TRUE	LA	LTHW	OK		
2	Assembly hall	kWh	Phase 1 tariff	Non-Domestic	TRUE	LA	LTHW	OK		
3	Portland House	kWh	Phase 1 tariff	Non-Domestic	TRUE	LA	LTHW	OK		

A "Customer" in the TFM represents an energy consumer that will be supplied directly using the energy network that is to be developed by the project. Where excess supply is made to customers on a wider energy network (e.g. the National Grid for electricity) then such supply is derived by the TFM based on energy spilled for export energy marked for "Grid export" in <INP_EnergyTypes>. Where customers are forecast to demand multiple energy types from the network then for each energy type, in line with the tariff selection, they should be entered as a separate row reflective of that energy type's forecast consumption profile. To the extent that energy efficiency measures are planned to be undertaken and where the project intends to fulfil the energy efficiency measures then the pre-energy efficiency demand should be entered in this section.

Up to 150 customers can be entered into the TFM. It should be noted that there is a presumption that where there are domestic connections no user will enter individual domestic connections but rather would enter the aggregation of domestic buildings. For example, a tower block with 300 domestic units would be expected to be entered into the TFM as a single "customer" – e.g. "Ben Jonson House". On this basis it is assumed that 150 individual customers will be more than adequate for the vast majority of schemes being developed. In the unlikely event that more than 150 customers are required then there are several options two of which are as follows:

1. The user updates the TFM to allow for more customers to be entered. This option is not recommended as there are a number of inter-dependencies in the TFM; however, with care updating <CALC_Customers_ANN> it could be done relatively easily as analysis is performed in the TFM on a tariff not customer basis through the use of the sumif function; or
2. The user combines some customers into customer and tariff types as it is highly improbable that customers will each receive bespoke tariffs. A project with more than 10 tariffs would be quite rare (possibly unique) based on the HNDU portfolio of projects being developed.

It is not recommended for duplicate customer names to be used but doing so should not impair the TFM's integrity.

The *Tariff* must be selected for each customer and refers back to <INP_EnergyTypes> section 2: Energy Sales. An integrity check is present to ensure that a tariff is entered when a customer label is created.

The *Type* refers to whether the customer is domestic or non-domestic. This distinction is primarily for VAT purposes where a different rate of VAT is available to domestic customers.

The *Existing?* asks whether the building connected is yet to be built or if it is already built and occupied. This has no impact on financial outputs put is used for template outputs for tab <HNDU_AppC>. This applies also for the category "**Sub-class**" which helps identify which broad category of building the customer relates to for reporting purposes.

Peak demand					
Customer		Tariff	Type	Energy	
1 Town hall	kW	Phase 1 tariff	Non-Domes	LTHW	
2 Assembly hall	kW	Phase 1 tariff	Non-Domes	LTHW	
3 Portland House	kW	Phase 1 tariff	Non-Domes	LTHW	

The peak demand section requires the user to enter the kW peak demand requirement of a customer in a given year. Primarily this is used for the counterfactual calculations in tab <CALC_Project_ANN> and do not impact any primary financial calculations within the TFM.

Up to five customers can be selected for the inclusion of energy efficiency measures. An important part of District Energy in a UK context is the potential for energy efficiency measures to be combined with supplying low carbon heat, cooling and/or power over a local energy network. The lower demand that energy efficiency measures will bring need not be seen as detrimental to the District Energy scheme rather an opportunity that this section allows the user to explore.

A customer should be selected from the drop down in column D highlighted as "A" above. The user should enter the number of years that the contract is expected to last for between the customer and the project for recovering the cost borne by the project for undertaking the energy efficiency measures on behalf of the customer.

The cumulative energy efficiency savings should be entered as a positive value (data validation is included) and should reflect the cumulative savings rather than the year-on-year incremental savings. This is because the pre-efficiency demand profile may be forecast to change over time and as such an incremental % would be more prone to error. The energy saving is calculated so that the user can ensure that this reconciles to his/her own forecast of savings.

The fuel that would have been expended reflects the cost that would have been incurred by the customer to self-supply (or import depending on energy type). The user should select the energy type from the drop down (if it is not present then the user should update the energy type inputs to include it in <INP_EnergyTypes>) and state the plant efficiency for generating the energy type (e.g. a gas boiler might be expected to between 60-90% efficient depending on age and model). Where the energy was simply imported (e.g. electricity) then the user should enter 100%.

The % of saving retained by the ESCo (Energy Service Company, referred to above as the "Project") is the value that will accrue to the ESCo as income being the value of energy saved.

The user then needs to enter the capital and operating cost of implementing the energy efficiency measures that are borne by the project. For capital costs the "UEL" refers to the useful economic life and is the period over which the asset will be depreciated for accounting purposes. The base year and index allows for nominal cash flow calculation. Capital costs should be entered in £000 as positive values. Operating costs should be entered in £000 as negative values. Data validation is present to better ensure this is adhered to.

This section of the worksheet allows the user to enter the individual energy input/output of each item of plant entered by the user in <INP_EnergyTypes> Section 1: "Embedded Generation". Values should entered as positive in kWh.

For each energy type that is set as an "export" (see <INP_EnergyTypes>) then the user needs to enter the kWh of losses forecast across the primary and secondary networks for each energy type.

System parasitics represent the energy required to operate the plant. For district heating this would primarily relate to electricity consumption for pumping, monitoring, lighting etc. kWh values should be entered as positive. Only the parasitical energy consumption that is expected to be **purchased** should be entered in this section.

The relevance of this is that in the event that a project self-supplies electricity to another process in the Energy Centre (e.g. a small CHP supplying electricity to a larger heat pump,

CHP supplying 5% of its generation to pumping etc.) then the TFM can be calibrated to reflect this benefit (retail cost of energy having been avoided). The remaining balance of parasitic energy requirement would then be entered in this section as a positive value expressed in kWh per year.

Worksheet: INP_General

Each energy type entered by the user in <INP_EnergyTypes> that was marked as "Import" is called up into this section. The base year is presumed to be the TFM's start year; however, the user could overwrite this if he/she wanted to. The user can enter a £/day fixed charge for the commodity and the p/kWh consumption charge. BEIS quoted forward curves should reflect the full cost of energy and as such more typically just the p/kWh inputs will be used; however, some projects may have existing energy purchase contracts that could be used to make the fixed/variable distinction.

Tariffs for energy exported to national grid represent the value of energy generated on site (or imported) that is exported to a wider energy network capable of purchasing all surplus energy that the project has available. Where the projects energy balance shows surplus supply (output energy – distribution losses – network demand > 0) and the user has set the energy type as a "Grid Export" (see worksheet <INP_EnergyTypes>), then the surplus is sold at the price set in this section.

A fixed tariff component is not included as the supply relationship is between the project and an energy market where the project is seen to be a price taker and therefore unable to levy a charge for the recovery of fixed costs. It is only able to achieve the marginal cost of supply. Should a scenario present itself where this is not the case then a blended p/kWh could be included to include both the fixed and variable income expected.

Customer Connections

For each customer the user should enter the number of individual customers that will be connected in a given period that corresponds to the fixed and one off connection charge assumption made in the tariff section of <INP_EnergyTypes>. Connections should be entered incrementally not cumulatively.

Taking an earlier example, if the user has entered "Ben Jonson House" in demand section reflecting 300 domestic units in a housing block and the fixed and connection tariff is reflective of an individual unit's fixed and connection charge, then the user should enter 300 connections. If however, the user had entered the whole block's fixed charged obligation and total connection charge in the tariff section then only 1 connection would be entered in this section. From a presentation and analysis perspective the former not the latter is preferable.

In the event that connection (and fixed charging) is based not on the number of connections but the kW peak capacity requirement, number of bedrooms etc. then the user should enter these values as opposed to the number of connections.

Money Inflation

A key part of the TFM is the ability to evaluate the impact of both real and nominal price escalation variation. This section allows the user to enter the wider money price escalation that the user has to adopt for every cash flow in the TFM. For example, it could be that tariffs are assumed to inflate, in money terms, in line with the Consumer Price Index (CPI); however, Operations & Maintenance (O&M) costs may align predominantly with a labour index which could inflate at a higher rate than CPI. The real cost of labour may stay constant but the wage inflation could rise at a faster rate than CPI leading to a nominal squeezing of cash flows. The ability to analyse this kind of risk is a core part of the TFM.

Up to 10 separate indices could be entered. An index must be used – i.e. starting with 1.00 and incrementing up/down in line with percentage changes. By way of example an indicative CPI and RPI set to inflate at 1.5% p.a. and 2.0% p.a. is provided in the TFM.

The user can switch money inflation off entirely in the TFM ("Apply money inflation in model?") – however, this is considered unnecessary as the TFM provides full real and nominal analysis with all values and outputs expressed in real and nominal terms.

Capex

The first section of the capex entry relates to replacement capital expenditure (repex) and capex sinking fund assumptions.

Adopt cash repex associated with UEL assumption in model? The default assumption is that this is not applied as it is assumed that technical consultants will have provided repex schedules as part of their work that will be included in the capex values entered. However, in the event that repex schedules have not been provided then the user can switch this to "TRUE" and this will result in each capital expenditure item being replaced at the end of their stated Useful Economic Life (UEL) multiplied by the % repex value that the user provides.

Adopt cash sinking fund for repex? Some project investors will want to minimise future funding obligations and will therefore opt to reduce the cash they can extract from the project preferring instead to reserve cash for future expenditure. Selecting "TRUE" switches this logic on in the TFM. All cash relating to the capex sinking fund is held as "restricted cash" on a given OpCo's balance sheet until such point that the repex obligation arises.

Annual interest rate assumed achievable for sinking fund. When reserving cash for future expenditure some companies will look to invest the reserved cash such that the combination of future contributions from the project cash flows plus compound returns investment pay for the future obligations. The greater the expected level of returns the lower the contribution needed from the project cash flows. The value entered in this cell represents what the project **hopes** to achieve on the cash they reserve prior to it paying for future repex.

Annual interest rate achieved by the fund. This represents the level of return that the fund actually achieves. To the extent that it is lower than the hoped for return then there will be a fund shortfall that will need to be made up by equity (or other funding) at the time the repex is incurred.

Whilst both the "assumed" and "achieved" rates are clearly both forecasts the purpose of this is to allow for sensitivity analysis in the event that repex reserving is being planned for.

Funding look ahead period. This is the period over which the repex funding horizon is evaluated. The further out the project evaluates the more spread the payments into the fund will be.

Capex is broken down into pre-determined categories:

- Energy Centre;
    - Generating Plant (per the plant entered by the user in <INP_EnergyTypes>;
    - Other capex in Energy centre;
- Private Wire;
- Primary distribution network;
- Connections;
- Engineering, procurement & project management; and
- Contingency

The user can amend all subheadings; however, this is not recommended as it will slightly undermine how the HNDU Appendix C template (<HNDU_AppC>), embedded into the TFM, is populated which would not be particularly helpful in the event that the user of the TFM is working with a Local Authority funded by HNDU with HNDU deliverables of which Appendix C would be one.

For each capex item the user must complete the following:

- UEL (Useful Economic Life) – with the exception of the plant items indicative UELs are provided for each capex category in line with project assumptions observed across HNDU's portfolio of supported projects;
- Base Year – this is presumed to be the Model's start year but can be overridden by the user to a later year but not an earlier year;
- Index – this is the money inflation index that is to be applied to the real capex cost entered in this section;
- Repex – in the event that the user has set repex associated with UEL assumption to TRUE then at the end of the UEL, the original cost of the asset is multiplied by the % of repex entered here by the user;
- Type – this allows the user to allocate which of "Generation", "Distribution" and "Retail" the asset is to assessed to relate to. Whilst a mandatory field, it is only relevant for projects that intend to "unbundle" their assets into different legal entities for which OpCos 1-3 are provided in the TFM for.
- The profile of capex is the entered into the time dependent columns as positive values. Data validation has been provided to better ensure this is adhered to.

In the likely event that repex schedules have been worked up by technical consultant these should be overlaid into the capex profile for a given asset category.

Operating Costs

O&M and overheads are entered into the TFM in summary form with the profile of costs allocated to one of: generation, distribution and retail. Values should be entered as negative values. Data validation is provided to help ensure this is adhered to.

Social Costs

6 SOCIAL COSTS				
CARBON FACTORS				
0	kg CO2e / kWh			
0	kg CO2e / kWh	REFER TO BEIS SUPPLEMENTARY GUIDANCE: EMISSIONS		
0	kg CO2e / kWh			
0	kg CO2e / kWh			
0	kg CO2e / kWh			

Social costs are broken down into several sub-sections:

- Carbon factors
- Social cost of carbon
- Air quality; and
- Counterfactual

Carbon factors refer to the kg CO2e/kWh of energy consumed. Published values for the core energy types are provided by BEIS in the [Green Book Supplementary Guidance: valuation of energy use and greenhouse gas emissions for appraisal](). Where more complex energy forms are used by the project, and which are not quoted in the supplementary guidance, then the user should refer to DEFRA's published emissions factors: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting.

SOCIAL COST OF CARBON				
% of carbon deemed to be traded	%			0%
Cost of carbon - traded	£/T CO2e	REFER TO BEIS SUPPLEMENTARY GUIDANCE: EMISSIONS		14.40
Cost of carbon - non-traded	£/T CO2e			72.08
Base year	Year	2020		
Index	Index	CPI		

Social cost of carbon is the section that provides a £/T CO2e value with the money of the year terms that the profile selected by the user. Some energy customers may already be included in the EU Emissions Trading Scheme (EU ETS) and others may not. Both these curves are published and updated annually in the the [Green Book Supplementary Guidance: valuation of energy use and greenhouse gas emissions for appraisal.]()

The user can set the approximate percentage split between traded and non-traded customers proposed to be connected to the network. The default assumption is that 0% of the customers are traded as the majority of customers for UK District Heating will be domestic and commercial buildings. Larger energy consumers, notably hospitals, typically have an exemption from EU ETS but this should be checked on a project-by-project basis.

AIR QUALITY					
0	p/kWh	REFER TO BEIS SUPPLEMENTARY GUIDANCE: EMISSIONS			
0	p/kWh				
0	p/kWh				
0	p/kWh				
0	p/kWh				
0	p/kWh				
0	p/kWh				
0	p/kWh				
0	p/kWh				
0	p/kWh				
Base year	Year	2020			
Index	Index	CPI			

The air quality factors are published in the [Green Book Supplementary Guidance: valuation of energy use and greenhouse gas emissions for appraisal](). Care should be taken to ensure that the appropriate cost of air quality impact of a given fuel type takes into account the urban

density of the proposed network's location. For this reason, values are not stored in the TFM as these will vary project-to-project.

COUNTER FACTUAL			
Include CF Fuel, O&M & capex and exclude project income?	T/F	FALSE	FALSE
General			
Output energy for counter-factual calculation	Energy	LTHW	OK
% of carbon deemed to be traded	%	0%	
Base year	Year	2020	
Index	Index	CPI	
Early period counterfactual			
Fuel	Energy	Natural gas	OK
Efficiency	%	86%	
Purchase cost of technology	£/kW	150	
Annual operating cost of technology	£/kW/Y	7	
Useful economic life	Years	20	
Subsequent counterfactual			
Year subsequent technology supercedes the initial technology	Year	2025	
Fuel	Energy	BEIS manufacturer electricity price (no infl)	OK
Efficiency	%	200%	
Purchase cost of technology	£/kW	1,000	
Annual operating cost of technology	£/kW/Y	10	
Useful economic life	Years	15	

The counterfactual section allows the user to assess an indicative counterfactual for each energy type in the TFM. Typically it is expected that a heating counterfactual will be selected; however, the TFM is indifferent to the energy type as long as the user has sensible assumptions for the counterfactual energy generating technology.

Include Counterfactual fuel, O&M & capex and exclude project income? By selected this as "TRUE" the TFM will not only include the counterfactual cost of carbon and air quality impacts but will also overlay the fuel costs, capital cost and O&M costs that would have been incurred by customers in the counterfactual scenario. Project income is removed from the calculation and the approach to calculating social NPV, social IRR etc. is a direct cost comparison between the cost of developing the network vs the cost of the counterfactual accounting for the relative CO2e and air quality impacts.

A challenge that such an approach faces is that such an approach presumes that the social time preference of the investor in the heat network is equivalent to the social time preference of the counterfactual scenario. In reality a domestic/commercial/public sector etc. heat offtaker will have a very different social time preference for the provision of heat – clearly to occupy a building in winter there needs to be heat! An institutional investor in a heat network could opt to invest in a range of projects of which the investment in a heat network would be one.

For this reason, the default setting in the model is "FALSE". What this means is that the TFM will calculate social NPV and social IRR _from the investor's perspective_ by taking the project cash flows (revenue less opex less capex) and overlay the impact of CO2e and air quality. If the project is able to satisfy itself, and indeed offtakers, that the tariff offered represents financial and/or social value for money to customers (the <Dashboard> provides an analysis tool to evaluate this) then the issue relating to differing social time preferences has been addressed. For example, if the capital cost of developing a heat network is an order of magnitude higher than the counterfactual heating solution but the tariff offered to customers is at or below the counterfactual cost of heat then this should be seen to have social value on the

basis that the heat network has provided CO2e savings and/or air quality improvement as would be shown by an SNPV being higher than the Project NPV and would be preferable from a customer perspective even if the overall capital cost is greater.

Output energy for counter-factual calculation – this is the energy type within the TFM that is to be appraised for the counterfactual.

% of carbon deemed to be traded – it would typically be expected that this value would be the same as the project% (see Social Cost of carbon section above); however, it is conceivable that an energy network could have an installed thermal capacity that would bring all of its customers connected into the EU ETS scheme where the counterfactual none would be. As such the user can enter a different value here to reflect this potential difference.

Early period counterfactual and subsequent counterfactual – these sections allow the user to transition the counterfactual energy generating technology. In the heat sector this is becoming increasingly pertinent where a gas boiler counterfactual is being questioned given our 2050 targets and legally binding obligations to decarbonise. The future homes standard sets a clear year of 2025 for a fundamental move away from gas heating in new build homes. As such the TFM allows the user to reflect a transition say from gas boiler to a greener technology such as air source heat pump.

Counterfactual costs incurred in the early period counterfactual are assumed to continue to operate to the end of the Useful Economic Life and then transition to the subsequent counterfactual assumptions.

Counterfactual costs incurred in or after the "year subsequent technology supersedes the initial technology" follow the assumptions entered in the "subsequent counterfactual" section.

Where wider upfront costs are anticipated with the installation of a given counterfactual technology (e.g. building fabric efficiency improvements to enable ASHP installation) then these should be assessed by the user and incorporated into the £/kW input. For wider ongoing costs these should be incorporated into the annual operating cost of the technology (£/kW/Y).

As all costs are either entered as a £/kW or £/kW/Y basis it is important that the user has entered the kW peak section in <INP_EBalance>.

Taxes

7 TAXES				
CORPORATION TAX				
GENERAL				
Apply corporation tax in model?	T/F	TRUE	TRUE	
Account for deferred tax in model?	T/F	FALSE	FALSE	
Substantively enacted corp. tax rates	%			19.00% 19.00% 19.00%
Receive cap. allow. of leased assets?	T/F	FALSE	FALSE	
Maximum number of consecutive years of losses for c/f	years	2		

A key tax evaluated in the TFM is corporation tax. The user can set whether corporation tax is or is not calculated in the TFM with the default being "TRUE".

Account for deferred tax in mode? Deferred taxation in the TFM refers to the accounting treatment of timing differences between the accounting basis and taxation basis of fixed

assets. Its primary purpose is to try to ensure that the profit and loss account reflects the anticipated tax position of the Company on an even basis by adjusting for the distortions that a given country's tax regime may have on post-tax profits. For example, where enhanced capital allowances are provided then, all things being equal, the tax carrying value of the company's assets will be lower than the net book value of the assets carried on the Company's balance sheet. The deferred tax calculation would result, in this example, with an additional charge through the P&L to reflect that more tax will be payable, thereby evening out the in-period distortion on tax that the ECA has created.

The TFM allows for this accounting treatment to be included or excluded, as deferred tax (included within IAS 12 – Income Taxes) and its consequences are not always appreciated with regards to dividends. Having a toggle allows the user to evaluate the extent to which deferred tax may or may not impact equity returns. If it is assessed to have a material impact then this could be explored further with a tax professional.

Substantively enacted corporation tax rates – these should reflect the current and substantively enacted (i.e. stated within a published UK budget) rates of corporation tax. The current rate of corporation tax (as at 27/03/2020) is 19%. The latest budget statement holds the rate at 19% and as such this rate should be held to the end of the TFM

https://www.gov.uk/government/publications/changes-to-corporation-tax-rates-from-1-april-2020/corporation-tax-main-rate-at-19-in-2020-and-charge-and-main-rate-for-2021

The user should ensure to monitor updates made by HMT with each published budget.

Receive capital allowances of leased assets? Capital allowances can be claimed on leased assets; however, the rules that surround this are complicated with specific rules for long leased assets. This toggle allows the user to evaluate whether the project gaining access to the capital allowances related to assets that are set to be leased in the TFM is or is not material to the post-tax project returns. To the extent they are then the user may consider procuring professional tax advice to assist in evaluating this further on the basis that a leased asset financing approach is assessed to be the preferred financing option.

Maximum number of consecutive years of losses for carry forward: company losses cannot be taken forward indefinitely. Currently (27/03/2020) trading losses in periods prior to 01/04/2017 can only be used as relief against profits of the same trade. For this reason the default the assumption in the TFM is that the maximum number of consecutive years losses can be carried forward for is 2 years.

CAPITAL ALLOWANCES - POOLS				
Main Pool	%	18.00%	18.00%	18.00%
Special Rate Pool	%	8.00%	8.00%	8.00%
Single Asset Pool - higher	%	18.00%	18.00%	18.00%
Single Asset Pool - lower	%	8.00%	8.00%	8.00%

The TFM is not intended to provide a detailed corporation tax computation, rather it is intended to provide the user with the potential to evaluate possible tax scenarios (e.g. higher/lower capital allowance pool allocation) and their impacts on financial returns. Where they are evaluated to be material then it allows the user to engage a tax professional with the confidence that the advice will provide significant benefit to the project.

Four capital allowance pools are included in the TFM and Enhanced Capital Allowances (ECA) can be allocated to individual energy generating plant items.

For simplicity's sake the user allocates non-energy generating plant and buildings to a writing down pool across generation, distribution and retail assets and states the % of cost deemed eligible for capital allowances:

	% Elligible	Allocation
Generation	100.00%	Main Pool
Distribution	100.00%	Main Pool
Retail	100.00%	Main Pool

Again this is to allow the user to run sensitivities and is not intended to produce an exact calculation of corporation tax obligations.

DEBT CAP RULES

		OpCo1	OpCo2	OpCo3
Is it assessed that the entity is thinly capitalised and thefore interest not deductible?	T/F	FALSE	FALSE	FALSE

Debt cap rules are in place where companies are assessed to be too thinly capitalised (i.e. where they place a large amount of debt but very little equity into a business). In the event that a company is assessed to be too thinly capitalised then not all debt interest is permitted to be deducted from profits chargeable to corporation tax. In the UK District Heating sector where Local Authorities are looking to develop heat network opportunities they will often borrow corporate debt and then look to on-lend to projects. In such cases they will typically seek to mirror the LA's funding profile to minimise revenue budget exposure (where the corporate debt service is not in turn serviced by the project debt service) and therefore on-lend the principal possibly with an additional margin to avoid state aid issues. In such a case there would be simply a peppercorn equity funding and the trading company would potentially be assessed under the debt cap rules to be thinly capitalised with restrictions on permitted deductible interest for corporation tax calculation purposes.

This section allows the user to switch these rules on and thereby removes interest and lease charge deductions from the Profits Chargeable to Corporation Tax (PCTCT) computation for corporation tax calculation purposes.

BUSINESS RATES

GENERAL

		OpCo1	OpCo2	OpCo3			
Apply business rates in model?	T/F	TRUE		TRUE			
% of rates return through LA rebate / exemption	%	0%	0%	0%			
Apply exemption for electricity generating plant	T/F	TRUE					
Business rates multiplier	%					50.40%	50.40%	50.40%
Decapistalisation rate	%					4.40%	4.40%	4.40%
Frequency of calculation	Years	3					
Method for indexation for nominal calculations	Indexation	CPI					

Business rates probably represent the single largest tax cost to UK District Heat Undertakings. This is because the methodology set out by the Valuation Office Agency (VOA) adopts the Contractor's Method which evaluates the Business Rates obligation on the asset value of the company. As UK District Heating typically has a high capital cost to operating margin ratio (hence the long 40+ year appraisal periods) this methodology is particularly keenly felt and therefore is a key area to evaluate for any investment appraisal.

The VOA's [Rating Manual section 6, part 3, Section 340: district heat undertakings](#) provides the detailed methodology for evaluating the rateable value for district heat undertakings. The TFM indirectly follows this method by adopting the summary calculation set out in the publication "[Financing heat networks in the UK](#)" (commissioned by BEIS and published in August 2018), section 7: Business Rates.

Given the very significant impact that Business Rates may have on project economics some Local Authorities may work with projects to reduce their obligation. This has been seen in the London Borough of Enfield and also a blanket adjustment in Scotland where legislation has passed to reduce the Business Rates Multiplier for district heat undertakings. As such the **% of rates return through LA rebate / exemption** allows the user to adjust the BR obligation through either an LA rebate or exemption. Projects would need to work with the collecting authority in the area to assess the extent to which the LA would be open to such a rebate mindful that between 50%-100% of rates are retained locally.

Apply exemption for electricity generating plant allows the user to toggle the impact of any power generating plant being excluded from the rateable value calculation.

The **Business Rates Multiplier** is the percentage applied to the VOA assessed rateable value of a business. The [current](#) (2019/20) BRM is 50.4% and is therefore included in the TFM as the default.

The **Decapitalisation Rate** is the percentage applied to the adjusted capital value of a business applied under the Contractor's Method. More detail is provided in the calculation section. The current rate is 4.4% and was set in the [last review in 2017](#). A consultation ran from March to May 2019 with regards the 2021 rates with a response still pending. As such the TFM is populated with the current rate but this should be monitored by users.

The **Frequency of calculation** refers to the frequency of evaluations of the rateable value of a business. The significance of this for UK District Heating is where capital expenditure is phased – a more frequent evaluation will mean that the rateable value of the business will be more aligned with the net book value of the business' assets. Three years has been set as the default as while currently 5 years is the current frequency there is stated intention to move to three years per the published [consultation](#) (see introduction paragraph 2).

VAT				
GENERAL				
Apply VAT logic in model?	T/F	FALSE	FALSE	
VAT Types				
Standard Rate	%		20.00%	20.00%
Reduce Rate	%		5.00%	5.00%
Zero Rate	%		0.00%	0.00%

VAT really only has two key consequences in the TFM:

- Working capital implications; and more critically
- Irrecoverable VAT

VAT ALLOCATION

			Recoverable	Non-Recoverable
Sales				
Customer connections	*Allocation*	Standard Rate		
Domestic	*Allocation*	Reduce Rate		
Non-Domestic	*Allocation*	Standard Rate		
Inter-company sales	*Allocation*	Standard Rate		
			Recoverable	Non-Recoverable
Capex	*Allocation*	Standard Rate	100%	0%
O&M	*Allocation*	Standard Rate	100%	0%
Fuel	*Allocation*	Standard Rate	100%	0%
Inter-company purchases	*Allocation*	Standard Rate	100%	0%

The user can allocate rates to the summarised project cash categories shown above. On the project cost side the user can set the percentage of VAT on the costs that is recoverable through the VAT return submitted to HMRC. Where irrecoverable VAT is included in the TFM then this will become a business expense with significant implications for returns.

VAT is a complex area and again the TFM is not intended to provide detailed VAT analysis rather it is intended to allow the user to evaluate whether VAT recoverability risk presents a material risk. This could be relevant where perhaps a public body or not-for-profit organisation is looking to develop a scheme and is not intending to incorporate a project vehicle to procure the infrastructure and own the assets. In such a case the organisation may find that it is unable to recover VAT. Being aware of the risk (part of the financial case assessment) could help inform the proposed legal and commercial structures should VAT be considered a significant risk. Further professional VAT advice could at that point be sought.

CLIMATE CHANGE LEVY (CCL)

Generating plant			https://www.gov.uk/guidance/climate-change-levy-rates			
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%
0	%	% input fuel and output energy subject to CCL (relevant only to gas)	100%	100%	100%

Climate Change Levy (CCL) is chargeable on natural gas but exemptions may be available for example or Good Quality CHP. This section allows the user to adjust the percentage of imported natural gas that is subject to CCL for a given plant item entered into the TFM.

CPS RATES FOR IMPORTS

	p/kWh	LINK TO ELECTRICITY	OK	0.81	0.78
	p/kWh	LINK TO GAS	OK	0.41	0.47

CCL RATES FOR EXPORTS

Generator in the Climate Change Agreement (CCA) scheme?	T/F		FALSE			
	p/kWh	LINK TO ELECTRICITY IF EXPORTED	OK	0.58	0.85
	p/kWh	LINK TO GAS IF EXPORTED	OK	0.20	0.34
Electricity reduced rate for business with CCA	p/kWh		OK	0.06	0.06
Gas reduced rate for for business with CCA	p/kWh			0.07	0.07
Base year	Year		2020		
Index	Index		CPI		

CCL rates for gas and electricity is entered into the "CCL Rates for Imports". Currently (2020) this is 0.406p/kWh for gas and 0.811p/kWh for electricity; however, there are discounts where a project holds a climate change agreement (92% discount for electricity and 81% discount for gas as at 2020). The user needs to select the commodity defined by the user in worksheet <INP_EnergyTypes>, from the drop down that relates to underlined imported natural gas and electricity (if applicable).

On exported energy CCL is payable on electricity and gas. As at 2020 these rates can be summarised as follows:

	2020	2021 Onwards
Gas (p/kWh)	0.406	0.465
Electricity (p/kWh)	0.811	0.775

There is a reduced rate for generators that have entered into a Climate Change Agreement (CCA) with the Environment Agency committing to reduce energy use and carbon dioxide emissions. For such generators there is a reduced CPS for electricity and gas exports. It is unlikely that gas exports will feature in the model's use; however, in theory this could be valid where the model is being used say for a biogas injection into a Gas Distribution Network (GDN). Again the user needs to select the commodity defined by the user in worksheet <INP_EnergyTypes>. The first should be linked to exported electricity and the second linked to exported natural gas. The CCA discount for electricity is currently 92% and 81% for gas in 2020 increasing to 82% from 2021.

Working Capital and Bad Debt

Working capital assumptions allow the user to evaluate the time value implications of payable and receivable days. The essential calculation for all payable and receivable calculations is to take the P&L income/expense and multiply it by the receivable/payable days divided by the number of days in the year to give the balance sheet receivable/payable amount. The difference between the P&L income/expense and the balance sheet receivable/payable is cash received/paid.

The bad debt functionality allows the user to apply bad debt assumptions for the different income streams within the model. Private network sales relate to all energy sales (fixed and variable) made to customers connected to the privately owned energy network (heat, cooling or private wire).

Other Income

The user can also simply input an "other" income stream as a profile of positive cash flows. The user should allocate which type of asset class the income generation relates to in the even that generation/distribution/retail assets are allocated across different legal entities. The user should enter the P&L income recognition, not the cash received, in the event that working capital assumptions are being applied.

Legal Structure: Investor List

The user can enter up to 20 investors. This list is used to populate options allowing for investors entered here to be providers of debt, grants and direct equity investment into specific operating companies.

Cost of finance refers to the investor's target cost of providing finance. It is used in Weighted Average Cost of Capital calculations within the model. Where the investor is selected by the user to be an equity investor in an operating company then this value is used as the discount rate for cash flows attributable to equity investors. For all other sources of capital in the model for which an investor is specified (debt and grants) the cost of finance is presentational only on the dashboard.

Appraisal (yrs) is only used in the model where the investor is selected by the user as an equity investor in an operating company. This value sets the appraisal period over which NPV and IRR calculations are evaluated over.

Legal Structure: Legal Entities

This section allows the user to select which legal entity assets are allocated to. It should be noted that energy sales are allocated "Generation", "Distribution" or "Retail" in the tariff section.

Where assets are allocated to more than one legal entity this will give rise to inter-company relationships. The pre-tax project returns required (nominal and real) are the rates of returns that are set to be required to be achieved by the company that does not have the end customer relationship. The TFM will calculate the necessary tariff such that the entered return is achieved. The user additionally enters the appraisal period over which the rate of return is evaluated. The "Sales calculation method" allows for two options for inter-company pricing: "Annuity" and "Use of System".

The Annuity method sets a flat fixed charge based on a standard annuity function within excel (PMT). The Use of System charge calculates a p/kWh such that the inter-company sale price of energy achieves the target return – this logic applies a levelized cost of energy approach.

Capital Structure: Grants

Up to 8 grants can be entered in the TFM. The user selects the date of the draw down (the actual date does not impact discounted cash flow calculations), who has issued the grant and who is the recipient of the grant. The TFM allows for two options of draw down "Bullet" and "profile". If "bullet" is selected then a single cell value entered by the user is modelled to be received in the year the date the grant is set to be drawn down. If "profile" is selected, then the user can essentially override the date of drawdown and can enter a series of drawdowns rather than a single drawdown in a given year.

Capital Structure: Loans

The first section of the loans inputs allows the user to enter a floating rate of interest to the extent that a floating rate loan(s) is intended to be used. Up to 5 different floating rates can be entered into the TFM (e.g. LIBOR).

The dividend lock up section allows the user to simulate a loan covenant whereby if debt is present in the model that there is a dividend lock (i.e. no dividend disbursements to equity investors) where Cash Flows Available to Debt Service (CFADS) relative to debt service

obligations (principal + interest payments) in a given period are less than the cover ratio entered by the user.

As the TFM calculates project cash flows in both real and nominal terms the user can select whether the dividend lock is applied based on real or nominal CFADS.

The "**For target cover ratio – maximum ratio before full payment"** option is relevant for where loan principal is set to amortise based on a cover ratio set by the user (see below). In the even that the CFADS are in excess of the value set here (default 8x) then the outstanding principal will be fully repaid in that period.

Up to 8 loans can be entered into the TFM. The user can select who has issued the loan (from the investor list – see above) who has received the loan (one of the three operating companies permitted in the TFM), when the loan is issued and the tenor of the loan.

The loan seniority selected ("Junior" or "Senior") impacts the CFADS on which cover ratios are calculated. If Junior is selected then CFADS include debt service to more senior loans. **If a senior vs junior distinction is required in the TFM then loans entered must be on a <u>most senior first</u> basis.** From a modelling perspective it only impacts where the principal repayment method selected is "Target Cover Ratio", this is because the TFM assumes that all cash shortfalls are met by equity (however, user warnings highlight if equity required is in excess of equity available).

It should be noted that the Model simplifies the calculation of CFADS in that it is calculated on a pre-tax pre-finance basis and is therefore a more general cash flow available to finance before taxes have been paid. This simplification is made to remove the need for more complex macros to be included in the Model to resolve the inherent circularity of tax, interest on cash and cash available for debt service all of which impact on the other. Where specific target ratios are being sought as part of a project finance arrangement, specific calculations would be required to overlay these additional cash outflows to determine the post-tax post-senior finance (e.g. leases if used) CFADS.

The draw down method allows for "bullet" and "profile" and is the same approach as per the grant section – see above.

The **interest type** allows the user to select "fixed" or "variable" interest. This selection impacts conditional formatting that highlights to the user which sections are to be entered (reinforced by the labelling which makes this clear also).

If the user has selected "fixed" interest, then the user enters the annual interest rate. If the user has selected "variable" interest, then the user selects which floating rate is to be used and the fixed margin over the floating rate that should be applied in the model.

There are a number of different loan repayment methods available:

- Bullet
- Mortgage style
- Balloon
- Target cover ratio
- Cash sweep
- Profile

Bullet is an interest only loan which repays in full in the last year of the loan's tenor.

Mortgage style is a principal repayment profile whereby the debt service (loan + interest) is constant in every period.

Balloon is where the loan is amortised to a target principal outstanding amount following a mortgage style repayment and the principal outstanding is repaid in full at that expiry of the loan's tenor.

Target cover ratio calculates the loan repayment in a given period to achieve a target Debt Service Cover Ratio (CFADS / Debt Service) set by the user. As noted above, if the loan is set to junior it will assume that all loans entered into the TFM above it (e.g. Loan 3 will see loans 1 & 2 as more senior) are paid first.

Cash sweep takes cash available and sweeps the percentage of cash set by the user until such point that the loan is repaid or the loan's tenor has expired

Profile allows the user to enter a bespoke repayment profile. The sum of the repayment profile must equal the loan drawn down or else an integrity error will show.

The **loan repayment start date** is the date from which principal repayments are modelled to commence.

The **loan interest start date** is the date from which interest payments are modelled to commence. If the user opts to **forgo interest prior to interest start date** then no interest would have accrued prior to that date. If the user selects "FALSE" to forgo interest then interest prior to the interest start date is capitalised (i.e. included in the outstanding loan principal balance).

Capital Structure: Leases

LEASES								
	% Capex Leased	Prem./(disc.): l'ee to l'or	Lease Start	Lease Duration	Lease type	Purchases by lessor?	Interest charge	.): l'or to l'ee
	%	%	Date	Years	Opp./Fin.	T/F	Annual %	%
Generation								
Distribution								
Retail								

The TFM includes functionality to allow for a basic form of lease finance. This allows for the accounting treatment of both a finance or operating lease. In 2016 IFRS 16: Leases superseded IAS 17: Leases. The key difference is that all leases, above a certain de minimis threshold and with a lease term longer than a year, will be on balance sheet. IAS 17 allows for leases classified as "operating lease" as off balance sheet. The TFM is therefore somewhat out of date with regards to IFRS 16; however, the user can select "finance lease" which would be consistent with IFRS 16 and should therefore be the default assumption under "Lease Type".

The **% of capex leased** will result in the capex carrying value as at lease start with a either a premium or discount to that value as set by the user. If "Purchases by lessor" is set to "TRUE" then all capex incurred from the lease start date up to the end of the lease term is purchased by the lessor (i.e. cash cost borne by the lessor not the lessee) and the project company as lessee pays a higher annual lease charge.

The **interest charge** represents the effective interest rate that the model calculates to accrue on assets leased by the project.

On completion of the lease term, assets that are leased by the project lessee are transferred from the lessor to the lessee. The Premium/(discount) from the lessor to the lessee represents the price paid by the project lessee to the lessor to terminate the lease reflective of the fact that some assets leased by the project lessee will not have fully depreciated at the point that the lease terminates.

Capital Structure: Cash Reserves

CASH RESERVES (OTHER THAN REPEX SINKING FUND)			

MAINTENANCE RESERVE

		OpCo1	OpCo2	OpCo3
Apply a maintenance reserve?	T/F	FALSE	FALSE	FALSE
Number of years to hold in reserve	years	1	1	1

DEBT SERVICE RESERVE

		OpCo1	OpCo2	OpCo3
Apply a debt service reserve?	T/F	FALSE	FALSE	FALSE
Number of years to hold in reserve	years	1	1	1

The TFM allows for cash reserving for O&M (maintenance reserve) and debt service. The TFM asks the user to set whether a maintenance or debt service reserve should be applied in a given operating company. If it is applied then the user is asked to set the lookahead period for the reserve should be sized for. Generally this functionality should only be considered if external debt finance is being considered where such reserves are often required.

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Capital Structure: Overdraft

OVERDRAFT				
		OpCo1	OpCo2	OpCo3
Maximum overdraft limit	£000			
Overdraft annual interest rate	%			
Cash sweep to overdraft %	%			

This section allows the user to the maximum amount of overdraft that each of the three legal entities permissible in the TFM that can be outstanding at the end of any given financial year. The interest rate sets the interest chargeable on the brought forward balance plus any drawdowns made in the year. The cash sweep to overdraft % sets the percentage of free cash available in a given period that should be allocated to repayment of an outstanding overdraft.

Capital Structure: Equity

The TFM treats equity as the balancing figure for funding cash shortfalls. Traditional PFI models would not adopt this approach but instead would set the amount of equity available and a model error would flag a funding shortfall. As will be seen below the TFM allows the user to set the maximum available equity for a given investor and if the combined equity available is less than the equity required then a model warning will be shown in the model integrity checks in the top left of each sheet in the TFM. It has been assessed that this approach is more appropriate for the District Heating sector as it is anticipated that the TFM may be used for business case preparation where it is necessary to first estimate the equity requirement forecast and seek approval of that amount. It is therefore more helpful that the model can calculate the equity requirement and not require a user to reset equity available.

DIVIDENDS						
Apply companies act rules for divis?	T/F	TRUE	TRUE			
Percentage of distribuable reserves distributed:						
OpCo1	%			100%	100%	100%
OpCo2	%			100%	100%	100%
OpCo3	%			100%	100%	100%

The dividends section allows the user to set whether the Companies' Act rules on making distributions (dividends) from a company are legal. Under the Companies' Act it would not be legal to make a distribution to equity holders if the company does not have sufficient distributable reserves to do so. This could be relevant in the heat network sector where relatively high non-cash P&L expenses would be expected in the form of annual depreciation which could lead to early period negative P&L reserve but positive cash.

The option to switch this logic off in the TFM allows the user to assess the extent to which dividend traps may be expected and seek to manage them through instruments such as shareholder loans which can be modelled in the loan section.

Additionally, the user can manually restrict dividend payments in the section "Percentage of distributable reserves distributed" section. An example of how this could be relevant might be where a two phase project sees the first phase of connections completed leading to a period of high earnings due to connection charges being received; rather than distributing the cash received to equity this may be forced by the user to be retained in the business in anticipation of the second phase construction.

INVESTORS				
		OpCo1	OpCo2	OpCo3
Investor 1	*SELECT*	Local Authority	Local Authority	Local Authorit
Investor 2	*SELECT*			
Investor 3	*SELECT*			
Investor 4	*SELECT*			
Investor 5	*SELECT*			

AVAILABLE EQUITY OVER INITIAL CONSTRUCTION PHASE				
		OpCo1	OpCo2	OpCo3
Investor 1	*£000*	15,000	15,000	15,000
Investor 2	*£000*			
Investor 3	*£000*			
Investor 4	*£000*			
Investor 5	*£000*			

CONTINGENT EQUITY OVER INITIAL CONSTRUCTION PHASE				
		OpCo1	OpCo2	OpCo3
Investor 1	*£000*			
Investor 2	*£000*			
Investor 3	*£000*			
Investor 4	*£000*			
Investor 5	*£000*			

The user can select up to 5 investors as investors into the network. The drop down list is populated from the investors entered by the user in the legal structure section – see above.

Against each investor the user sets the equity available for investment. As has been said in the introduction to this section, this will trigger a warning if breached but the TFM will still assume that the shortfall is made by the investor. Analysis within the TFM allows the user to identify the period and extent to which the breach is forecast to be made.

Additionally, the user can specify if a certain amount of contingent equity is available. This will be more relevant to projects that are in middle/late commercialisation stage evaluating terms of shareholder agreements where more than one investor into a network is intended. In such circumstances provisions for contingent equity within the shareholder agreement may be made. This section allows the agreed amounts to be entered and sensitivity testing run to assess the extent to which sufficient resilience is in place for unexpected costs during construction (or after).

% OWNERSHIP				
		OpCo1	OpCo2	OpCo3
Investor 1	%	100%	100%	100%
Investor 2	%			
Investor 3	%			
Investor 4	%			
Investor 5	%			

SHARE OF DIVIDEND STREAMS (Assymetric if different to % ownership)				
		OpCo1	OpCo2	OpCo3
Investor 1	%	100%	100%	100%
Investor 2	%			
Investor 3	%			
Investor 4	%			
Investor 5	%			

The ownership percentages set the obligations with regards share of investment commitment. If the TFM has assessed that £1m of equity investment is required in a given period the percentages set in this section (**% Ownership**) dictate the split across the investors.

However, it is possible in the model to configure an asymmetric relationship between ownership and access to dividend streams. There could be a number of reasons this is relevant but generally it might be summarised as relevant where the investment hurdle rates of the different investors are not the same. An example might be in a Private-Public Partnership where the private sector may be seeking a commercial rate of return and the public investor is seeking a social rate of return. The user should first mirror share of dividend stream as that of the ownership structure but then use the investor solve tool on the dashboard (see Dashboard section) to solve to a given investor's entered hurdle rate by changing the share of dividend streams.

Model Outputs

Dashboard

The TFM's dashboard is the main output of the model. It has been designed to fulfil several functions:

1. Provide detailed summary analysis across key project metrics for quick extract to slides/reports/emails. These relate to:
   - Project returns
   - Capex
   - Customer detriment
   - Quality of project cash flows
   - Project cash flow risk analysis
   - Energy balance analysis
   - Plant operating margin analysis
   - Carbon analysis
   - Investor returns analysis

2. Allow the user to solve the model for a variety of outcomes by adjusting various areas of the TFM:
   - Adjusting tariffs (tariff solver)
   - User calibrated adjustments (project model solver)
   - Adjusting grants, loans or the split of dividends relative to ownership (investor model solver)

Project Metrics

PROJECT METRICS UNDER SCENARIO ASSUMPTIONS					

RETURNS		Pre-tax (R)	Pre-tax (N)	Post-tax (R)	Post-tax (N)
Project hurdle rate	%	8.00%	10.70%	6.40%	9.06%
Assessment period	Years	40	40	40	40
Project IRR (pre-grant)	%	4.08%	5.65%	1.18%	2.87%
Project IRR (post-grant)	%	4.08%	5.65%	1.18%	2.87%
Social IRR (pre-grant)	%	3.22%	4.77%	0.72%	2.37%
Project NPV (pre-grant)	£000	(9,601)	(10,906)	(14,794)	(15,322)
Project NPV (post-grant)	£000	(9,601)	(10,906)	(14,794)	(15,322)
Social NPV (pre-grant)	£000	(13,221)	(14,351)	(18,637)	(19,025)
Payback (pre-grant)	Years	19.64	17.94	34.74	30.59
Payback (post-grant)	Years	19.64	17.94	34.74	30.59
Disc. Payback (pre-grant)	Years	n/a	n/a	n/a	n/a
Disc. Payback (post-grant)		n/a	n/a	n/a	n/a
Social payback (pre-grant)	Years	30.21	19.66	34.76	33.70

R = Real; N = Nominal

Levelised Cost of LTHW					
Select energy type:*		LTHW			
Express levelised cost in whole life terms or T0 terms?*		Whole life			
Money terms of levelised cost*:		Real			

Years over which LCOE calcualted:		15	25	35	40	60
Non-LTHW income	p/kWh	-	(0.00)	(0.00)	(0.00)	(0.00)
Grant	p/kWh	-	-	-	-	-
Capex	p/kWh	19.28	14.80	12.82	12.37	12.10
Fuel costs	p/kWh	4.80	4.74	4.73	4.72	4.72
O&M	p/kWh	0.09	0.07	0.07	0.07	0.07
Taxes & Levies	p/kWh	2.49	2.19	2.07	2.04	2.00
Levelised cost of energy	p/kWh	**26.65**	**21.81**	**19.69**	**19.21**	**18.89**
Levelised value of connection	p/kWh	7.69	5.73	4.96	4.79	4.43
Levelised value of fixed charge	p/kWh	5.79	6.22	6.34	6.37	6.40
Levelised value of variable charge	p/kWh	3.00	3.00	3.00	3.00	3.00
Levelised tariff	p/kWh	**16.49**	**14.95**	**14.31**	**14.16**	**13.83**

Money terms:	Real	Graph Start Period:	2020
		Graph End Period:	2050

Real Project Cash Flows

* The whole life cost of energy shows the flat price that would need to be charged on each unit of energy exported to private network customers over the period analysed. The T0 cost of energy shows the price of energy that would need to be charged to private network customers for the selected energy type at the start of the project on the basis that project cost escalation would be passed onto the customer by contractual means.

* The nominal whole life analysis would show a pricing strategy whereby indexation risk is priced into an initial tariff and all the tariff is left unchanged. Such an approach would unlikely be prudent or acceptable to either project or customer but provides a benchmark for analysis.

1.5. Returns

The returns section provides the user with the key financial metrics estimated by the model. Nominal cash flows refer to cash flows that have been adjusted for general price inflation that is included in the model. Real cash flows refer to cash flows that have not been adjusted for general price inflation but have been adjusted for real price inflation. For example, the price of gas might be expected to become increasingly more expensive as it becomes more scarce / carbon impact is priced / etc. and so while still expressed in 2020 money terms would be more expensive 10 years from today.

For each value there are four values presented:

- *A pre-tax real and nominal value*
  These two values appraise cash flows prior to business rates, corporation tax and any irrecoverable VAT.

- *A post-tax real and nominal value*
  These two values appraise the same cash flows as above but overlay business rates, corporation tax and any irrecoverable VAT

Taking each metric in turn:

Label	Description
Project IRR (pre-grant)	This value estimates the Internal Rate of Return (IRR) of income less operating expenses less capex (including replacement) over the assessment period set by the user in the "assessment period"
Project IRR (post-grant)	This value estimates the IRR of the same cash flows as above but additionally includes any grants that have been included in the model.
Social IRR (pre-grant)	This value depends on the user's selection of "Include CF Fuel, O&M & capex and exclude project income?" in the Counterfactual section of <INP_General>. If the user has set this to "TRUE" then the Social IRR is calculated by treating the avoided capex, O&M and fuel as income. From this the project costs (capex, O&M, fuel etc.) are subtracted. The project carbon and air quality impact is treated as a cost and the counterfactual carbon and air quality impact is treated as income. The IRR is then estimated of these net cash flows over the user defined assessment period.

If the user has set the value to "FALSE" the Project IRR (pre-grant) cash flows are called up and the project carbon and air quality impact is treated as a cost and the counterfactual carbon and air quality impact is treated as income. The IRR is then estimated of these net cash flows over the user defined assessment period. |

Label	Description
	An explanation of the significance of these two options is provided in the section on the Counterfactual above.
Project NPV (pre-grant)	This value calculates the net present value of the project cash flows described in Project IRR (pre-grant) above, discounting the cash flows using the project hurdle rate set by the user.
Project NPV (post-grant)	As above but overlaying any grant cashflows in the TFM
Social NPV (pre-grant)	This value calculates the net present value of the project cash flows described in Social IRR (pre-grant) above, discounting the cash flows using the project hurdle rate set by the user.
Payback (pre-grant)	This is the simple payback over the user defined assessment period – i.e. the number of years it takes to be repaid all cash outflows. The cash flows assessed are those set out in Project IRR (pre-grant) above.
Payback (post-grant)	As above but overlaying any grant cashflows in the TFM
Disc. Payback (pre-grant)	This is the discounted payback over the user defined assessment period. This calculates the number of years it takes to achieve a Net Present Value = 0 at the user defined hurdle rate. The cash flows assessed are those set out in Project IRR (pre-grant) above.
Disc. Payback (post-grant)	As above but overlaying any grant cashflows in the TFM
Social payback (pre-grant)	This is the simple payback over the user defined assessment period but applied to the cash flows set out in Social IRR (pre-grant).

The graph in this section is an interactive graph allowing the user to review different periods as well as the option to select real / nominal money terms:

Money terms:	Real	Graph Start Period:	2020
		Graph End Period:	2050

1.6. Levelised cost of energy

The levelised cost of energy is one of the core calculations within the model as it is fundamental to assessing value for money against alternative heating solutions and appraising

long term energy offtaker value for money. The standard method for calculating the levelised cost of energy for real cash flows is formulaically summarised as follows:

$$\frac{p}{kWh} = \frac{\sum_{t=1}^{x} \frac{NPCx}{(1+r)^x}}{\sum_{t=1}^{x} \frac{(HDx)}{(1+r)^x}}$$

Where:

- *NPC = Net project costs*
- *r = the real discount rate (as a %)*
- *HD = heat demand in a given period x (as kWh)*

For nominal cash flows this adjusted as follows:

$$\frac{p}{kWh} = \frac{\sum_{t=1}^{x} \frac{NPCx}{(1+r)^x(1+Mi)^x}}{\sum_{t=1}^{x} \frac{(HDx)}{(1+r)^x}}$$

Where:

- Mi = the rate of money inflation assumed within the nominal discount rate

The real calculation calculates a p/kWh value that, when multiplied by the profile of energy demand, and the profile of project costs included within NPC over the assessment period are deducted from the revenue will discount to zero at the real discount rate (r).

The nominal calculation calculates a p/kWh that will inflate each year in line with the assumed rate of money inflation. When nominal project costs are deducted from these income streams the net present value of those cash flows when discounted at the nominal discount rate [(1+r)(1+Mi)-1] will equal zero.

The significance of these calculations is that they provide a whole life, time value adjusted, appraisal of the cost of supplying energy, accounting for the variable timing of cash flows. This allows for solutions with low up-front costs but high operating costs (e.g. direct electric heating) to be compared with projects with high up-front costs but low operating costs (e.g. heat pumps). This method of appraisal is standard in the electricity generation sector but remains less prevalent in the heat sector. It is hoped this, and other published tools such as BEIS' Calculating the full cost of energy used by buildings, will encourage greater use of this metric for evaluating district heating value for money.

The above calculations provide a means for benchmarking costs; however, the p/kWh established in this method will not be the tariff that is offered to customers. This is for several reasons:

- A tariff will most likely be broken into at least three components: one off connection charge, annual fixed charge and a variable p/kWh;

- The variable tariff would unlikely be contractually pegged to general price inflation and more likely would be pegged to the underlying fuel that is converted to thermal energy (e.g. electricity, gas, biomass etc.).

An additional calculation that the TFM undertakes allows the user to evaluate is the p/kWh value that would need to be charged on the basis that it escalates in line with projected revenue inflation (e.g. pegged to underlying commodity prices). This is referred to in the TFM as the T0 method and can be formulaically summarised as follows:

Real cash flows	Nominal cash flows
$$\frac{p}{kWh} = \frac{\sum_{t=1}^{x}\frac{NPCx}{(1+r)^x}}{\sum_{t=1}^{x}\frac{(HDx)}{(1+r)^x(1+Ri)^x}}$$	$$\frac{p}{kWh} = \frac{\sum_{t=1}^{x}\frac{NPCx}{(1+r)^x(1+Mi)^x}}{\sum_{t=1}^{x}\frac{(HDx)}{(1+r)^x(1+Ri)^x}}$$

Where:

- Ri refers to the revenue inflation in a given period

This method would not typically be used but helps provide the user with an understanding of the extent to which the modelled cash flows are or are not reliant on real price indexation – the greater the variance between the whole life method and the T0 method the greater underlying indexation is influencing results prompting the user to analyse, report on and ultimately seek to mitigate indexation risk by contractual means.

The TFM includes integrity checks to ensure that the calculations do indeed achieve an NPV = 0.

Levelised Cost of LTHW			Select energy type:	LTHW		
	Express levelised cost in whole life terms or T0 terms?*			Whole life		
	Money terms of levelised cost⁺:			Real		
Years over which LCOE calcualted:			15	25	35	40	60

The user is able to select the energy type (this is any output energy entered in <INP_EnergyTypes>), the method for calculating levelized cost (whole life or T0 – see above) and the money terms (real/nominal).

The user is also able to change the appraisal period for each column analysed; however, the periods provided are considered to be consistent with standard project needs with the 40 year appraisal being relatively standard for Heat Network assessment periods and the most likely column used.

The discount rate used to calculate the real levelized cost is the real pre-tax hurdle rate entered by the user. The discount rate used to calculate the nominal levelized cost is the nominal pre-tax hurdle rate entered by the user. The rationale for a pre-tax rather than post-tax

rate being used is that a post-tax hurdle rate is generalising what the effective tax rate is anticipated to be and an adjustment applied accordingly. As tax has been calculated in detail in the model it is therefore more appropriate to use the target hurdle rate that excludes a high-level estimate for effective tax.

Taking each line in turn:

Label	Description
Non-[energy] income	As the total project cost base is used to calculate the levelized cost it is necessary to subtract any income generated from energy types other than that selected by the user to be analysed.
Grant	This is the levelized value of any grants awarded to the project companies within the assessment period ("Years over which LCOE calculated")
Capex	This is the levelized cost of an capex and replacement capital expenditure incurred to deliver the project within the assessment period ("Years over which LCOE calculated")
Fuel costs	This is the levelized cost of **all** fuel costs incurred by the project. As such, to the extent that the project is delivering multiple energy outputs (e.g. steam, LTHW and cooling) this is the levelized cost of all energy imports to deliver those outputs. This is appraised over the assessment period ("Years over which LCOE calculated")
O&M	This is the levelized cost of all O&M and overhead costs included within the model. This is appraised over the assessment period ("Years over which LCOE calculated")
Taxes & Levies	This is the levelized cost of all taxes that are cash settled (i.e. excluding deferred tax): business rates, corporation tax and irrecoverable VAT

The levelized cost of delivering the energy the energy type selected is then compared to the levelized tariff. The method for calculating the levelized tariff is exactly the same as that set out in the explanatory section above but instead of costs, discounted income is divided by discounted energy supply.

For the pre-tax Project NPV to equal zero the levelized tariff will equal the levelized cost of energy less the levelized cost of taxes & levies. For the post-tax Project NPV to equal zero the levelized tariff will equal the levelized cost of energy.

Capex Analysis
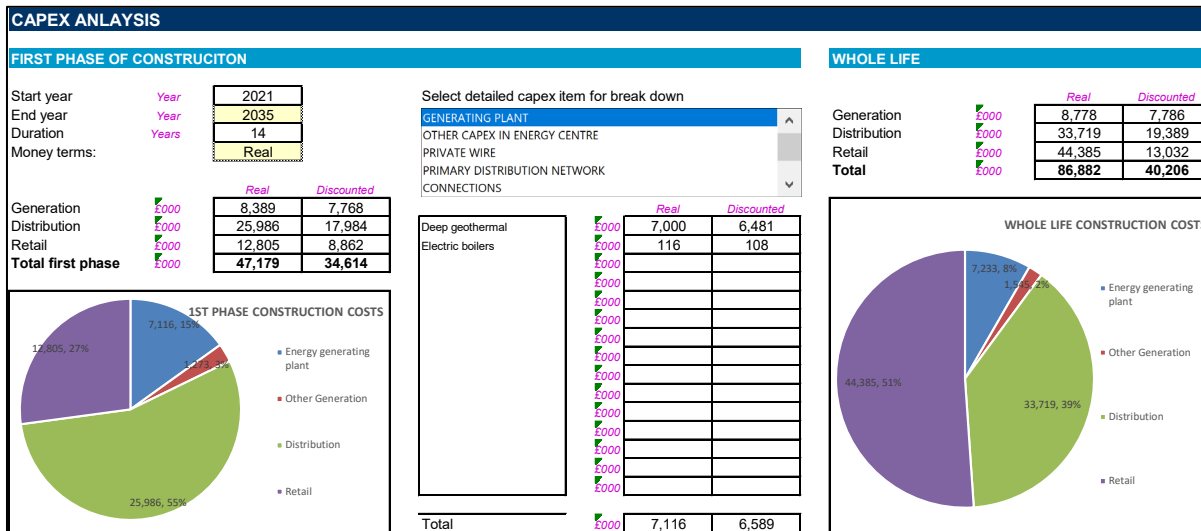
The capex analysis section allows the user to view a summary of capex over an initial phase (set by the user) as well as the whole life (i.e. including subsequent phases and replacement capex). Additionally the user can use a listbox to see the breakdown of capex shown in the pie charts. In the above extract it can be seen that the use has selected "GENERATING PLANT" that totals to £7.116m which ties to the blue segment in the 1st phase construction.

Discounted values are done so using the pre-tax real/nominal discount rates set by the user in the returns section of the dashboard.

Tariff Analysis

The section of the dashboard allows the user to:

- analyse the tariff proposed and its relative value to the project;
- adjust the tariff(s) to achieve a target rate of return;
- adjust the tariff(s) to achieve a target levelised value; and
- appraise the tariffs from a customer perspective (i.e. with a different social time preference for discount rates) against the counterfactual(s) set in the TFM

KEY TARIFF VALUES										
				LEVELISED TARIFF (Whole life, 40YR, Real)						
Tariff	Energy Type	Demand	Customers	Connection	Fixed	Variable	Total	Connection	Fixed	Av. Variable
	Energy	MWh/y	#	p/kWh (Real)	p/kWh (Real)	p/kWh (Real)	p/kWh (Real)	£000/con.	£/Day	p/kWh
Domestic	LTHW	27,946	3,800	4.58	4.70	3.00	12.28	6.00	1.37	3.00
Commecial	LTHW	9,315	6,618	5.41	11.39	3.00	19.80	1.00	0.46	3.00
Total		37,262	10,418							
kWh weighted average	LTHW			4.79	6.37	3.00	14.16			

The number of rows visible relates to the number of tariffs entered into the TFM. The user should press the "CALIBRATE DASHBOARD" macro button at the top of the dashboard to ensure the correct number of rows are visible to the user. This need only be done when all tariffs have been entered into the TFM.

The columns presented are explained below:

Label	Description
Energy Type	Each tariff can have only one energy type allocated to it (<INP_EnergyTypes>). This is called up for the user's benefit here.
Demand	This shows the average annual energy demanded by customer's on the tariff type shown. It is expressed in MWh per year.
Customers	This shows the number of customers in the tariff selected; however, depending on the customer type, it may alternatively show the basis that connection charges and fixed income is made. This could be kW peak, # bedrooms etc. As such care is needed when referring to this column in reports that the basis of charging is understood for a given tariff as that will define what numbers presented in this column represent.
Levelised tariff: connection	This shows the calculated levelized value of connection charges. It is calculated over the period set by the user in the "Solve tariff by target returns": "Recovery period" at the pre-tax discount rate entered by the user in the returns section. The row that shows the kWh weighted average should tie to the levelized tariff shown in the returns section in the column relating to pre/tax real/nominal (as selected by the user in "Solve tariff on real or nominal basis") over the recovery period set.
Levelised tariff: fixed	This shows the calculated levelized value of fixed annual charges. It is calculated over the period set by the user in the "Solve tariff by target returns": "Recovery period" at the pre-tax discount rate entered by the user in the returns section. The row that shows the kWh weighted average should tie to the levelized tariff shown in the returns section in the column relating to pre/tax real/nominal (as selected by the user in "Solve tariff on real or nominal basis") over the recovery period set.
Levelised tariff: variable	This shows the calculated levelized value of variable kWh charges. It is calculated over the period set by the user in the "Solve tariff by target returns": "Recovery period" at the pre-tax discount rate entered by the user in the returns section. The row that shows the kWh weighted average should tie to the levelized tariff shown in the returns section in the column relating to pre/tax real/nominal (as selected by the user in "Solve tariff on real or nominal basis") over the recovery period set.
Levelised: total	This is the sum of the connection + fixed + variable levelized tariffs and therefore reflects the total levelized tariff expressed as a p/kWh value.
Connection	This column shows what the £000 cost per connection (or whatever basis the user has entered into the TFM for connections – e.g. kW peak) and therefore this forms part of the tariff card proposed.

Label	Description
Fixed	This column shows the £/day fixed tariff proposed per connection (or whatever basis the user has entered into the TFM for connections – e.g. kW peak) and therefore this forms part of the tariff card proposed.
Variable	This column shows the p/kWh starting tariff proposed and therefore this forms part of the tariff card proposed.

This section allows the use to solve the TFM to achieve outcomes based on either achieving a target return or achieving a target price. The user selects which tariffs are to be changed in order to achieve either the target return or target price. There is an option to use the combobox, above the multi-select list box, to select all or those customers of a specific energy supply type. The user can press the "CLEAR" macro button to the right of the listbox to clear the selections.

Solve Tariff by target Returns

The recovery period is the period over which the appraisal period for returns is assessed. The user can solve on a real or nominal basis. The user can solve using the whole life method for levelized tariff or the T0 method: this selection only impacts the solve tariff by target price section below.

The "solve with" dropdown allows the user to select what should be changed in order to achieve the target outcome. This allows for the following combination of tariff components:

Connection
Fixed
Variable
Connection + Fixed
Connection + Variable
Fixed + Variable
Total

This is believed to be a comprehensive list of all possible combinations of tariff components modelled within the TFM. As such the user, through his/her selections in the multi-select list

box and this drop down, is able to target individual or combinations of tariff areas to be changed to achieve target outcomes.

The "solve to" dropdown allows the user to select which of the key model calcualted Net Present Values are to be solved to NPV = 0. The user selected target is highlighted green in the table and the discount rate used for the calculation is shown next to the live calculated value of the NPV. The cash flows included in the list that have not been explained above are described in the Financial Returns and Investor Analysis sections below.

It should be noted that "Levered_NPV" and "Social Equity NPV" both require the user to select which operating company are to be solved to. The default selection is "OpCo1"; however, where multiple operating companies have been calibrated in the Model it would be necessary to select which is to be targeted. The user would be advised to select the OpCo that is selected to be responsible for "Retail" (i.e. B2C) as inter-company sales would not be influenced by a change in end customer tariff and therefore a solution would not be possible for entities that do not control the retail relationship.

Recovery period:	years	40	SOLVE TARIFF
Solve tariff on real or nominal basis:	R/N	Real	
Whole life or T0 solve?	list	Whole life	UPDATE TARIFF
Solve with:	list	Variable	
Solve to:	list	Project_real_pre_tax_post_grant	

Having completed the selections above the user should press the "SOLVE TARIFF" macro button in this section. The status bar will provide the user with an update on the status of the solve. Depending on machine speeds (and the tolerance set within <SYS_Checks> - default 0.1) this will likely take 3-5 minutes and should solve within 10-15 iterations.

If it is taking too long or the user realises that a mistake has been made in the selection, the user should press the ESC button on the keyboard and a VBA debug dialog box will appear. After pressing "End" the user should press the "UNDO SENSITIVITY" macro button at the top of the dashboard to revert the model to its position prior to the "SOLVE TARIFF" button having been pressed.

When a solution has been found a dialog box will appear confirming this to have been achieved. The user can then press the "UPDATE TARIFF". This will hard code the new tariff card calculated into <INP_EnergyTypes>. As such if the user has daisy chained the scenario manager to the tariff section it will be necessary to copy the new tariff to the scenario manager and re-link the input tariff section to the scenario manager.

If the adjusted tariff is not accepted by the user then he/she should press the "UNDO SENSITIVITY" macro button at the top of the dashboard to revert the model to its position prior to the "SOLVE TARIFF" button having been pressed.

Solve tariff by target price

SOLVE TARIFF BY TARGET PRICE										
				All LTHW levelised tariff values:					Temporary values for user:	
Solve to:	p/kWh	4.44	SOLVE TARIFF	Connection	Fixed	Variable	Total		4.42	5.70
Solve to all tariffs combined?	T/F	TRUE		p/kWh (Real)	p/kWh (Real)	p/kWh (Real)	p/kWh (Real)			
			UPDATE TARIFF	-	-	3.00	3.00		4.53	4.07

The dashboard additionally allows the user to adjusted the selected tariff(s) to solve to a target levelized value. The "Solve with" dropdown in the previous section selects which component of the tariff is to be adjusted and is highlighted green in this section.

The "Solve to all tariffs combined?" allows the user to set whether the "solve to" value represents the connection + fixed + variable (TRUE setting) or just the value selected to be changed – in this case "variable". So, in the example above, the user has set that a target of 4.44p/kWh **total** levelized tariff is sought and that only the variable component of the commercial tariff (see listbox selection above) is to be changed. Had the user selected "FALSE" then the TFM would change the commercial tariff such that the levelized value of the variable component is equal to 4.44p/kWh.

There are some "temporary values for user" cells that are there to allow the user to store target values which can be helpful when updating multiple tariffs.

Customer detriment analysis

CUSTOMER DETRIMENT ANALYSIS									
Combined Customer Analysis	Real	Assessment:	years	40	Energy analysed:	Heat	Real discount rate:		3.50%
					T0 or whole life cost?	Whole life	Inflation assumption:		1.50%
	p/kWh					p/kWh			
Whole life connection charge (Real 40YR)	3.21			Whole life heating plant purchase (Real 40	4.35			Project	CF
Whole life fixed charge (Real 40YR)	6.65			Whole life O&M (Real 40YR)	1.04	CO2e	p/kWh	0.05	0.38
Whole life variable charge (Real 40YR)	3.00			Whole life variable charge (Real 40YR)	6.40	Air quality	p/kWh	0.04	0.20
Netywork offer	12.86			**Counterfactual cost**	11.79	Social Cost	p/kWh	0.09	0.57
						Combind offer	p/kWh	12.95	12.37
Individual Customer Analysis									
Domestic									
NETWORK OFFER TO END CUSTOME	p/kWh	VAT		COUNTERFACTUAL	p/kWh	VAT			
Whole life connection charge (Real 40YR	3.21	0%		Whole life plant purchase (Real 40YR)	3.55	0%	Developer pays con.		FALSE
Whole life fixed charge (Real 40YR)	5.19	0%		Whole life O&M (Real 40YR)	0.83	0%	Include VAT?		TRUE
Whole life variable charge (Real 40YR)	3.00	0%		Whole life variable charge (Real 40YR)	6.40	0%			
VAT	-			VAT	-				
Whole life total network charge (Real 4	11.40			**Whole life total CF charge (Real 40YR)**	10.78		**Finacial Saving / (cost) (p/kWh)**		(0.62)
Whole life carbon (saved)/cost (Real 40YF	(0.33)			Installed heat capacity (kWth)	11,454		Customer #		3,147
Whole life air quality (benefit)/cost (Real 4	(0.16)			Av. annual consumption per conn. (MWh)	27,946		Carbon saved (TCO2e/Y)		524
				Av. financial saving/(cost) £/yr/cust.	(55.50)		Carbon saved (TCO2e/Y/Customer)		0.17
Whole life total social charge (Real 40Y	10.92			Av. annual social saving/(cost) £/yr/cust	(12.55)		**Social Saving / (cost) (p/kWh)**		(0.14)

Overview

The customer detriment analysis section allows the user to consider the combined tariff proposed compared to the counterfactual using the customer's expected (or agreed) discount rate. For domestic customers it might be reasonable to expect that HMT's Green Book social time preference of 3.5% would be adopted, so too for public sector offtakers. Commercial customers may require a different discount rate; however, thought should be given to this as heat and/or cooling are not typically seen as optional in commercial buildings – they are necessary for business to be conducted within them. As such, adopting a "commercial" hurdle rate from the perspective of an offtaker could be argued to misrepresent what the discount rate is doing here – we are not appraising whether the commercial offtaker should or should not invest in heating/cooling (it is a given that they require it), rather we are assessing whether the proposed district heating/cooling proposal does or does not present value for money against the assessed counterfactual. As such, adopting a social time preference of 3.5% may well be appropriate.

Combined Customer Analysis

Unlike the solve tariff section the customer analysis section will combine tariffs that supply energy that falls under the overarching energy type assessed as the counterfactual: heat, cooling or electricity. Typically this will not differ from the solve tariff section but could do where distinctions are made in energy types. For example, it could be conceivable that tariffs are established for the supply of steam, medium temperature hot water, low temperature hot water for space heating and domestic hot water. All of these individual energy types would fall under the definition of "heat" and would be appraised collectively in this section. That is why the "Energy analysed:" is called up from the counterfactual section of the inputs.

The user needs to enter:

- The money terms that assessment is made: real/nominal;
- The assessment period;
- Whether the whole life or T0 method of calculation is used (see Levelised Cost section above);
- The real discount rate (i.e. the discount rate used to reflect the customer's social time preference)
- The inflation assumption is used to convert the real discount rate to nominal in the event that the user selects "Nominal" money terms

The first column represents the collective financial cost to the customer. If the user sets the same discount rate as that used in the returns section then the calculated value will agree to the levelized tariff section of the returns table (see above). The line items of this section are explained as follows:

Label	Description
[Whole life / T0] connection charge	The levelized value of the connection charge offered to the customer at the discount rate used for the customer assessed over the assessment period.
[Whole life / T0] fixed charge	The levelized value of the fixed charge offered to the customer at the discount rate used for the customer assessed over the assessment period.
[Whole life / T0] variable charge	The levelized value of the variable charge offered to the customer at the discount rate used for the customer assessed over the assessment period.
Network offer	The sum of the above and reflects the financial cost. The social cost of carbon and air quality impact is assessed in the final column (see below).

The second column evaluates the collective financial cost of the counter-factual solution. The line items of this section are explained as follows:

Label	Description
[Whole life / T0] heating plant purchase	The levelized value of purchasing and installing the core plant e.g. boilers, heat pumps, chillers etc. depending on the energy selected for counterfactual assessment.
[Whole life / T0] O&M	The levelized value of the annual maintenance charge associated with the counterfactual installed plant.
[Whole life / T0] variable charge	The levelized value of the fuel costs of the counterfactual installed plant to meet the same heat demand.
Counterfactual cost	The sum of the above and reflects the financial cost. The social cost of carbon and air quality impact is assessed in the final column (see below).

The final two columns provide the social impact of carbon equivalent emissions and air quality impact of both the district heating offer and the counterfactual. Typically it would be expected that the DH social impact will be lower than the counterfactual; however, where low carbon alternative solutions are proposed it is possible that the social impact of the counterfactual may be marginally lower than the DH proposed solution but it would be hoped that the overall social cost (financial + social impact) would be lower than the counterfactual.

Individual tariff analysis

If it is assessed that the DH proposed tariff is lower than the counterfactual then this strongly suggests (but not necessarily, particularly if there are phased connections) that each individual tariff can be calibrated to demonstrate value for money against the counterfactual. This section allows the user to assess whether individual tariffs represent value for money. The section "Key tariff values" should have highlighted where tariffs proposed may potentially not represent value for money. For example, looking at the commercial levelized tariff against the domestic the total levelized tariff (at the project discount rate) is shown above to be 14.16p/kWh but the commercial is estimated to be 19.80p/kWh at an 8% discount rate and the domestic is 12.28p/kWh.

Using the individual tariff assessment the user could select the commercial and then the domestic tariff and consider the extent to which they could be changed (using the target tariff section above) to get both to demonstrate value for money and increase the likelihood that the offtakers will agree to the tariff evaluated by the TFM.

Individual Customer Analysis							
Domestic							
NETWORK OFFER TO END CUSTOME	p/kWh		VAT	**COUNTERFACTUAL**	p/kWh		VAT			
Whole life connection charge (Real 40YR)	3.21		0%	Whole life plant purchase (Real 40YR)	3.55		0%	Developer pays con.	FALSE
Whole life fixed charge (Real 40YR)	5.19		0%	Whole life O&M (Real 40YR)	0.83		0%	Include VAT?	TRUE
Whole life variable charge (Real 40YR)	3.00		0%	Whole life variable charge (Real 40YR)	6.40		0%		
VAT	-			VAT	-				
Whole life total network charge (Real 4	**11.40**			**Whole life total CF charge (Real 40YR)**	**10.78**			**Finacial Saving / (cost) (p/kWh)**	**(0.62)**
Whole life carbon (saved)/cost (Real 40YR)	(0.33)			Installed heat capacity (kWth)	11,454			Customer #	3,147
Whole life air quality (benefit)/cost (Real 4	(0.16)			Av. annual consumption per conn. (MWh)	27,946			Carbon saved (TCO2e/Y)	524
				Av. financial saving/(cost) £/yr/cust.	(55.50)			Carbon saved (TCO2e/Y/Customer)	0.17
Whole life total social charge (Real 40Y	**10.92**			Av. annual social saving/(cost) £/yr/cust	(12.55)			**Social Saving / (cost) (p/kWh)**	**(0.14)**

The key difference between this section and the combined analysis is that this section includes the option to appraise VAT. This is very relevant for domestic customers where VAT will not be recoverable. VAT on domestic heat is currently 5%, but VAT on conventional heating plant is 20% as is annual maintenance. The inclusion of VAT on domestic tariffs can therefore have a substantial impact on the VFM assessment where the domestic occupier is expected to maintain and replace heating plant.

Project Cash Flow Analysis
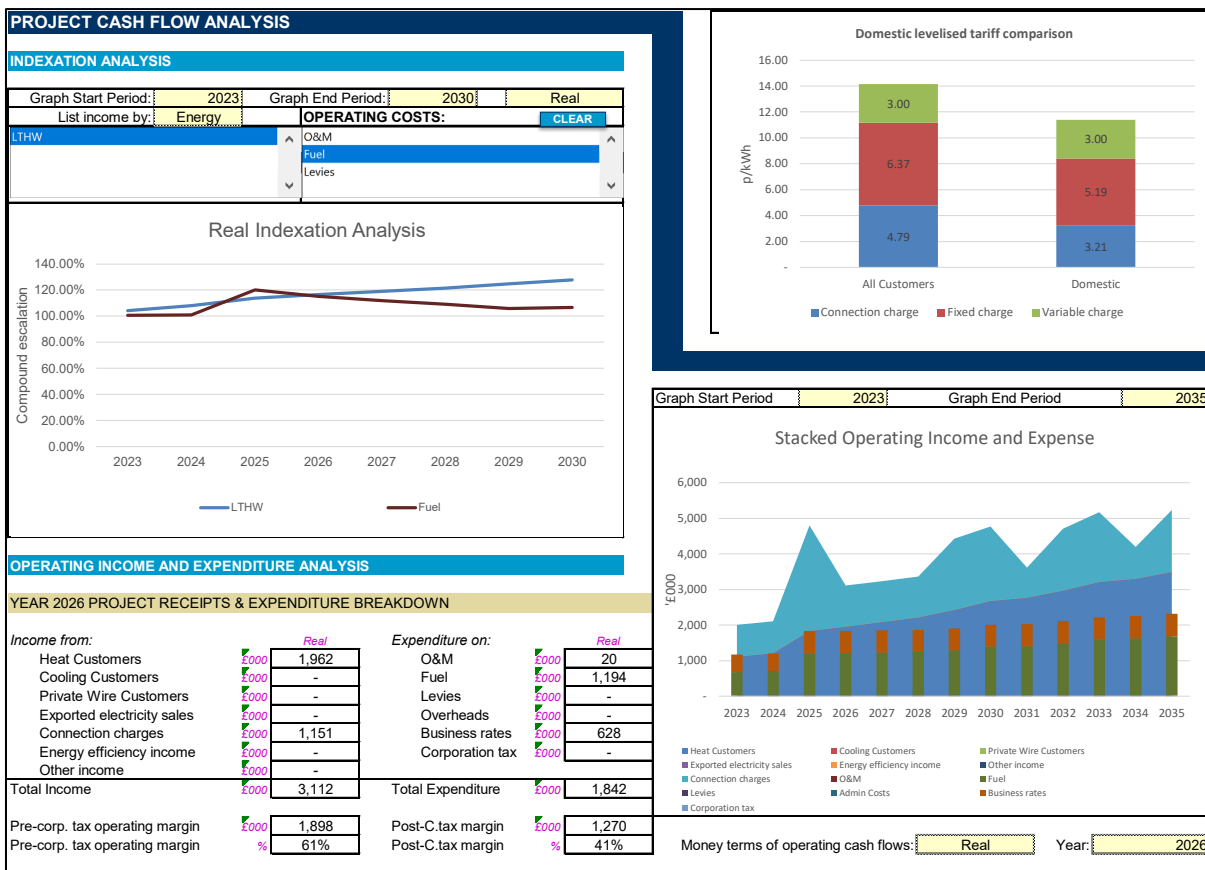
Indexation Analysis

Understanding how income and operating expenses are modelled to escalate is important. To the extent that energy income escalation and the cost base are modelled to differ this difference should be explored and appraised. The graph takes income and costs and divides them by the heat demanded in a given period to express the income and expense as a p/kWh value. What is plotted is the year-on-year percentage change of these values. For example, where O&M costs are held flat but demand is modelled to increase there would be a downward

inflationary trend as the same O&M service cost is provided despite customer demand increasing.

This section of the TFM is not intended to establish whether indexation is appropriate / correct but rather highlight where a difference appears to be present and allow the user to then decide to undertake more detailed analysis which could lead to a refinement of the indexation assumptions adopted in the TFM either for tariff, underlying costs or both. Ultimately the TFM should be calibrated to reflect the contractual terms for indexation included within negotiated Energy Supply Agreements.

Operating Income and Expenditure analysis

This is composed of two sections: an interactive graph that shows the operating cash flows (i.e. excluding capex and replacement expenditure which are included in the project chart in the returns section). It further provides functionality to select a given year in the chart and provide numerical analysis allowing for pre- and post-tax margin analysis.

A key limitation of NPV/IRR analysis is that they are unable to provide an indication of the quality of operating cash flows and can hide issues which might question the project as a going concern. This section allows the user to unpick this.

Project Cash Flow Risk Analysis

This section of the dashboard allows the user to identify some key sensitivities across the key operating cash flows:

- Tariff;
- Capex;
- Fuel; and

- Opex

That is not to say these are the only project risks (e.g. taxation, future regulation/change in law etc.) but should identify areas of concern. The user can set the percentage change that should be applied against each sensitivity and can then run each sensitivity individually or press the "RUN ALL". If these macros are not run they will be highlighted orange and the TFM's master checks (shown in the top left of each worksheet) will be highlighted orange.

In addition this section includes a chart showing the impact of the tariff change across each tariff entered in the TFM. This helps show which customer(s) represent the highest value and the impact on project NPV should a reduction in tariff be negotiated.

Project Model Solver

In Tab <SYS_Sensitivity> the user is able to calibrate bespoke sensitivities. In the column with the label "Project Model Solver" (Column AB in v004.008) the user should select which line item is to be adjusted by setting it to TRUE. Then on the Dashboard the user selects the "Solve to:" dropdown which corresponds to the list described in the Solve Tariff section above.

The user should press the "SOLVE" button and when a solution has been found the percentage change to the items selected to be changed is pasted by the macro in cell "Solve adjustment:". The user should then press either the "RESTORE" or "UNDO SENSITIVITY" macro buttons to remove the sensitivity calculated. **It is important that the user takes this step** or else the sensitivity applied will be retained and continue to be applied which may not be intended by the user.

Energy Analysis

ENERGY ANALYSIS

ENERGY BALANCE

WHOLE SYSTEM EFFICIENCY   Year: 2035

Energy	Primary import MWh	Export to network MWh	Export to grid MWh	Network Losses MWh	Customer Supply MWh	Whole system %	Customer Demand MWh	Variance MWh	Variance %
Electricity import	1,903	-	-	-	-		-	-	0.00%
LTHW	-	54,905	-	19,424	35,480		35,480	-	0.00%
Heat from well	54,641	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
	-	-	-	-	-		-	-	0.00%
Total	56,544	54,905	-	19,424	35,480	62.75%	35,480	-	0.00%

ENERGY CENTRE SYSTEM EFFICIENCY

Energy	Import MWh	Conv. Loss MWh	Parasitics MWh	GENERATE MWh	(Spill)/gain MWh	To Grid MWh	NETWORK MWh	Efficiency %
Electricity import	1,903	-	(1,639)	-	-	-	-	
LTHW	-	-	-	54,905	-	-	54,905	
Heat from well	54,641	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
Total	56,544	-	(1,639)	54,905	-	-	54,905	97.10%

The TFM provides a summary energy balance for a given year (selected by the user in cell "Year:"). This allows a user to check that the energy balance makes sense. For example, in the above energy balance it would be noted that the whole system efficiency is 62.75%. For a network importing heat (in this case from a deep geothermal well) this should be considered poor performance. On closer inspection it is clear that the network losses assumed are very high at 55% (19.424MWh/year of losses vs 35.480MWh/year of demand). This should prompt the reviewer to raise the issue with the technical engineers as this level of losses would not be CP1 compliant and will have a material impact on returns modelled.

Another important area to consider is the extent to which there is energy spill. Where this is the case again this should be flagged to technical engineers for review.

A chart below the energy balance can help identify which periods warrant further investigation:
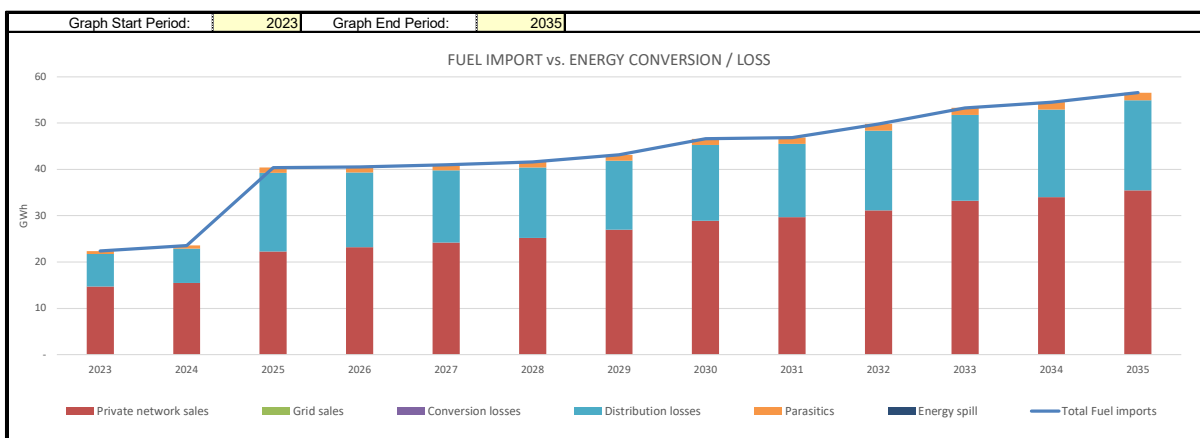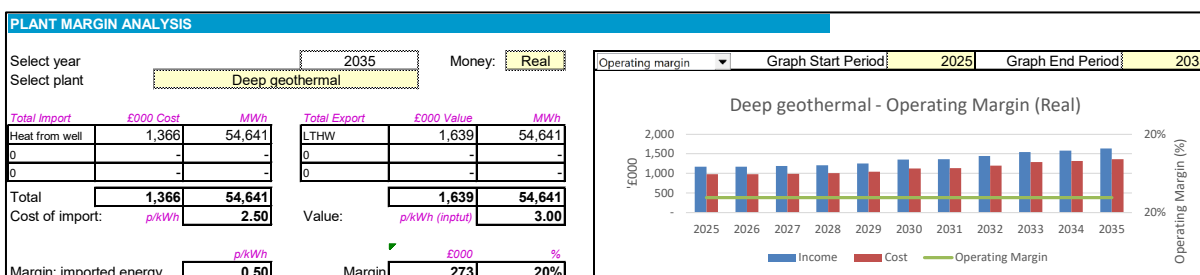

A plant level energy balance is provided. Rows are hidden based on the number of plant items entered into the TFM. When the user presses "CALIBRATE DASHBOARD" this will hide and unhide relevant rows:


The year appraised corresponds to the year selected by the user for the energy balance.

Plant Margin Analysis

This sub-section of the Energy Analysis section allows the user to consider the estimated marginal operating profitability of each plant item modelled based on energy imported and the marginal value of energy exported (i.e. excluding fixed charges).

In the example above heat sold to customers from heat imported from the deep geothermal well is shown to provide a 20% margin on heat imported; however, when looking at the electric boilers assumed to be in place we can see a much worse position:
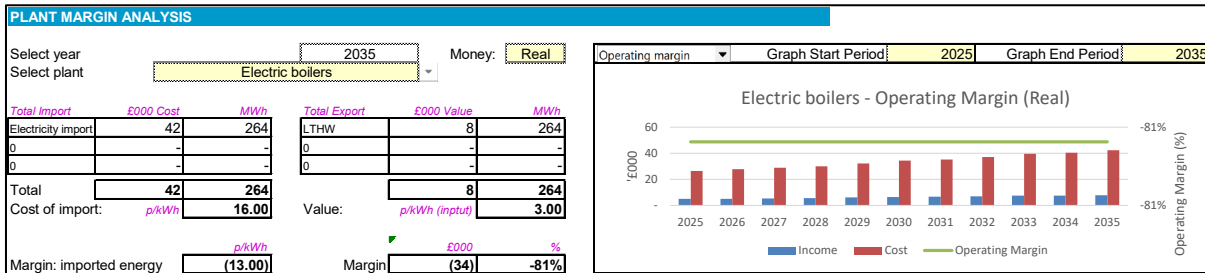
Both here and in the detailed energy balance we can see that electric boilers are estimated to make up a very small portion of overall heat supplied; however, this should flag a commercial/technical risk that in the event that the deep geothermal well is unavailable the project would be making an operating loss on each unit of heat supplied to customers, estimated here to be 13p/kWh – not a happy position! This might trigger consideration for contractual terms that could in part or whole preserve the operator's margin.

It should be noted that the combo-box drop down also includes a chart that shows energy prices across the period selected by the user.

Carbon Analysis

The carbon analysis section allows the user to consider the project's carbon footprint, the estimated counterfactual carbon footprint and the difference between the two. If not all energy types are shown in the graph the user should press the "CALIBRATE DASHBOARD" macro button at the top of the dashboard.
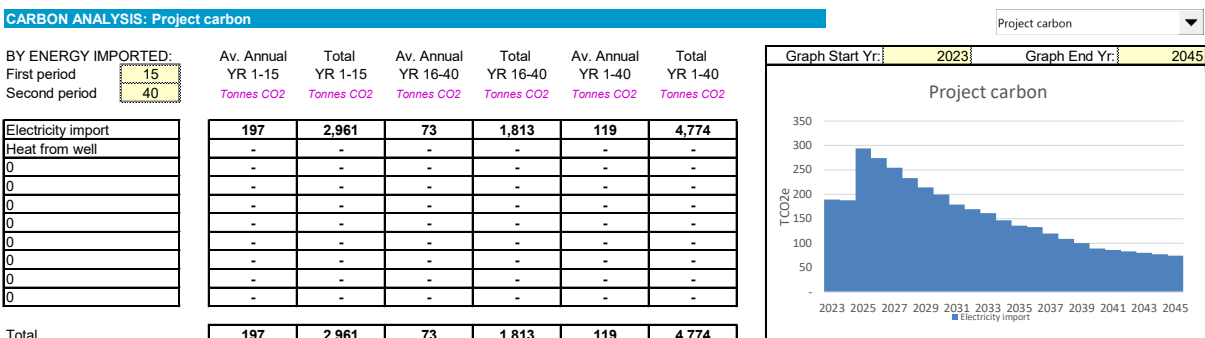
The user can set the period over which the assessment is appraised for summary values as well as change the period over which the graph is appraised.

Financial Analysis

This section is designed to analyse investor returns at a legal entity level where all previous analysis has been at a project level (i.e. not making a distinction between assets being owned across legal entities).
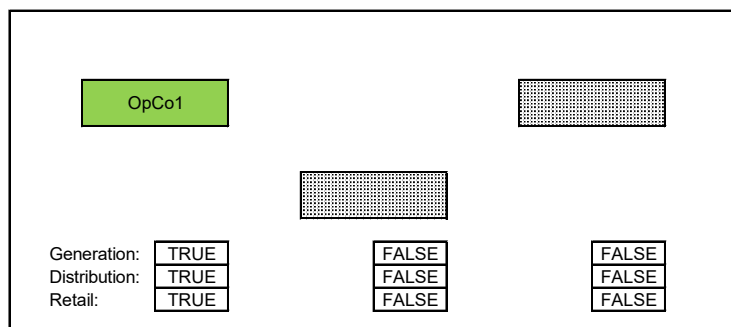
The diagram in this section provides a visual representation of how assets have been allocated across legal entities included in the TFM.

Financial Returns

The financial returns section provides the key financial metrics at an operating company level. The user can select whether metrics are evaluated in real or nominal money terms. Typically it might be expected that financial returns are appraised in nominal terms.

Columns represent the returns attributable to each operating company. Below is an explanation of each metric:

Label	Description
Appraisal period	The period over which assessment of cash flows is made
Include terminal value?	If this is set to TRUE then the carrying value of the Operating Company's net assets (i.e. assets less liabilities) is included in the cash flow in the year after the appraisal period ends

Unlevered pre-tax return	This is equivalent to the IRR of the real/nominal Project pre-tax (pre-grant) cash flows discussed in the returns section above.
Unlevered pre-tax return (grant)	This is equivalent to the IRR of the real/nominal Project pre-tax (post-grant) cash flows discussed in the returns section above.
Unlevered post-tax return (grant)	This is equivalent to the IRR of the real/nominal Project post-tax (post-grant) cash flows discussed in the returns section above.
Levered NPV @ investor cost of equity	This calculates the Net Present Value of cash flows after other forms of finance have been accounted for (debt, overdraft, lease etc.) at the weighted average cost of equity.
Simple payback (levered)	This is the simple payback calculated on the equity cash flows summarised above.
Disc. Payback @ investor cost of equity	This is the number of years it takes to achieve NPV=0 on the equity cash flows summarised above when discounted at the weighted average cost of equity
Social Equity IRR	The Social Equity IRR takes the cash flows attributable to equity (see above) and then overlays the social cash flows (see Project Social IRR discussion in returns section). These are allocated to each OpCo in line with their share of total assets. The IRR of these cash flows is estimated over the assessment period.
Social Equity NPV	The net present value of the equity + social cash flows is calculated using the weighted average cost of equity.

Capital structure

CAPITAL STRUCTURE					Nominal
Year:	2035	*Company*	OpCo1	OpCo2	OpCo3
Share capital		£000	26,447	-	-
Weighted cost of Equity (investor cost of equity)		%	4%	0%	0%
Debt finance		£000	-	-	-
Debt interest charge		%	0%	0%	0%
Lease finance		£000	-	-	-
Lease finance charge		%	0%	0%	0%
Unamortised grants provided		£000	-	-	-
Total capital		£000	26,447	-	-
Weighted average cost of capital (excl. grant)		%	3.50%	0.00%	0.00%

This section shows the capital structure and weighted average cost of capital (excluding grants). The user can select the year that is analysed. The money terms are selected in the financial returns section discussed above.

Financial sources and uses pie charts are provided in this section. The user can select the period appraised allowing for both construction and operations period analysis:
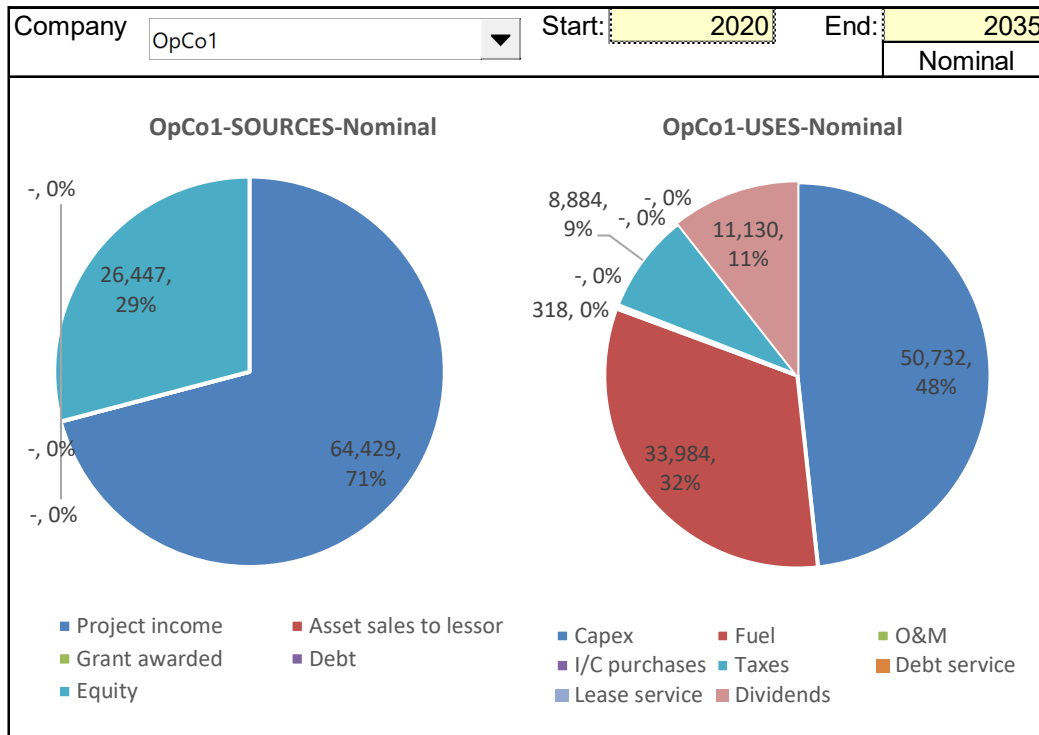
The combobox allows the user to switch between each of the three operating companies.

Investor Analysis

The investor analysis section allows the user to target individual investor returns within a given operating company. The user selects the company analysed in the combo-box. On making the selection it provides the list of investors invested in the company, their share of profits, their ownership percentage and the number of yeas that they appraise returns over.

The user then selects an investor from the drop down list: "Investor selected for analysis (debt or equity")". This will then pull up the investor returns attributable to the investor selected. Taking each item in turn:

Label	Description
Appraisal period	This is a call up from the investor inputs in <INP_General> and is dependent on the user selection of "Investor selected for analysis (debt or equity)". It represents the period over which IRR and NPV calculations are based.
Terminal value?	This is a call up from the financial returns section (see above). If it is set to TRUE then the company's net asset value in the period immediately following the last appraisal period is included in the IRR/NPV calculation.
Investor investment hurdle rate	This is a call up from the investor inputs in <INP_General> and is dependent on the user selection of "Investor selected for analysis (debt or equity)". It represents the discount rate used for NPV and discounted payback calculations.
Peak debt o/s to entity at year end	Where debt has been issued by the investor to the operating company selected for analysis this value shows the maximum amount of debt owing to the investor selected (as valued at the end of a given financial year) expressed in £000.
Year of peak debt	This is the year where the peak debt occurs.
Weighted av. Interest	This is a calculation of the weighted average interest over the debt term. The significance of this is where interest has been set as not payable for early period. It should be noted that this is not the effective interest rate for accounting purposes.
Minimum DSCR	This calculates the lowest debt service cover ratio over the loan's tenor. It should be noted that capital expenditure (including capital replacement – "repex")
Average DSCR	This calculates the average debt service cover ratio over the loan's tenor. The user can review the DSCR graphically by selecting the combobox that has the default "Capital structure" shown to "DSCR" to interrogate this further.

Label	Description
Share capital invested – first phase	This is the amount of equity (as opposed to shareholder debt) that has been invested into the operating company selected by the investor that has been selected over the "first phase". The "first phase" is defined by the user in the capex section of the dashboard.
Total share capital invested	This is the total amount of share capital forecast to be invested by the investor selected into the operating company selected on the dashboard. Money terms selected (nominal/real) should be noted when reporting.
Pure investor return	This metric shows the return on equity over the appraisal period. This is an IRR estimate (guessing at the investor's hurdle rate) assessed on equity invested by the investor selected vs. dividends attributable to the investor received.
Simple investor payback	This is the number of years it takes the operating company to return the investment made through dividend payments.
Discounted investor payback	This is the number of years it takes the operating company to return the investment made + achieving the required return on investment, i.e. NPV of cash flows assessed at the investor's equity hurdle rate = 0.
Investor NPV @ cost of equity	This is the net present values of the equity cash flows at the investor's hurdle rate over the period assessed. It should be noted that if the user has input a nominal equity hurdle rates then the money terms for investor analysis should be set to nominal and vice-versa for a real equity hurdle rate.
Blended investor IRR	The blended investor IRR appraises both equity cash flows attributable to the investor selected **and** the cash flows associated with share holder loans issued by the investor to the operating company selected. This is an important set of cashflows as it will not be uncommon for equity to use a combination of share capital and shareholder loans when capitalising a heat network operating company.
Blended investor NPV	This is the Net Present Value of the blended investor cash flows (see Blended investor IRR) at the investor's hurdle rate entered in <INP_General>. It should be noted that if the user has input a nominal equity hurdle rates then the money terms for investor analysis should be set to nominal and vice-versa for a real equity hurdle rate.
Blended investor payback	This is the number of years it takes the operating company to return the investment of debt + equity through dividend, interest and principal repayments.

Label	Description
Blended investor disc. Payback	This is the number of years it takes the operating company to return the investment made (including loan principal) + achieving the required return on investment, i.e. NPV of cash flows assessed at the investor's investment hurdle rate = 0.
Equity Social IRR	The equity social IRR takes the equity cash flows and overlays the social cash flows calculated in the TFM (see Social IRR (pre-grant) definition in Returns section above). An adjustment is made to reflect the investor's share of these social cash flows and is calculated as the amount invested by the investor selected divided by the total amount of investment into the operating company selected.
Equity Social NPV	This is Net Present Value of the Equity Social cash flows (see above) discounted over the appraisal period at the investor's hurdle rate
Equity Social payback	This is the number of years it takes the operating company to return the investment of equity through dividend and social value attributable to the investor (see Equity Social IRR)
Equity Soc. Disc. Payback	This is the number of years it takes the operating company to return the investment made + achieving the required return on investment, i.e. NPV of equity social cash flows assessed at the investor's investment hurdle rate = 0.
Blended Inv. Social IRR	As with Equity Social IRR but in addition including loans issued by the investor to the operating company
Blended Inv. Social NPV	As with Equity Social NPV but in addition including loans issued by the investor to the operating company
Blended Inv. Payback	As with Equity Social payback but in addition including loans issued by the investor to the operating company
Blended Inv. Disc. payabck	As with Equity Social discounted payback but in addition including loans issued by the investor to the operating company

Investor Model Solver

The investor model solver allows the user to solve the model for the investor selected for either pure equity returns or blended returns (loans issued by the investor + equity cash flows). The user can set whether the model solves by changing grants, loans issued or the share of dividends allocated to the investor vs. the share of ownership.

It should be noted that the TFM's default sensitivity is to adjust all grants and all loans awarded to achieve the target outcome (NPV=0, Social NPV = 0, simple payback or discounted payback) is achieved. If the user wants to tailor which loans or grants are adjusted this can be done in tab <SYS_Sensitivity>: "Grant sensitivity" and "Loan sensitivity".

When the user has calibrated the model solver he/she should press "SOLVE". The macro will populate the cell labelled "Solved adjustment" with the percentage change required to achieve the target outcome. The model should then be restored to remove the sensitivity applied and the user can then manually adjust the loan/grant/dividend share either directly in <INP_General> by [1 + solved adjustment] or else via the scenario manager if this has been calibrated for grant / loan sensitivity scenarios.

Financial Statements

Each operating company has a real and nominal set of financial statements. The level 2 groupings are intended to broadly correspond to IAS 1: presentation of financial statements; however, as notes to the financial statements are not provided breakdowns are provided at level 3 giving the user a further level of detail. Each level 3 item is a single cell call up from the relevant OpCo workings and can be followed through if further interrogation is required.

A global tax check is provided in real and nominal terms beneath each set of financial statements. This acts as a proof that the tax computation is profit before tax multiplied by the prevailing tax rates adjusted for:

- Depreciation not deducted from profits on assets that are not eligible for capital allowances;
- The tax effect of capital allowances and accounting depreciation of assets eligible for capital allowances operating in different ways (e.g. reducing balance vs. straight line depreciation);
- Non-taxable income – grants;
- The tax effect of losses;
- The tax effect of losses not permitted to be offset against future profits (i.e. where too many periods of losses have occurred resulting in subsequent losses not being permitted to be carried forward;
- The tax effect of capital allowances not permitted to be offset – this primarily would arise where an entity recognises replacement expenditure but there is insufficient time remaining for the relevant asset pool to have been written down against taxable profits.

HNDU&GHNF

These tabs are output sheets for relevant BEIS revenue and capital support programmes. They are intended to help consultants start populating forms that are required by these programmes but require additional information to be included (orange cells) and will still require consultants to review and check that values entered are consistent with techno-economic modelling which the TFM only summarises.

Model Calculations

CALC_Customers_ANN

This worksheet calculates the pre-indexation fixed and variable network income. It further provides necessary consumption data for a number of calculations across the TFM as well as is used on the dashboard for customer analysis.

1.   CUSTOMER DEMAND

1.7. BY CUSTOMER: PRE-ENERGY EFFICIENCY

This section is a call of up of individual customer energy demand in kWh taken straight from <INP_EBalance>

1.8. BY CUSTOMER: ENERGY EFFICIENCY MEASURES

This section calls up by way of a sumif calculation the energy demand saved by each of the customers selected for energy saving measures over the base consumption level.

1.9. BY CUSTOMER: AFTER ENERGY EFFICIENCY

This section takes the energy consumption by customer and subtracts any energy saving set against a given customer in the section above.

1.10.   BY TARIFF: AFTER ENERGY EFFICIENCY

This section summarises the individual adjusted customer demand into the tariffs and customer types. The customer types are set as default to "At Risk" and "Not at Risk", which are intended for GHNF customer detriment assessment.

1.11.   DASHBOARD SUMMARY DEMAND

This section is used for the Graph 9 in the TFM on the dashboard and makes up the private network sales bar within the graph.

2.   ENERGY SALES BY CUSTOMER AND TARIFF

1.12.   CUSTOMER ENERGY VOLUME TARIFF: BEFORE TARIFF SENS

This section calls up the variable tariff in INP_EnergyTypes expressed in the money terms set by the user in the tariff inputs section. Real and nominal price adjustments are made in tab <CALC_Projct_ANN>.

1.13.   CUSTOMER ENERGY VOLUME TARIFF: AFTER TARIFF SENS

This section applies any sensitivity set in <SYS_Sensitivity> against the variable component each tariff included in the model. The calculation is:

- Adjusted variable tariff (p/kWh) = Pre-adjusted variable tariff (p/kWh) * (1+adjustment)

1.14.   CUSTOMER ENERGY SALES: AFTER DEMAND SENSITIVITY & TARIFF SENS

This section multiplies the "By customer: after energy efficiency" demand by the adjusted variable tariff. The divisor of (10^5) is applied to turn pence into £000.

1.15. TARIFF ENERGY SALES: AFTER DEMAND SENSITIVITY & TARIFF SENS

This section multiplies the "By tariff: after energy efficiency" demand by the adjusted variable tariff. The divisor of (10^5) is applied to turn pence into £000.

1.16. NUMBER OF CONNECTIONS

Network connections are entered into the TFM in the period they occur. The call up in this section does the following:

- Takes the largest number of connections value in prior periods (i.e. the last period when a connection was made);
- it adds any new connections in the period via a sumif; and
- ensures that there is at least one period of energy consumption by the tariff

This is a somewhat involved calculation (three components) but was not broken out due to the space requirements that would have entailed.

1.17. FIXED TARIFF - PRE-SENSITIVITY

The connections (but equally these could be kW peak, # bathrooms etc. depending on the basis of fixed charging proposed by the project for a given tariff) are multiplied by the £/day charge multiplied by the number of days in the period divided by 10^3 to express the value in £000.

1.18. FIXED TARIFF - AFTER SENSITIVITY

The "Fixed Tariff – pre-sensitivity" values are multiplied by [1+sensitivity] as set in the "FIXED" sensitivity section in tab <SYS_Sensivity>

CALC_EBalance

This worksheet takes the input energy balance and summarises it for analysis. The key output for the financial modelling is:

- Assessing energy imported that is paid for (including system parasitics); and
- Energy that is exported to wider energy networks – e.g. private wire, DNO/national grid etc.

In addition it evaluates the extent to which the energy balance spills energy or assumes more demand there is supply when losses and parasitics have been considered.

1. ENERGY SUPPLY

There are 15 sub-sections and a summary sub-section in this section. Each of the 15 sub-sections are identical and call up the three possible energy inputs and three possible energy outputs of the plant. From these values the TFM derives the conversion losses by energy output.

The summary sub-section summarises the fuel import in kWh by:

- Energy type; and
- Plant;

Energy export is summarised by energy type and then sub-catgorised into the three overarching energy types of: heat, cooling and electricity. Each of these overarching energy types are then analysed in more detailed to understand how each plant item contributes to heat, cooling and electricity generation.

Finally, there is a section that calls up energy import/export for plant margin analysis selections on the dashboard.

2. DISTRIBUTION LOSSES

The TFM allows for up to 10 different types of energy to be specified by the user, as such there are 10 sub-sections in this section and a summary sub-section. Each of the 10 sub-sections are identical.

The calculations use a sumif() function to call up the total amount of output energy at the plant level of each energy type.

The primary and secondary losses are then overlaid to give the losses at the point of connection. Where customers do not have secondary distribution infrastructure (e.g. building risers and laterals to an HIU) or do have them but invoicing is undertaken at a building bulk supply meter then the user need only have entered the primary distribution losses.

The resulting value of generation less losses provides the energy available at the point of connection which should correspond to input customer demand.

3. END CUSTOMER SUPPLY

1.19. END CUSTOMER DEMAND BY ENERGY TYPE

This sub-section calls up customer demand across all energy types, overlays total grid exports (see below) to calculate the total supply of energy to customers met by onsite energy plant. This is used to populate the dashboard energy balance.

Demand and losses allocated to the TFM's overarching energy types (heat, cooling and electricity) is also summarised in this section. This is used exclusively for a BEIS form.

1.20. SUPPLY LESS LOSSES

This sub-section uses a sumif() function to call up the resulting supply at the point of customer connection by energy type as calculated in section 2 above. This value is then further aggregated into the TFM's overarching energy types (heat, cooling and electricity). This is used to populate the dashboard energy balance.

1.21. EXCESS / (SHORTFALL) OF SUPPLY

This subtracts supply at the point of connection, by energy type from customer demand by energy type. A positive value suggests that there is surplus supply and a negative value suggests that there is insufficient supply to meet demand. Both would be concerning (depending on the level of the variance) but the latter more so as the TFM will be including income for energy that could not be physically supplied.

1.22. CAN ENERGY BE EXPORTED OUTSIDE OF PRIVATE NETWORK?

When entering energy types the user is asked to specify whether an energy export type can be exported to a wider energy network. In the even that it is selected to be exportable to a wider energy network this section assumes that any excess calculated in the previous section is energy that therefore can be exported to the wider energy network.

To the extent that surplus energy is not exported to a wider energy network then the TFM will derive the amount of energy that is effect wasted (a.k.a. spilled). A shortfall will be shown as a negative value and spilled energy as a positive value.

4. ENERGY CENTRE PARASITICS MET THROUGH IMPORTS

This is a straight call up from the input sheet.

It should be noted that if a CHP is being modelled to self-supply electricity either to meet system parasitics or possibly for other heat generating plant (e.g. electric heat pump) the TFM neds to be calibrated carefully to simulated. There are two core methods:

a. The CHP's output electricity in <INP_EBalance> is separated into electricity that is exported to customers and electricity that is used for self-supply (as such the export energy types would be: low temperature hot water, customer electricity export and self-supply electricity export). The export energy for self-supply would be selected to match the retail electricity for electricity imported to meet parasitic energy centre electricity requirements.

In this way the net effect of electricity export and parasitic electricity imports would net off but would be presented on the financial statements in gross terms. This would need to be explained but IRR/NPV/payaback etc. calculations would reflect the value of self-supply

b. The CHP's output electricity is reduced by the amount of electricity intended to meet the parasitic / other heat generating plant electricity import requirements. This approach is simple but will suggest that the CHP's overall efficiency is less than would be expected and therefore this would need to be explained when reviewing the detailed plant performance on the dashboard.

5. DASHBOARD

The sub-sections in this section perform the necessary call ups to populate the dashboard energy balance based on the user's selection.

Calculations relating to Low/Zero Carbon (LZC) Assessment are performed in order to populate relevant BEIS templates.

CALC_Project_ANN

This is TFM's core calculation sheet for all project level calculations covering:

- Fuel
- Capex
- O&M and overheads
- Social costs
- Climate Change Levy
- Counterfactual calculations
- Customer Detriment analysis
- Private energy network sales income
- Wider energy grid sales
- Other income
- Project metrics
- Dashboard analysis

1. FUEL COST

1.1. IMPORTED FUEL

This sub-section calls up fuel calculated to be imported relating to plant fuel imports and adds these to energy imported to meet parasitic energy centre requirements.

Ky project flags for operations are linked to the first and last period of fuel imports. "Full stage" is assessed to be the period from which the average annual fuel import ceases to materially change (materiality set as the TFM's model tolerance of default 0.1).

The real cost (fixed and variable) of each of the 10 energy types are called up from <INP_General> using an index(match()) function. The real variable cost is the kWh * the p/kWh call up charge divided by 10^5 to give a £000 value. Only energy types that are entered as "Import" energy types are included in this analysis.

Fixed costs associated with energy imports (to the extent modelled) are calculated by multiplying the £/day call up by the number of days in the year for all energy types marked as "Import". These are divided by 10^3 to express th value in £000.

1.2. IMPORTED FUEL - REAL & NOMINAL COST

The £000 values calculated in the previous section are calculated in money of the year terms entered by the user. Each of the 10 energy types are rebased to the TFM's base year (default is the first period of the TFM) to provide the real price of fuel.

To derive nominal values the TFM first rebases the cash flow to the TFM's first year (the default assumption is that the TFM's base year and start year are the same) and then escalates the cash flows from the base year to money terms in each period applying the money inflation (e.g. CPI/RPI) assumption selected for nominal money terms.

A summary section provides the full cost (fixed + variable) expressed in p/kWh terms and the marginal cost (variable only) expressed in p/Wh.

The TFM includes a sensitivity overlay in the final section as well as calculating the compound real and nominal price inflation associated with fuel. These values are used for revenue price escalation in the private network income section.

1.3. FUEL ACCOUNTING SUMMARY

This section provides the accounting corkscrew account for real and nominal cash flows. Creditor days on the carried forward balance are calculated as the liability recognised multiplied by the creditor days divided by the number of days in the period. Cash is the balancing figure.

2. CAPITAL COST

The TFM's capex input section includes 7 sections:

- Generating plant;
- Other energy centre capex;
- Private wire capex;
- Primary distribution network capex;
- Customer connections capex;
- Engineering, procurement and project management capex; and
- Contingency

Each of these has a different number of line items that correspond to HNDU's Appendix A minimum level of capex breakdown assumptions recommended for techno-economic models. The calculations for each line item are identical.

The cost profile, as entered by the user in <INP_General> is called up. This is re-based to real and nominal terms in line with the method set out in Fuel Costs above. The capex sensitivity for "Generation", "Distribution" or "Retail" classed assets is then applied.

The corkscrew account for the fixed asset balance sheet treatment is as follows:

Label	Description
b/f Asset balance	The asset carrying value as at the end of the prior period
Additions recognised	The debit side of the initial recognition in line with the profile entered by the user adjusted for indexation and sensitivities applied as per description above.
	If the user has selected that repex be applied in the model (i.e. a repex profile has not been entered by the user which would not be a typical situation) then the TFM calculates the replacement based on the useful economic life assumption.

Label	Description
Depreciation	The P&L charge that straight line depreciates assets over the useful economic life. An offset function is used to manage this as this allows for multiple periods of additions.
Final write off	The carrying value of assets are fully written down when operations cease.
c/f asset balance	The sum of the above

The corkscrew account for the liability arising when new fixed asset additions are made is as follows:

b/f Asset balance	The asset carrying value as at the end of the prior period
b/f payable balance	The liability carrying value as at the end of the prior period
Liability recognised	The credit side of the initial recognition in line with the profile entered by the user adjusted for indexation and sensitivities applied as per description above.
Cash paid	The difference between c/f payable position and the b/f + in period additions
c/f payable balance	Calculated based on the capex payable days assumption adopted in the TFM. It is calculated by multiplying the in period additions by the payable days divided by the number of days in the period.

The final sub-section of the capex section summarises all capex corkscrew accounts into real and nominal corkscrew accounts split into Generation, Distribution and Retail asset classes. This is to allow allocation of capex costs associated to each within relevant operating companies.

Additionally the final section derives relevant construction period flags based on capex figures entered and user values entered on the Dashboard.

1.23.   Understanding the repex and depreciation calculations

Offset functions are not generally used in the Model as they are hard to audit and, if not designed correctly, can create unintended logic circularities. This sub-section explains how the calculations are designed.

						2043/44	2044/45	2045/46	2046/47	2047/48	2048/49	2049/50
FINAL HNDU Template Financial Model (Pop	Sheet Integrity checks:	OK	Financial Year									
CALC_Project_ANN	Sheet Warnings:	OK	Year			2043	2044	2045	2046	2047	2048	2049
No Integrity Errors	Money indexation applied?	TRUE	Period Start Date			01/04/2043	01/04/2044	01/04/2045	01/04/2046	01/04/2047	01/04/2048	01/04/2049
WARNING! Potential input error - refer to ch			Period End Date			31/03/2044	31/03/2045	31/03/2046	31/03/2047	31/03/2048	31/03/2049	31/03/2050
WARNING! Macros not run	1 ▼	MAP	Annual Period			23	24	25	26	27	28	29
			Days in year			366	365	365	365	366	365	365
	Units Call Calc. Check Warning	Total										

4 PRIMARY DISTRIBUTION NETWORK

5 CONNECTIONS

	Units	Call	Calc.	Check	Warning	Total	2043/44	2044/45	2045/46	2046/47	2047/48	2048/49	2049/50
Customer HIUs - heat	£000	Real	Retail			1	-	-	-	-	-	-	-
Index	Index	CPI	1	OK			1.39	1.41	1.43	1.45	1.47	1.49	1.52
Cost Base Year	Flag	2021	1.00	OK			-	-	-	-	-	-	-
Model Base Year	Flag	2021	1.00				-	-	-	-	-	-	-
Real-Cost of-Customer HIUs - heat	£000	Real					-	-	-	-	-	-	-
Deflate from model base year	Index						-	-	-	-	-	-	-
Inflate from model base year	Index						1.39	1.41	1.43	1.45	1.47	1.49	1.52
Combined index	Index						1.39	1.41	1.43	1.45	1.47	1.49	1.52
First capex	Flag						-	-	-	-	-	-	-
Sensitivity	%	0.00%			First Replacement:		-	-	1	-	-	-	-
					Depreciation offset:		(22)	(22)	(20)	(20)	(20)	(20)	(20)
Real							1,617	1,303	988	2,223	2,458	2,721	3,013
b/f ASSET balance	£000	Real					1,617	1,303	988	2,223	2,458	2,721	3,013
Additions recognised (BS)	£000	Real	Real-Capex Real-Capex- Real-Cape	12,578			-	-	1,576	579	608	638	670
Depreciation (P&L)	£000	Real	Real-depre Real-depreciation-Cust	(11,853)			(314)	(314)	(342)	(343)	(345)	(346)	(348)
Final write off (P&L)	£000	Real	Real-final w Real-final write off-Cus	(725)			-	-	-	-	-	-	-
c/f ASSET balance (BS)	£000	Real	Real-c/f ASSET balance (BS)-Customer				1,303	988	2,223	2,458	2,721	3,013	3,335
					years to first cap								
Useful economic life	Offset flag	20	TRUE			2	20	20	20	20	20	20	20
Repex	£000	Real	100% Real-repex			4	-	-	1,576	579	608	638	670
b/f PAYABLE balance	£000	Real					-	-	-	(259)	(95)	(100)	(105)
Liability recognised (BS)	£000	Real	Real-Capex-liability recognised-Ret	(12,578)			-	-	(1,576)	(579)	(608)	(638)	(670)
Cash Paid (CF)	£000	Real	Real-Capex-cash paid-Retail	12,578			-	-	1,317	743	603	633	665
c/f PAYABLE balance	£000	Real					-	-	(259)	(95)	(100)	(105)	(110)

The rows labelled "Useful economic life" essentially build up the number of years that can be looked back to the first capex having been recognised and is limited to the useful economic life of the asset class recognised. In the case above, this is 20 years (user defined in tab INP_General). As assets only start to depreciate from the start of operations, many projects will show capex having been incurred prior to that start date. In the event that the repex functionality (INP_General: *Adopt cash repex associated with UEL assumption in model?)* has been switched on, to avoid assets being replaced too early the repex calculation at the first replacement date (in this case 20 years after the start of operation) sums all of the capital expenditure prior to operations start date. In the cell selected above the formula is:

=IF(AK1481<>0,(SUM(OFFSET(AK1467,,-AK1481-
$K1481*AK1472,,MAX(($K1481+1)*AK1472,1)))*($H1482)*(AK1481=$G1481) +
(OFFSET(AJ1482,,-
AK1481+1)*(SUM(AK$14:AK$23)<>0)))*$H1481*SUM($M1472:AK1472),0)*(SUM(M27:AK$
27)=0)

This is a long formula (certainly not in line with the FAST "Rule of Thumb" principle). The section:

SUM(OFFSET(AK1467,,-AK1481-
$K1481*AK1472,,MAX(($K1481+1)*AK1472,1)))*($H1482)*(AK1481=$G1481)

Is only applied at the first replacement date (the flag shown in the row labelled "Sensitivity" with the sub-heading "First replacement"). The offset function moves the cell reference by the number of years to the start of operation plus the number of years between when assets were first purchased and the start of operations. The width of the range is extended to the right to include the first purchase and any purchases up to the first year of operation. The depreciation calculations follow a similar logic.

All subsequent repex periods essentially look back to the cell that is the number of years of the useful economic life of the asset.

The second component of the formula is looking back to a single cell x-1 years where x is the useful economic life of the asset. One year is removed as the reference cell within the formula is already offset by one year (in the example below column AJ vs the calculation cell being column AK):

+ (OFFSET(AJ1482,,-AK1481+1)*(SUM(AK$14:AK$23)<>0)

3. OPERATING COSTS

3.1.   O&M

O&M costs relating to "Generation", "Distribution" and "Retail", entered in <INP_General> are called up and rebased into real/nominal values in line with the method set out in Fuel Costs above. An O&M sensitivity is applied.

3.2.   OVERHEADS

Overhead costs relating to "Generation", "Distribution" and "Retail", entered in <INP_General> are called up and rebased into real/nominal values in line with the method set out in Fuel Costs above. An overheads sensitivity is applied.

3.3.   OPERATING COST SUMMARY

O&M and overheads are added together. The corkscrew accounts follow the logic of capex payables.

3.4.   REAL PRICE INFLATION ANALYSIS

This section calculates the real price inflation of operating costs when benchmarked against fuel imported and expresses this as a compound index.

4. SOCIAL COSTS OF PROJECT

4.1.   SOCIAL COSTS OF CARBON

The fuel imported is multiplied by the kgCO2e/kWh input assumption within <INP_General>. Typically these values should correspond either directly to BEIS/DEFRA published factors or else be derived from them.

Carbon avoided through wider exports acknowledges that where a network is exporting energy to wider energy networks those networks need not import that energy from other sources and therefore emissions are avoided. A traditional example would be the export of excess electricity from a CHP engine. The calculation multiplies the energy exported to wider energy networks by the kgCO2e/kWh factor and then subtracts this from the total tonnes of CO2e to give the project's net carbon emissions expressed in TCO2e.

The counterfactual is a call up from the counterfactual section – see below.

Carbon abatement is the difference between the project carbon equivalent emissions and the counterfactual.

The "Selected" sub-heading refers to what the user has selected on the dashboard in the carbon analysis section: "Project Carbon", "Counterfactual" or "Carbon abatement".

The "Dashboard Analysis" subsection summarises the selected carbon equivalent emissions into summary periods. The default periods are 15 and 40 years but the user can change this on the dashboard.

The final sub-section "Project cost of Carbon (Social)" monetises the net project carbon equivalent emissions based on the percentage of emissions

4.2. AIR QUALITY IMPACT

The air quality impact of fuel used by the project is calculated by multiplying the kWh of fuel imported by the p/kWh air quality impact of fuels entered in <INP_General>. Where projects are forecasting electricity to be exported to wider energy networks the air quality saving that this offers by displacing wider energy generation is deducted to give the net air quality impact of the project.

The cost is rebased in line with the calculations set out in Fuel Costs above.

5. CLIMATE CHANGE LEVY - CLIMATE PRICE SUPPORT (GENERATOR OBLIGATIONS)

5.1 FUEL CONSUMED BY PLANT WITH NO EXEMPTIONS FROM CCL

This sub-section establishes whether the fuel imports of each of the 15 possible plant items in the TFM have or have not been categorised as "gas" or "electricity" in the CCL section of <INP_General>. As some items of plant may be exempt, or part exempt, from CCL a percentage adjustment is applied to any gas/electricity imports associated with each plant item. These are then summarised into the categories:

- Input electricity liable to CPS
- Input gas liable to CPS

Where an exporter is exporting electricity, gas or other energy output assessed for end-customers to be liable to pay CCL, the TFM will label the kWh as "[energy type]-Output energy liable to CCL".

5.2 COST OF CLIMATE PRICE SUPPORT TO GENERATOR

The input electricity and gas liable to CPS are called up from the previous section using the sumif() function. The respective Climate Price Support charge (p/kWh) is then applied to the imported kWh of gas/electricity subject to CPS and this is then rebased following the method set out in Fuel Costs above.

5.3 SUMMARY OF GENERATORS CCL AND CPS OBLIGATIONS

The real and nominal CPS liabilities are taken to corkscrew accounts that follow the logic of the capex payable accounting corkscrew account explained above.

5.4 PERCENTAGE OF CCL LIABLE EXPORT COMMODITES SUBJECT TO CCL ON CUSTOMER PURCHASE

This section is only used by section 5.5 and summarises the energy output that is assessed necessary to charge CCL on to end customers. Charging of CCL on heat is a complicated area dependent on a number of factors and as such the TFM does not try to answer all these

questions. Instead this section provides the user with % of energy that could be subject to CCL to end customers, which in turn could be further analysed in calculations outside of the TFM.

5.5 TARIFF CCL LIABILITY BORNE BY CUSTOMER

This section is not used in the TFM as it does not relate to a cash flow relating to the project. However, it could be relevant and important for post-tax customer detriment analysis; for example, there are currently exemptions for CCL on heat in community heating schemes but not all customers may have access to this exemption. As such the TFM does not seek to price this for customers but does perform a high level calculation allowing for subsequent calculations outside of the model tailored to individual project specifics to the extent that CCL is deemed to be a significant issue / barrier.

6. COUNTER-FACTUAL

6.1 COST OF COUNTER-FACTUAL TECHNOLOGY (PURCHASE + O&M)

The operations flag of each of the 15 units of plant are called up. The installed capacity of the plant for each period of operation is shown. This is used only for graphical analysis (TFM chart 14) on the dashboard and a point of comparison to the stated peak customer heat demand.

The total peak demand for the energy anlaysed is called up via a sumif() function ("Total peak demand of counter-factual". An additional sumifs() function is used to identify the total peak demand of the energy selected for existing buildings: "Existing peak demand of counter-factual". "New development additions" is the difference between total peak and existing peak and is deemed by the TFM to reflect buildings for which plant will need to be installed at the point heat is first modelled to be supplied.

A series of flags are then modelled. Taking each in turn as they are key to all subsequent calculations:

Label	Description
Period prior to core asset replacement	The first period where connections are made
End of life of first replacement	The period x years after the first period when connections are made. This flags marks the point from which that all "early period counterfactual" plant are assumed to be replaced by the "subsequent period" technology.
	This significance of this is for policies such as the Future Homes Standard due to come into effect in 2025. New build developments prior to this year may possibly assume gas combi-boilers as the heating plant which may be expected to last 15 years. As such, assuming the first connection is in 2023 then all assets installed prior to 2025 in the counterfactual scenario would be assumed to

Label	Description
	be gas combination boilers that are replaced in 2038 with the subsequent technology.
Start year of subsequent technology replacement	The year from which the subsequent counterfactual technology takes effect for new connections on or after that year. Following on from the example above, this would mark the year from which an Air Source Heat Pump counterfactual might be applied.
First replacement period	This is the period between the first connection made and the start of the subsequent technology. Any new connections made in during this period would follow the counter-factual assumptions of the "early period counterfactual".
Operating period of first period purchased assets	This is the period between the first connection made and the end of the "End of life of first replacement".
Subsequent replacement period	This is the period from the "Start year of subsequent replacement technology" to the end of the TFM's period of operations
Subsequent only period	This is the period from the "End of life of the first period" to the end of the TFM's period of operations and reflects the period over which all heat is supplied under the assumptions of the subsequent counterfactual.
Early period subsequent replacement	This is a flag that calculates the years in which the early period assets are replaced subsequent to the "End of life of the first replacement". For example, continuing from the above, the gas combination boilers that were replaced with ASHPs in 2038, on the assumption of them having a 15 year life would show replacement in 2053.
Subsequent period subsequent replacement	This is a flag that calculates the years in which the subsequent period counterfactual assets are replaced in line with the useful economic life of the subsequent period assets modelled. This flag is calculated as x years after the "Start year of subsequent technology replacement"

Using the flags set out above, the TFM establishes the kW of capacity installed over the initial and subsequent periods both in terms of additions and cumulative capacity. The new addition capacity values are multiplied by the cost of the counterfactual plant purchase and installation across initial and subsequent period counterfactuals. The annual operating cost is calculated by multiplying the cumulative capacity by the £/kW/year counterfactual operating cost across initial and subsequent period counterfactuals.

The resulting capital and annual operating expenses are rebased in line with the method set out in the fuel cost section above.

6.2 COUNTER-FACTUAL FUEL COST

The TFM calls up the annual energy demand over the "first replacement period". The value as at the "Start year of the subsequent replacement period" is then held constant until the "End of life of the first replacement period". This reflects that the counterfactual for customers who have adopted a technology prior to the subsequent period coming into effect will continue to consume fuel attributable to the first replacement period until the end of life of the asset installed in the early period counterfactual.

Energy demand subsequent to the first replacement period is called up and the energy demand met by the initial period technology is subtracted from this value to give the energy demand met by the subsequent technology. The TFM's labelling suggests that this is heat as predominantly it is expected that this is what will typically be assessed but it could as easily be cooling, electricity or a more nuanced analysis of heat types, e.g. steam, HTWH, MTHW, LTHW etc.

For both initial and subsequent heat demand this is divided by the conversion efficiency of the counterfactual technology to give an input fuel. This assumption presumes that the counterfactual plant is located at the point of consumption and therefore there are no distribution losses. If that is not the case then the user should enter a conversion efficiency that accounts for expected distribution losses.

The derived counterfactual fuel cost is derived by multiplying the kWh of fuel consumption by the variable cost of fuel plus the annual fixed cost of fuel assumed in the TFM. This is then rebased in line with the methodology set out in the Fuel Cost section above.

6.3 COUNTER FACTUAL - SOCIAL COST OF CARBON

The initial and subsequent stage fuel are multiplied by the TFM's kgCO2e/kWh and divided by 10^3 to derive the TCO2e assumed under the counterfactual scenario. This is then monetised and rebased in line with the method set out for valuing the cost of project carbon above.

6.4 COUNTER FACTUAL - AIR QUALITY IMPACT

As with 6.3 but applying the factors for air quality.

6.5 COUNTER FACTUAL - SUMMARY

This section summarises the counterfactual costs set out above. Logic is applied whether or not to include the cost of purchase & installation, O&M and fuel – please refer to the Social IRR

(pre-grant) definition discussion above that sets out why this logic may or may not be included in counterfactual analysis.

The levelized cost, both whole life and T0 (see levelized cost discussion above), are calculated in both real and nominal terms. A dashboard summary section is provided based on the selections made. These are presented in the Customer Detriment Analysis for all customers on the network on the Dashboard.

6.6 SOCIAL IMPACT

This section compares the proposed network cost of carbon and air quality against the counterfactual. A saving is shown as a positive value and worsening is shown as a negative value. Values are presented in the money terms as selected by the user on the dashboard in the customer detriment section.

6.7 PROJECT OFFER AT SOCIAL TIME PREFERENCE

This section evaluates the levelized price of energy that the network is offering across all customers broken down by:

- Connection charge;
- Fixed charge;
- Variable charge;
- Carbon cost;
- Air quality impact

Values are expressed as p/kWh – please see levelized cost section above for detailed discussion and summary explanation of the calculation methodology.

7. CUSTOMER DETRIMENT ANALYSIS - DASHBOARD

This section allows the user on the dashboard to select a specific tariff and analyse the energy network's levelized tariff against the counterfactual tariff.

7.1 DASHBOARD SELECTIONS

This section calls up the selections made by the user on the dashboard relating to the customer detriment analysis section.

7.2 Relevant call ups

This section calls up relevant information relating to the tariff selected using sumif() logic.

7.3 Network scenario levelised tariff – financial

This section calculates the levelized price of the energy relating to the tariff selected by the user on the dashboard in line with the calculations set out in section 6.7 above.

7.4 Network scenario levelised tariff - social cost

This section calculates the tariff selected on the dashboard's share of total project energy demand. Total project air quality and carbon impact costs are allocated in line with that share.

7.5 Counterfactual levelised cost of heating technology and annual maintenance

The purchase, installation and operating cost of the counterfactual is calculated in the same way as set out in section 6.1 but applied to the capacity call ups relevant to the tariff selected.

7.6 Counterfactual levelised cost of fuel

The cost of fuel is calculated in the same way as set out in section 6.2 but applied to the demand call ups relevant to the tariff selected.

7.7 Counterfactual Social impact

The social cost of CO2e and air quality impact is calculated in the same way as set out in sections 6.3 and 6.4 respectively.

7.8 Net social impact of customer tariff

This section calculates the net savings/(additions) of tonnes of CO2e as well as calculating the levelized value of CO2e savings (negative value) and air quality improvement (negative value) of the proposed network offer against the counterfactual.

8. PRIVATE NETWORK TARIFF SALES

8.1. END CUSTOMER ENERGY SUPPLY

This is a call up of end customer demand by energy type and is primarily for reference only.

8.2. CONNECTION CHARGES

Connections (be they dwelling, kW peak, # bathrooms etc.) are called up from <INP_General> by customer. Thy are then summarised by tariff and multiplied by the £000/connection charge entered in <INP_EnergyTypes> against a given tariff. A sensitivity is then applied as set against each tariff in <SYS_Sensitivity>. The charges calculated are then rebased to real and nominal values in line with the methodology described in Fuel Costs above.

8.3. WEIGHTED REAL PRICE INDEXATION

This section is intended to calculate real price weighted operating cost index of the project per kWh of fuel used by the project. The separate fuel and operating cost inflation per kWh of fuel used are called up. Th percentages are then weighted based on the total fuel + operating costs and from this a weighted index is derived.

8.4. ENERGY SALES TO PRIVATE NETWORK - VARIABLE INCOME

The TFM allows up to 30 tariffs and as such the logic described here is repeated 30 times. The variable income as calculated in <CALC_Customers_ANN> is called up at the "Not at risk" vs "At risk" sub-categorisation level within tariff groups. The user, in <INP_EnergyTypes>, will have specified the means of indexation:

Label	Description
Weighted	If weighted has been selected then the real price tariff will escalate in line with the weighted average operating cost base escalation calculated above.
Allocated	If "allocated" has been selected then the fuel index will escalate in line with the real price indexation derived from the fuel selected by the user in proportion to the % allocation set by the user. The operating cost index follows the percentage change as within the

Label	Description
	Weighted real price index calculation and in proportion to the % allocation set by the user. A blended compound index is then derived from these.
Real price index	The compound real price index of the commodity selected is called up from the Fuel Cost section

The called up customer income is then rebased in line with the real price escalation and nominal price escalation assumptions selected by the user following the methodology described in Fuel Costs above.

8.5.　ENERGY SALES TO PRIVATE NETWORK - FIXED INCOME

As with variable income but calling up the fixed income from <CALC_Customers_ANN>

8.6.　SUMMARY OF PRIVATE NETWORK TARIFF SALES (RETAIL BUSINESS INCOME)

This summarises the private energy network income, applies the bad debt assumption and presents the summarised income in a corkscrew account with the balance sheet carried forward position adopting the receivable days assumption within the model applied to the in period income recognised less bad debt.

9.　GRID EXPORTS

9.1 ENERGY EXPORTED TO EXTERNAL NETWORKS (E.G. NATIONAL GRID)

Excess energy calculated in <CALC_EBalance> to be exported to wider energy networks are called up in kWh values. They are then multiplied by the p/kWh marginal price forecast to be achieved to give export value expressed in £000.

9.2 EXPORT VALUE

This section rebases the cash flows (see Fuel Costs above), applies the TFM's bad debt assumption for wider grid exports and applies the debtor day assumption to the carry forward balance based on the in period income.

10.　ENERGY EFFICIENCY MEASURES MONETISED

This section is designed to calculate the income and costs associated with monetising energy efficiency measures for up to five customers connected to the energy network.

10.1　CUSTOMERS 1-5

Up to 5 customers on the energy network can be modelled in the TFM to have energy efficiency measures implemented and monetised by the network. As such these calculations are repeated 5 times.

SAVINGS

The TFM calls up the input energy (fuel) that would have been consumed had the energy efficiency measures not been implemented – this has been calculated in <INP_EBalance> as part of the user inputs. The calculations then call up the marginal and fixed costs associated with the energy type that has been saved. The sum of these two costs are then rebased in line with the standard calculations within the TFM (see Fuel Costs) to give the real and nominal energy cost savings.

A flag is derived based on the user selections in <INP_EBalance> as to the length of the energy efficiency contract between the energy consumer and the project company. Over this contract period the savings calculated are multiplied by the % allocated to the ESCo to give the income associated with the energy efficiency measures that would be payable by the energy consumer to the project company for installing energy efficiency measures.

CAPITAL COSTS OF MEASURES

The capex of the energy efficiency measures borne by the project company are called up and rebased in line with the standard calculations within the TFM (see Fuel Costs) to give the real and nominal capex values. The capex sensitivities applied in the TFM to generation, distribution and retail type capex are applied depending on which category of asset class the EE measures are allocated to. It should be noted that this classification is primarily for the purposes of attributing the costs incurred to the user's required project company. For example, if two companies have been established in the model – a generator and a separate company responsible for energy distribution and all customer interfacing – then the energy efficiency capex would be best placed to be allocated to "retail" on the basis that the latter company would be responsible for the EE measures and against which "retail" capex expenditure will likely have been allocated in <INP_General>.

Capex corkscrew accounts, reflective of both the asset and liability, are used and correspond to the capex corkscrew accounts described above in section 2.

OPERATING COST OF MEASURES

The operation and maintenance costs associated with the energy efficiency measures are called up and rebased in line with the standard calculations within the TFM (see Fuel Costs) to give the real and nominal values. These are summarised below into accounting corkscrew accounts.

10.6   ENERGY EFFICIENCY SUMMARY

The income, capex and opex attributable to the project company delivering the energy efficiency measures are summarised in this section into corkscrew accounts split across "generation", "distribution" and "retail". The purpose of this allocation is to enable the income and associated costs to be moved across one of the three operating companies permissible within the TFM depending on the user's allocation of asset classes.

11.   OTHER INCOME

Other income allows the user to enter income that is not modelled in the TFM. This could be for projects with access to wider income sources such as ancillary services to the National

Grid, legacy subsidy income through the Renewable Heat Incentive, or other such income streams that will be available to the project but that would otherwise be missed by the TFM.

The calculations involve calling up the user inputs, rebasing in line with the TFM standard calculations (see Fuel Costs) and allocating to relevant corkscrew accounts split across "generation", "distribution" and "retail" for the reasons set out in section 10.6 above.

12. PROJECT CASH FLOWS AND METRICS

This section undertakes the core project metric calculations used in the TFM.

12.1 PROJECT CASH FLOWS

This section calls up all the pre-tax project income and expenses (tax is assessed at a company level not project level). A cash reconciliation to the combined real and nominal cash flow statements (less tax and inter-company transactions) is provided to ensure internal integrity between financial statements and returns analysis.

These cash flows are used for analysis for Dashboard graphical and numerical values.

12.2 PRE-TAX REAL PROJECT/SOCIAL IRR, NPV and PAYBACK

The real pre-tax project cash flows are called up from the previous section. An assessment period, defined by the user on the dashboard, is applied to the cash flows to give the cash flows assessed over the appraisal period. These are then discounted to the first period that a cash flow arises at the pre-tax real discount rate entered in the dashboard returns section. The IRR and sum of the discounted cash flows are calculated with the guess of the IRR calculation being the discount rate assumed.

A simple payback calculation is performed on the pre-tax project cash flows from the year that a cash flow first arises. A discounted payback calculation is performed on the pre-tax project cash flows from the year that a cash flow first arises using the pre-ax real discount rate entered in the dashboard returns section.

The real pre-tax social cash flows are called up from the previous section. The same calculations described above (NPV, IRR, simple payback and discounted payback) are performed on the social cash flows.

12.3 PRE-TAX POST-GRANT REAL PROJECT/SOCIAL IRR, NPV and PAYBACK

As with the previous section but with any grants awarded across each of the three operating companies included.

12.4 PRE-TAX NOMINAL PROJECT/SOCIAL IRR, NPV and PAYBACK

As with section 12.1 but instead of real cash flows the nominal cash flows are called up. Additionally the nominal pre-tax discount rate is used from the dashboard and the appraisal period for NPV and IRR is assessed in line with the nominal pre-tax column on the returns section of the Dahboard.

12.5 PRE-TAX POST-GRANT NOMINAL PROJECT/SOCIAL IRR, NPV and PAYBACK

As with the previous section but with any grants awarded across each of the three operating companies included.

12.6 POST-TAX REAL PROJECT/SOCIAL IRR, NPV and PAYBACK

The TFM calls up the real cash payments relating to corporation tax, business rates and irrecoverable VAT across the three operating companies modelled in the TFM and overlays these onto the real project cash flows (see section 12.2).

The NPV, IRR, simple payback, discounted pay back, social IRR, social NPV and simple social payback are calculated over the user defined appraisal period and the post-tax real project discount rate defined by the user for NPV and discounted payback calculations.

It should be noted that the working capital implications of recoverable VAT are not included in this calculation on the basis that VAT returns are generally quarterly and therefore in an annual model

12.7 POST-TAX POST-GRANT REAL PROJECT/SOCIAL IRR, NPV and PAYBACK

As with the previous section but with any grants awarded across each of the three operating companies included.

12.8 POST-TAX NOMINAL PROJECT/SOCIAL IRR, NPV and PAYBACK

As with section 12.6 but with nominal tax related cash flows called up.

12.9 POST-TAX POST-GRANT NOMINAL PROJECT/SOCIAL IRR, NPV and PAYBACK

As with the previous section but with any grants awarded across each of the three operating companies included.

12.10 LEVELISED COST

This section calculates the levelized cost of energy as selected on the dashboard in the project metrics section. The calculation methods follows the logic set out in section *Levelised cost of energy*.

12.11 LEVELISED TARIFF – COMBINED

This section calculates the levelized value of the income streams associated with the energy type selected on the dashboard in the project metrics section (connection, fixed and variable income). The calculation methods follows the logic set out in section *Levelised cost of energy*.

12.12 LEVELISED TARIFF – INDIVIDUAL

This section calculates the levelized value of each of the 30 tariffs that can be entered in the TFM in line with the method set out in the previous section. The values selected by the user on the dashboard are summarised in the next section and then taken to the dashboard (see below).

12.13 LEVELISED TARIFF - COMBINED SUMMARY

This section, using sumif() logic, sets out the levelized connection, fixed and variable income of each of the 30 tariffs as calculated in the previous section. These values are then called up in the "KEY TARIFF VALUES" section of the dashboard.

12.14   CONSISTENCY CHECK WITH TOTAL LCOH CALCULATIONS

This section checks that the discounted connection, fixed and variable income as well as the total energy analysed at an individual level reconciles with the total value analysed in "LEVELISED TARIFF – COMBINED".

13.   DASHBOARD SUPPLEMENTARY ANALYSIS

13.1   OPERATING MARGIN ANALYSIS

This section calls up the operating income and expense of the project and allows the user to select a given year to be analysed on the dashboard in real or nominal terms.

13.1   PLANT MARGIN ANALYSIS

This section is intended to allow the user to assess the marginal operating profitability of each generating plant item.

Cost of imported fuel:

- The marginal cost of fuel for each energy import type of the plant selected on the dashboard is called up;
- The kWh of fuel imports relating to the plant item selected are called up from <CALC_EBalance> "DASHBOARD PLANT MARGIN ANALYSIS – ENERGY" section;
- The marginal cost of the plant's fuel is the cost of import (p/kWh) multiplied by the energy imported divided by 10^5 to give £000 value.

Value of exported energy:

- The total private network sales – kWh – are called up for each energy output from the plant selected;
- Total private network variable income for the output energy from the plant selected. The formula involves choosing the real or variable income as well as including a sumifs() logic whereby both the output energy of the plant and variable income only are called up;
- The variable value (p/kWh) of the output energy is derived from the variable sales and energy sold lines called up. These output energy values represent the total private network value of the energy sold and so could represents more than just plant item selected;
- The same method is applied for any energy exported to wider energy networks (e.g. national grid);
- The weighted average of the private network and grid exports for each of the plant's output energy types is derived with the weighting based on the volume of energy sold;
- The plant's exported energy is then multiplied by the weighted average value of each of the three possible output energy types of the plant selected.

The fuel import (expressed in MWh on the dashboard), fuel import cost, output energy (expressed in MWh on the dashboard) and output energy value calculated are taken to the Plant Margin analysis section on the dashboard and to Chart 12 in the graphical analysis tab (<CALC_Graph_Ann>).

CALC_SOLVES

This tab is exclusively used for the macro-based calculations within the TFM. The TFM is solved using tab <SYS_Sensitivity> which uses sensitivity scenarios to select which line items in the TFM are adjusted by the sensitivity applied (see section below that describes this tab in more detail).

1. CALIBRATE TARIFF

This section is designed to enable the VBA routines "Solve_Tariff" and "Solve_Tariff_To_Value" to operate.

1.1 DASHBOARD CALL UPS
"Solve with" refers to the user selection on the dashboard:

TARIFF CALIBRATION

KEY TARIFF VALUES

Tariff	Energy Type	Demand	Customers						Connection	Fixed	Av. Variable
	Energy	MWh/y	#						£000/con.	£/Day	p/kWh

LEVELISED TARIFF (Whole life, 40YR, Real)

				Connection	Fixed	Variable	Total				
				p/kWh (Real)	p/kWh (Real)	p/kWh (Real)	p/kWh (Real)				
Domestic	LTHW	27,946	3,800	4.58	4.70	3.00	12.28		6.00	1.37	3.00
Commecial	LTHW	9,315	6,618	5.41	11.39	3.00	19.80		1.00	0.46	3.00
Total		37,262	10,418								
kWh weighted average	LTHW			4.79	6.37	3.00	14.16				

SOLVE TARIFF BY TARGET RETURNS   All ▼

KEY METRICS IMPACTED BY TARIFF CHANGE:

	Appraisal	Discount	NPV
	Years	%	£000
Project_real_pre_tax_pre_grant	40	8.00%	(9,601)
Project_real_pre_tax_post_grant	40	8.00%	(9,601)
Project_real_post_tax_pre_grant	40	6.40%	(14,794)
Project_real_post_tax_post_grant	40	6.40%	(14,794)
Project_nominal_pre_tax_pre_grant	40	10.70%	(10,906)
Project_nominal_pre_tax_post_grant	40	10.70%	(10,906)
Project_nominal_post_tax_pre_grant	40	9.06%	(15,322)
Project_nominal_post_tax_post_grant	40	9.06%	(15,322)
Social_real_pre_tax	40	8.00%	(18,531)
Social_real_post_tax	40	6.40%	(19,435)
Social_nominal_pre_tax	40	10.70%	(24,310)
Social_nominal_post_tax	40	9.06%	(24,458)
Levered_NPV OpCo1	40	3.50%	(3,219)
Social Equity NPV OpCo1	40	3.50%	(13,516)
Investor NPV @ cost of equity	40	3.50%	(16,994)
Blended Investor NPV	40	3.50%	(16,994)

Domestic
Commecial   C L E A R

Recovery period:	years	40	SOLVE TARIFF
Solve tariff on real or nominal basis:	R/N	Real	
Whole life or T0 solve?	list	Whole life	UPDATE TARIFF
Solve with:	list	Variable	
Solve to:	list	Project_real_pre_tax_post_grant	

SOLVE TARIFF BY TARGET PRICE

All LTHW levelised tariff values:

Connection	Fixed	Variable	Total
p/kWh (Real)	p/kWh (Real)	p/kWh (Real)	p/kWh (Real)
-	-	3.00	3.00

Temporary values for user:

4.42	5.70
4.53	4.07

Solve to:	p/kWh	4.44	SOLVE TARIFF
Solve to all tariffs combined?	T/F	TRUE	UPDATE TARIFF

Against each of the possible user selections (Connection, fixed, variable, connection + fixed etc.) the solve section has been calibrated to reflect the combination of connection, fixed and variable income streams that could be varied to achieve a targeted outcome in the TFM:

		Connection	Fixed	Variable
Connection	T/F	TRUE	FALSE	FALSE
Fixed	T/F	FALSE	TRUE	FALSE
Variable	T/F	FALSE	FALSE	TRUE
Connection + Fixed	T/F	TRUE	TRUE	FALSE
Connection + Variable	T/F	TRUE	FALSE	TRUE
Fixed + Variable	T/F	FALSE	TRUE	TRUE
Total	T/F	TRUE	TRUE	TRUE

These should not be changed by the user as doing so will result in values being changed by the TFM that would not correspond to the user selection of what should be changed.

The next section shows the tariffs that have been selected in the multi-select listbox on the dashboard. When the user selects an item in the listbox (*lbTariffSelect*) this triggers the VBA

routine "Tariff_Listbox" which updates the range "rngTariffSelected" to show a "TRUE" or "FALSE" value against each of the tariffs in the TFM that have been selected or not respectively in the listbox:

Tariffs selected					User selected	Solve for	Connection	
Domestic	LTHW		£000	Real	FALSE	FALSE	FALSE	1
Commecial	LTHW		£000	Real	TRUE	FALSE	FALSE	2
-	-		£000	Real		FALSE	FALSE	3
-	-		£000	Real		FALSE	FALSE	4
-	-		£000	Real		FALSE	FALSE	5

The column "Solve for" checks whether the user's selected "Solve with" includes connection income to be changed. If the user has selected a tariff and the "Solve with" selection includes connection income being changed then the column "Connection" will show that the tariff needs to be adjusted for connection income (in addition to fixed/variable depending on what has been selected to be changed). This logic is repeated for fixed and variable income adjustment by tariff in the two sub-sections below.

1.2 SOLVE

This section calls up all of the different NPV values calculated by the TFM and selects the live NPV value selected by the user on the dashboard (highlighted green on the dashboard). The selected value is named "dcTariffCurrent" and is used in the VBA routine "Solve_Tariff" to gauge the effect of changing "dcSensitivity" on its proximity to the target value "dcTariffTarget". The default target value is £0 on the basis that an NPV=£0 is presumed to be the user's target when solving for NPV.

Targeted		£000	NPV	(9,601)	
Target		£000	NPV	-	
Sensitivity		List item	Indiviudal tariff		4

The "Sensitivity" is a default sensitivity scenario selection and has been calibrated in <SYS_Sensitivity> to reflect the listbox and "Solve with" selections on the dashboard as calculated in section 1.1 immediately above.

1.3 TARIFF MIGRATION

When either VBA routine "Solve_Tariff" or "Solve_Tariff_To_Value" have found a solution the user can run VBA routine "Migrate_Tariff" to copy the values of this section to the tariff section in <INP_EnergyTypes> and revert the sensitivity to its position prior to the tariff sensitivity being run.

1.4 TARGET TARIFF SOLVE

This section is designed to allow the user to target a specific levelized value for either individual connection, variable or fixed income against tariffs selected on the dashboard or combining them together.

For example the levelized value of connection fees may be 1.5p/kWh, fixed income 2.0p/kWh and variable of 3.0p/kWh giving a combined levelized tariff of 6.5p/kWh. If analysis suggested that a target combined tariff of 10.0p/kWh was needed but that the variable price of 3.0p/kWh should not be changed, then the user could select "Solve to all tariffs combined?" as "TRUE", set the target value as 10.00p/kWh and "Solve with" to one of the following "Connection",

"Fixed" or "Connection + fixed" depending on what was deemed most appropriate. Alternatively the user could set "Solve to all tariffs combined?" as "FALSE" and then set the target value to 5.5p/kWh and the "Solve with" to "Fixed". In this way the TFM would adjust the fixed only component of the tariff and elevate it 3.5p/kWh with the result that the overall tariff achieves 10.00p/kWh.

While this logic may appear at first glance to be similar but approached from opposite ends its relevance is felt when tariffs need to be built up incrementally, first adjusting say the variable, then fixed and finally connection.

The calculations call up all connection, fixed and variable income as well as energy demanded relating to the tariffs selected. These are expressed in either real or nominal terms depending on the user selection. The monetary values are then discounted at either the pre-tax real or nominal discount rate depending on the user's selected money terms. The energy values are always discounted at the real discount rate (see levelized cost section above for rationale).

The levelized value selected and the target levelized value is multiplied by 10^3 to increase the accuracy of the solve from 0.1 (the TFM's default model tolerance) to 0.0001p/kWh.

2. TARIFF SENSITIVITY ON DASHBOARD

This section provides the workings for the VBA routines "tariff_sens_dash" and "Tariff_Tornado_Sens".

2.1 DASHBOARD CALL UPS

This calls up the user selections on the dashboard: money terms and sensitivity to apply (default 10%). The VBA routine "tariff_sens_dash" stores the previous sensitivity applied (if any) and the sensitivity scenario that was previously selected in range "drngTariffPrevious".

2.2 MACRO OUTPUTS

LIVE CALCUALTIONS

Impact of change on:		Live		Real	Nominal
Av. Annual Fuel costs		(1,735)		(1,735)	(2,695)
Av. Annual Electricity income	Electricity	-		-	-
Av. Annual Heat income	Heat	3,692		3,692	5,784
Av. Annual Cooling income	Cooling	-		-	-
Project NPV (pre-tax)		(9,601)		(9,601)	(10,906)
Carbon impact - 15Yr Total (TCO2e)		2,961			

TARIFF IMPACT EXTRACTS

Efficiency Sensitivity	Match	Tariffs	6	
Impact of change on:		Pre-Sens	No-Sens	Post-Sens
Av. Annual Fuel costs		(1,735)	(1,735)	(1,735)
Av. Annual Electricity income		-	-	-
Av. Annual Heat income		3,692	3,692	3,323
Av. Annual Cooling income		-	-	-
Project NPV (pre-tax)		(9,601)	(9,601)	(12,594)
Carbon impact - 15Yr Total (TCO2e)		2,961	2,961	2,961

Percentage of grid export				
Is the Project NPV within tolerance of live?		0	0	1 OK

The VBA routine "tariff_sens_dash" stores the TFM's live values for discounted fuel, energy income, project NPV and carbon impact prior to making a change to the TFM's sensitivity value ("Pre-sens" column). A 0% sensitivity is then applied and the calculated output values are stored ("No-Sens") column. The user defined sensitivity is then applied and these values are

stored ("Post-Sens"). The routine then reverts the TFM back to the sensitivity applied prior to the routine being run. A check is maintained to ensure that at least 1 of macro stored project NPV value corresponds to the live NPV. If it does not then the macro warning will show in the top left of every worksheet.

2.3 TARIFF TORNADO CHART

The same logic applies as per the pervious section; however, in VBA routine "Tariff_Tornado_Sens" the macro loops through each tariff and adjusts each individually by the sensitivity applied, stores th overall project NPV and then ranks the tariff that has largest impact on project NPV. These values are taken to a horizontal bar chart on the dashboard's sensitivity section to show which tariffs have the largest impact on overall returns.

3. CAPEX SENSITIVITY ON DASHBOARD

As with section 2.2 above but relating to VBA routine "Capex_Sens_DASH"

4. FUEL SENSITIVITY ON DASHBOARD

As with section 2.2 above but relating to VBA routine "Fuel_sens_dash"

5. O&M SENSITIVITY ON DASHBOARD

As with section 2.2 above but relating to VBA routine "OM_Sens_Dash"

6. PROJECT SOLVER

The project solver can be found in the "PROJECT CASH FLOW RISK ANALYSIS" section of the dashboard:

It is intended to allow the user solve the TFM by calibrating sensitivity scenario "Project Model Solver" in tab <SYS_Sensitivity>. The user might choose to focus on a combination of different model variables that he/she calibrates. For example, a user may wish to undertake break even analysis to understand how much would operating costs (fuel + O&M) have to change in order

to meet a pre-tax project NPV. By calibrating sensitivity scenario "Project Model Solver" to show TRUE against "Operating costs" and "Cost of Fuel" this could be achieved. Equally for capex, financing structure and other key cash flows in the TFM.

The calculations in <CALC_Solves> in this section simply call up the selected live NPV calculated by the TFM. When the user presses "SOLVE" the VBA routine "Model_Solver_Solve" is run. The macro switches the sensitivity scenario to "Project Model Solver" and then adjusts dcSensitivity until such point that the live NPV = 0 using goalseek logic.

The resulting sensitivity adjustment is then stored in "sysProjectModelSolveOutput" on the dashboard (the green cell shown above labelled "Solved adjustment:"). One complete the user can restore the TFM back to the pre-sensitivity state by pressing "RESTORE" or "UNDO SENSITIVITY" on the dashboard.

7. MODEL FINANCING SOLVER

This solver is located in the financing section of the dashboard:

The solver operates in the same way as the project solver with a few minor differences:

- The sensitivity logic is more defined in that there are pre-calibrated scenarios for solving by changing grants, loans or the selected investor's share of dividends vs. their upfront investment;
- The "solve by" logic focuses on investor returns: pure equity or blended equity returns (i.e. investor share capital + share holder loans); and
- The "solve to" allows for solving NPV = 0, Social NPV = 0, achieving a simple payback over the investor's appraisal period and solving to a discounted payback over the investor's appraisal period.

It should be noted that solving on the basis of a payback (simple or discounted) may struggle to be solved by the TFM if the project cash flows do not extend beyond the appraisal period set. For example, if the user has set an investor appraisal period of 40 years and entered 40

years of project cash flows & energy balance then it is improbable that the TFM could solve for this. Instead, 50-60 years of cash flows would be needed and the starting position relatively close to the solution using the TFM to finesse the final solution having manually adjusted to achieve a close but not exact approximation to the target payback period.

The VBA routine used for this solver is: "Model_Financial_Solver_Solve".

CALC_Graph_Ann

This worksheet calls up relevant data from the TFM for graphical analysis on the dashboard. All graphs, almost without exception, have dedicated range names allowing for dynamic analysis depending on user selections of money values and periods over which graphical analysis is shown. The named range convention is as follows:

- Pre-fix of "gphG" and then the graph number
- Cashflows/energy values called up have a start cell labelled as [prefix][graph number] followed by "CF" [cash flow number] and "Start"
- The dynamic range names take the start value and offsets it by the number of years to the analysis start year. The offset then includes the number of years from the end year to the start year thereby dynamically flexing the value range analysed based on the user's selection.
- The naming convention for the dynamic range name is [prefix][graph number]["CF"][cash flow number] – e.g. gphG12CF1

Each graph is not discussed in detail as it is viewed that they are self-explanatory being principally call-ups of calculations explained elsewhere in this document with calculations focussed on selecting monetary terms (real vs. nominal).

OpCo[x]

The OpCo worksheets are identical in all bar the value in cell I5 which corresponds to the OpCo number (1-3):

Sheet Integrity checks:	OK
Sheet Warnings:	OK
Money indexation applied?	TRUE
OpCo	1

The purpose of the OpCo worksheets is to:

- allocate project expenses;
- establish inter-company charging by those companies which do not hold end customer relations on the private energy network (as defined by <INP_EnergyTypes> "Allocate private network to:" selection);
- allocate pre-tax finance (debt, leasing, loans and reserves);
- calculate the estimated tax position of the company;
- derive the balancing equity investment requirements; and
- calculate company and investor level returns analysis

1. PROJECT COST BASE AND ASSOCIATED WORKING CAPITAL

This section sets out which capital and operating expenses an operating company is modelled to incur. For simplicity's sake costs (and revenue) in the TFM are allocated across one of three umbrella categories:

- Generation;
- Distribution; and
- Retail

The user in <INP_General> "Legal Structure – Legal Entities" selects which operating company (OpCo) is allocated cash flows attributed to each:

LEGAL ENTITIES			

Asset Allocation	OpCo1	OpCo2	OpCo3
Generation	TRUE	FALSE	FALSE
Distribution	TRUE	FALSE	FALSE
Retail	TRUE	FALSE	FALSE

The default is that all cash flows are allocated to OpCo1; however, this can be amended by the user in that section of <INP_General> should an unbundled structure be analysed.

1.1 ALLOCATION OF CASH FLOWS

This section calls up whether Generation, Distribution or Retail cash flows have been allocated to the OpCo.

1.2 GENERATION

This section calls up the real and nominal generation related capex, O&M and fuel. Capex and O&M call ups also include capex and O&M associated with energy efficiency measures undertaken. The called up values are multiplied by the "TRUE" or "FALSE" of the inclusion of Generation related cash flows in the previous section.

1.3 DISTRIBUTION

This section calls up the real and nominal distribution related capex and O&M. Capex and O&M call ups also include capex and O&M associated with energy efficiency measures undertaken. The called up values are multiplied by the "TRUE" or "FALSE" of the inclusion of Distribution related cash flows in the previous section.

1.4 RETAIL

This section calls up the real and nominal retail related capex and O&M. Capex and O&M call ups also include capex and O&M associated with energy efficiency measures undertaken. The called up values are multiplied by the "TRUE" or "FALSE" of the inclusion of Retail related cash flows in the previous section.

1.5 CAPEX, O&M and FUEL ACCOUNTING SUMMARY

The capex, O&M and fuel corkscrew accounts relating to Generation, Distribution and Retail call ups are summarised into real and nominal corkscrew accounts.

1.6 CLIMATE CHANGE LEVY PAYABLE BY GENERATOR

CCL payable for fuel imports is allocated to the OpCo to which Generation cashflows has been allocated. The values from the CALC_Project_ANN relating to CCL are called up in real and nominal terms.

1.7 SUMMARY PROJECT COST BASE FOR SUBSEQUENT CALCS SHOULD RETAIL INCOME NOT BE IN OPCO

The cash costs are summarised in this section and are used in determining inter-company charging calculations below.

2. REVENUE STREAMS

2.1 PRIVATE NEWTORK INCOME

Real and nominal private network income (i.e. income from customers on the energy network(s) modelled) is called up from <CALC_Project_ANN> in line with the OpCo allocated private network income. The default TFM assumption is that the OpCo that is allocated Retail cash flows has the B2C relationship; however, this assumption can be changed by the user in <INP_EnergyTypes>:

ONSITE TARIFFS		
Base year	*Year*	2020
Money Index	*Index*	CPI
Allocate private network to:	*select*	Retail

2.2 GRID EXPORTS

As above but with regards to surplus energy sales exported to a wider energy network (e.g. National Grid). The default assumption in the TFM is that the OpCo that is allocated Generation cash flows has the B2B relationship; however this assumption can be changed by the user in <INP_General>:

TARIFFS FOR ENERGY EXPORTED TO NATIONAL GRID		
Base year	*Year*	2020
Index	*Index*	CPI
Allocate national grid income to:	*select*	Generation

2.3 ENERGY EFFICIENCY INCOME

Energy efficiency income in the TFM permits the user to allocate cash flows associated with the five customers modelled for EE measures to a mix of the three categories (Generation, Distribution or

Retail) on the theoretical basis that conceivably EE measures could be borne by a combination of the operating companies modelled and not just one. For this reason there are call ups for income relating to Generation, Distribution and Retail from the Energy Efficiency income calculations in <CALC_Project_ANN> with the OpCo "TRUE" / "FALSE" adjustments made as above based on the allocation of these cash flows to a given OpCo.

The Generation, Distribution and Retail income streams relating to energy efficiency attributable to the OpCo are then summarised in real and nominal corkscrew accounts.

2.4 OTHER INCOME

Other income is called up in the same way as the EE income and summarised also.

2.5 PROJECT INCOME FOR SUBSEQUENT CALCULATIONS

Cash income attributable to the operating company is summarised in this section and are used in determining inter-company charging calculations below.

3. INTER-COMPANY SALES & PURCHASES

3.1 INTER-COMPANY SALES WORKINGS

This section is designed to calculate both an annuit and use of system charge such that the set real and nominal hurdle rate for inter-company sales is achieved. The hurdle rate, appraisal period and method for these i/c sales are set by the user in <INP_General>:

LEGAL ENTITIES			
Asset Allocation	OpCo1	OpCo2	OpCo3
Generation	TRUE	FALSE	FALSE
Distribution	TRUE	FALSE	FALSE
Retail	TRUE	FALSE	FALSE
OpCo Names	Used for labels in Model		
OpCo1	*string* OpCo1		
OpCo2	*string* OpCo2		
OpCo3	*string* OpCo3		
If generation/distribution are separate from retail:	OpCo1	OpCo2	OpCo3
Real pre-tax project return requried	*%* 5.00%	5.00%	5.00%
Nominal pre-tax project return required	*%* 7.62%	7.62%	7.62%
Appraisal period	*Years* 40	40	40
Sales calculation method:	*List* Use of system	Use of system	Use of system

The TFM allows for a sensitivity to be run on inter-company sales target return. As such it is possible, using the Project Model Solver to determine (if solvable) the rate of return that would need to be charged such that the OpCo with the B2C relationship achieves the targeted return.

Annuity

The TFM discounts the costs and income attributed to the OpCo over the assessment period at the sensitised hurdle rate set by the user. This sum of the discounted cash flows therefore represents the present cost of the future cash flows that would need to be met by an annuity

payment. Using excel's built-in annuity calculator the annual charge necessary to provide the equivalent of the present cost calculated as income such that the net present value of income less costs = £0.

A check is included in the TFM to ensure that this logic has been achieved.

Use of system charge

The use of system charge method works on the principles of the T0 levelised cost method described above. A p/kWh value that is modelled to escalate in line with end customer inflation is calculated such that the discounted value (at the sensitised hurdle rate) of the use of system income is equal to present cost of the net costs incurred by the OpCo.

A check is included in the TFM to ensure that this logic has been achieved.

Observation

Generally an annuity will be a challenging form of inter-company expense to the OpCo responsible for paying this charge. This is because many networks are designed for phased growth and therefore would likely struggle with a high early year charging mechanism. The use of system approach would be more aligned with the overall project cash flow growth. As such this method is set as the default method in the TFM; however, such a position would need to be agreed by parties involved and any adjustments required made to the TFM in this section to reflect proposed contractual terms.

3.2 INTER-COMPANY SALES SUMMARY

This section summarises the inter-company sales workings into real and nominal corkscrew accounts. A bad debt assumption is not presumed for this income on the basis that it would be a single B2B relationship and the presumption is that it would be paid.

3.3 INTER-COMPANY PURCHASES SUMMARY

For the company that is set to have the private network income, and therefore liable for inter-company purchases, this section calls up the i/c sales value(s) calculated in section 3.2 above from the other 2 OpCos as an i/c cost. This is done via worksheet <OpCo_Shared>.

4. PRE-TAX FINANCE

4.1 CAPEX SINKING FUND

The capex sinking fund logic is applied if the user sets this logic to TRUE in the TFM. The default assumption is that a sinking fund would not be adopted as it would expensive to do so and future repex of a material nature would form a business investment case of its own at that future date. Such apposition would need to be discussed with advisors and/or internal finance colleagues to consider the appropriateness of requiring the project to pre-finance future repex.

The logic is set in <INP_General>:

REPLACEMENT ASSUMPTIONS

Adopt cash repex associated with UEL assumption in model?	*T/F*	FALSE
Adopt cash sinking fund for repex	*T/F*	TRUE
Annual interest rate assumed achievable for sinking fund	*%*	3%
Annual interest rate achieved by the fund	*%*	3%
Funding look ahead period	*Years*	15

The calculations use an offset function to sum the total amount capex forecast over the lookahead period and discount these cash flows at the interest rate assumed achievable for the sinking fund. The discount rate applied is: $1/[(1+r)^t$ where r is the assumed rate achievable and t is the funding look ahead period.

The present value of the look ahead capex is converted into an annuity using the assumed interest rate achievable and an annuity period of 15 years. This annuity amount is assumed to be cash paid by the project into a reserve account / investment portfolio that is restricted. The growth rate of the fund is calculated by brought forward balance plus in period additions multiplied the annual interest rate achieved by the fund. The rationale for distinguishing "actual" vs. "assumed" in a model that is all based on forecast assumptions is to allow the user to explore the possible implications of presuming a certain level of interest achievable and actually realising something else leading to greater/lesser in period capex payments.

The rationale for using a discount rate that presumes that cash is incurred at the end of the funding look ahead period is that the carrying value of the sinking fund will have been added to with previous period annuity values and will reflect the revalorisation adjustment of each year's worth of interest earned. As such the real and nominal fund should always be sized such that the final capex payment will always be met exactly by the final disbursement from the fund on the basis that the assumed and realised rates of interest are the same.

4.2 GRANTS

The grant inputs are called up and the grant draw down profile plus sensitivity applied is profiled for each of the 8 permissible grants.

In line with IAS 20: Government Grants the grant is amortised through the P&L over the operating life of the network on the basis that the grant was awarded to enable the network as a whole.

An investor summary is also provided for investor analysis.

4.3 LEASES – WORKINGS

This section calculates the accounting and cash implications of assets allocated to Generation, Distribution and Retail being leased. These calculations are summary in nature and are not intended to reflect an actual lease agreement, but rather show the order of magnitude impact of lease / asset financing a portion of assets proposed. It is probable that lessors would look to lease the more moveable plant items that have a resale/re-leasing value and as such care should be taken when assuming lease finance could be made available to a given project.

For each of Generation, Distribution and Retail the calculations are identical. Each sub-section is split into real and nominal calculations which are identical barring the money terms of the called up values.

Flags are used to show the lease start year, the lease period and the end of lease. A counter is used to show the number of years remaining on the lease.

In the first year of the lease the brought forward book value of the asset class (Generation, Distribution or Retail) is called up. In a sale and lease back scenario it is improbable that the lessor or the lessee would agree to valuing the asset at its carrying value as its fair value may be higher or lower. As such the user can enter a discount (-ve percentage) or premium (+ve percentage) in the <INP_General> "Prm./disc.): l'ee to l'or" field:

LEASES								
	% Capex Leased	Prem./(disc.): l'ee to l'or	Lease Start	Lease Duration	Lease type	Purchases by lessor?	Interest charge	.): l'or to l'ee
	%	*%*	*Date*	*Years*	*Opp./Fin.*	*T/F*	*Annual %*	*%*
Generation	20.00%	-15%	01/01/2022	15	Finance lease	TRUE	5.00%	-100%
Distribution								
Retail	20.00%	-15%	01/01/2022	15	Finance lease	TRUE	5.00%	-50%

In the example lease entered above it is assumed that on selling 20% of the assets booked a discount of 15% to the asset carrying value would be given to the lessor. As such 80% of the carrying value would be received as cash and 20% would be booked as a loss to the P&L.

In the event that the user has selected that "Purchases by lessor?" is "TRUE" then the % of capex leased entered multiplied by capex additions are assumed to be borne by the lessor and that the assets purchased are leased to the lessee for the remainder of the lease period.

At the end of the lease term the assets are assumed to be bought back by the project. On the basis that the lease term is expected to broadly match the useful economic life of the assets leased then it would be presumed that something close to a 100% discount on the pre-leasing asset book value of OpCo would be the purchase price of the assets not fully depreciated by the lessee to the lessor.

In the example above it is assumed that a 50% discount is applied to retail assets and 100% to generation. The logic in this example is that the generation assets will have nearly fully depreciated at the point the lessee adopts the lessor's asset; whereas retail assets have, in this example, been purchased by the lessor during the lease period and it has been estimated that of the retail assets leased they have on average lost half their value against total book value.

The annuity value of each year's additions is calculated based on the effective interest rate, the estimated terminal value of the lease (final sale back price valued in the first period of lease payments) and the lease term. A lessor corkscrew account is used to show a summary lessor position; however, this would not be the actual accounting position of the lessor as the annuity has not been split into principal and interest components. Given the TFM is intended solely for the possible lessee, a more formal lessor position was not modelled.

From a lessee perspective, where the user has selected "Finance Lease", the annuity payments in each period are valued at present value on the basis that they continue at that

rate for the remainder of the lease period. In each financial year the difference between the b/f lease liability and the calculated present value of future lease payments over the remainder of the lease term (presumed to be the minimum lease period) are credited to the lease provision. The lease is revalorised at the effective interest rate and the annuity payments deducted. The carrying value of the finance lease liability should always amortise to £0 in the final period of the lease and an integrity check is included. Where this check would fail is if the lease term is set longer than the TFM's maximum 60 years.

Where the user has selected "Operating Lease" the lease charge simply corresponds to the annuity payment.

Capex adjustments are calculated to reflect the proportion of Property, Plant and Equipment on the balance sheet that are leased. These are subtracted from PPE on the balance sheet but are itemised in a sub-group so that the user can see both the amount deducted from the carrying value. Where a finance lease option has been selected the asset side of the lease is held on balance sheet and depreciated over the remainder of the lease term. These two adjustments to PPE can be seen in the example balance sheet extract below:

LONG TERM ASSETS								
Property, plant and equipment		£000	Nominal		-	17,670	17,343	17,253
Fixed assets		£000	Nominal		-	17,670	17,600	17,524
Irrecoverable VAT on fixed assets		£000	Nominal		-	-	-	-
Offset for grant received against capex		£000	Nominal		-	-	-	-
Leased assets capitalised		£000	Nominal		-	-	1,289	1,197
Adjustment for leased assets		£000	Nominal		-	-	(1,546)	(1,467)
Interest capitalised		£000	Nominal		-	-	-	-

4.4 LEASES SUMMARY

This section uses sumif() logic to call up all relevant corkscrew accounts relating to finance/operating leases included within the OpCo modelled.

4.5 LOAN WORKINGS

Up to 8 loans can be modelled within the TFM. The user specifies which Operating Company draws down the loan and which investor has provided the loan. This section of the TFM calculates the drawdown, repayment, interest and accounting treatment of the loans including the treatment of fees associated with loans.

The "PROJECT CASH FLOWS" section summaries the real and nominal project income and expenditure with and without capital expenditure. The relevance of distinguishing between with and without capex is to allow debt service cover ratio (DSCR) calculations to exclude and include capex respectively.

The workings for Loans 1-8 are identical across the three operating company worksheets. The first section of the workings calls up the user inputs from <INP_General>:

LOAN 1			1								
Loan issuer	investor	LOAN 1Loan	1	Third party debt							
Loan receiver	company	LOAN 1Loan	2	OpCo1	1						
Date of issue	date	LOAN 1Date	3	01/04/2027			-	-	-	-	
Loan tenor	years	LOAN 1Loan	4	25			-	-	-	-	
Loan issue fees - % of principal	%	LOAN 1Loan	5	0.00%							
% of issue fees wrapped into debt	%	LOAN 1% of	6	0.00%							
Repayment priority	Senior/junior	LOAN 1Repa	7	Senior							
Method of draw down	method	LOAN 1Meth	8	Bullet							
If bullet:	£000	LOAN 1If bul	9	17,122							
If drawdown profile:	£000	LOAN 1If dra	10				-			-	
Interest type:	fixed/var.	LOAN 1Intere	11	Fixed	1						
If fixed: annual interest rate	%	LOAN 1If fixe	12	4.00%							
If variable: floating rate peg	e.g.LIBOR	LOAN 1If var	13	-	1		0.00%	0.00%	0.00%	0.00%	
If variable: margin over float	%	LOAN 1If var	14	0.00%			0.00%	0.00%	0.00%	0.00%	
Repayment method	method	LOAN 1Repa	15	Mortgage style							
If Balloon - target end value:	£000	LOAN 1If Bal	16	-							
If Cash Sweep - % of available cash	%	LOAN 1If Ca	17	0.00%							
If target cover - in period DSCR ratio	ratio	LOAN 1If targ	18	-							
If repayment profile:	£000	LOAN 1If rep	19				-			-	
Loan repayment start date	date	LOAN 1Loan	20	01/04/2027			-	-	-	-	
Loan interest start date	date	LOAN 1Loan	21	01/04/2027			-	-	-	-	
Forgo interest prior to interest start date?	T/F	LOAN 1Forg	22	FALSE							
Loan sensitivity	%			0.00%							

The workings then set out the loan principal outstanding corkscrew account:

Loan sensitivity	%		0.00%							
b/f principal outstanding	£000					-	-	-	17,978	18,697	19,445
Principal drawdown	£000	Third party debt: Principal d Bullet	1	17,122		-	-	17,122	-	-	-
Interest wrapped into debt (EoP)	£000	Third party debt: Interest wrapped into debt (EoP)		2,152		-	-	685	719	748	-
Fees wrapped into debt	£000	Third party debt: Fees wrapped into debt		171		-	-	171	-	-	-
Principal repayment	£000	Third party debt: Principal r Mortgage sty	2	(19,445)		-	-	-	-	-	(568)
c/f principal outstanding	£000				OK	-	-	17,978	18,697	19,445	18,877

This account shows the carrying value of the loan principal at the balance sheet date ("c/f principal outstanding"). All in year transactions that impact the carrying value of the loan principal are called up from workings below relating to:

- Loan principal that is drawn down;
- Accrued interest that is wrapped into loan principal;
- Fees that are wrapped into loan principal; and
- Loan principal repayments

FEES								
Loan issue fees	£000					-	-	342	-
Fees wrapped into debt (CALC)	£000					-	-	171	-
Fees payable (CALC)	£000					-	-	171	-

Fees associated with the issuance of a loan is a basic calculation of: loan drawn down multiplied by the user input "Loan issue fees - % of principal". "Fees wrapped into debt (CALC)" is the amount of the fees payable that are wrapped into the loan principal. The difference between the total loan issue fees and the fees wrapped into debt are the fees that are payable in the period in which they were calculated ("Fees payable (CALC)").

In line with the accounting requirement to hold debt at its amortised cost (IFRS 9: Financial Instruments) it is necessary to amortise the fees incurred over the life of the loan rather than simply expensing them to the P&L account. As such two corkscrew accounts are used to first calculate the amortisation of the fees to reflect the P&L and balance sheet treatment and a corkscrew account to reflect the cash flow treatment relating to the cash payable in a financial year relating to fees not wrapped into debt:

Periods remaining	years				-	-	25	24
b/f fees capitalised	£000				-	-	-	329
Fees recognised	£000				-	-	342	-
Fees depreciated	£000				-	-	(14)	(14)
c/f fees capitalised	£000				-	-	329	315
b/f Fees payable	£000				-	-	-	-
Fees payable	£000				-	-	171	-
Fees paid	£000				-	-	(171)	-
c/f Fees payable	£000				-	-	-	-

Interest is calculated as loan principal b/f plus any draw downs (assumed first day of the year) multiplied by the interest rate in the period (either fixed rate or floating rate + interest rate margin). Like fees, interest can be wrapped into debt based on user selections. From an accounting perspective, IAS 23: Borrowing Costs requires interest accrued during construction to be capitalised. As such calculations for interest first calculate the interest accrued. The debit is taken to Property, Plant and Equipment (PPE) in periods during construction and to interest expense in the P&L for operating periods (or pre-construction if applicable). The credit is taken to principal outstanding for periods where interest is wrapped into debt and to interest payable for all other periods:

INTEREST						
Interest rate	%		0.00%	0.00%	4.00%	4.00%
Interest payment period	Flag		-	-	-	-
Interest wrapped into debt period	Flag		-	-	1	1
Interest charge	£000		-	-	685	719
Construction period	Flag		-	-	-	1
Interest capitalised	£000		-	-	-	719
Interest expensed to P&L	£000		-	-	685	-
Interest wrapped into debt period	£000		-	-	685	719
Interest payment	£000	Third party debt: Interest payment	-	-	-	-

The next series of calculations set out the variety of repayment methods that can be modelled within the TFM:

Debt principal repayment	
Bullet	This method repays the principal outstanding at the end of the loan's tenor
Balloon	This method amortises the loan principal following the mortgage style of repayment to the value set by the user and repays the resulting balance as a bullet payment at the end of the loan's tenor
Mortgage style	This method amortises the loan principal such that in every period the principal + interest is the same (where the user sets a forward interest rate curve that differs period-by-period this will not hold true but the loan will fully amortise)
Target Cover Ratio	This method targets a DSCR set by the user. In periods where the debt service would be greater than principal + interest payable then the calculations are limited to the principal outstanding. It should be noted that the Cash Flow Available to Debt Service (CFADS) exclude capex.

In the event that a user has selected debt to be "SENIOR" in <INP_General> then the target cover ration will treat CFADS as cash flow before any other debt service payments have been made. Should the user select "JUNIOR" in <INP_General> then loans allocated to a given OpCo that come prior to the loan calculated will be assumed to have been serviced (principal and interest paid) prior to the debt service obligations of the loan calculated. |

Cash sweep	This method takes the percentage set by the user and applies it to the cash available to debt service as calculated in the Target Cover Ratio. In the final period of the loan any outstanding balance is repaid in full. It should be noted that the cash sweep method excludes the impact of capex and is calculated on a pre-tax basis. As such it is a simplification and intended to allow a user to begin to solve a bespoke repayment profile dependent on pre-tax cash available but further modelling would be required if such a repayment method was to be sought. It is therefore not recommended to adopt a cash sweep assumption of 100% and a profile would need to be manually inserted by a competent financial modeller if a cash sweep exactly matching post-tax CFADS was to be sought. In such an event the "Profile" method would most likely be the more appropriate method for developing a bespoke principal repayment profile.
Profile	The user can profile his/her own repayment profile. The total repayment amounts must exactly equal the amount drawn down or else there will be an input error flagged by the TFM. To the extent that interest is wrapped into debt calculations for its repayment are overlaid in line with the % of principal repaid as per the user's repayment profile entered.

4.6 LOAN SUMMARY

The first sub-section of the loan summary summarises the accounting treatment of all aspects of the project's 8 possible loans:

ACCOUNTING

b/f principal outstanding	£000			-	-	(17,978)
Principal drawdown	£000		(17,122)	-	(17,122)	-
Interest wrapped into debt (EoP)	£000		(2,131)	-	(685)	(719)
Fees wrapped into debt	£000		(171)	-	(171)	-
Principal repayment	£000		19,423	-	-	532
c/f principal outstanding	£000	OK		-	(17,978)	(18,165)
b/f fees capitalised	£000			-	-	329
Fees recognised	£000		342	-	342	-
Fees depreciated	£000		(342)	-	(14)	(14)
c/f fees capitalised	£000	OK		-	329	315
b/f fees payable	£000			-	-	-
Fees payable	£000		(171)	-	(171)	-
Fees paid	£000		171	-	171	-
c/f fees payable	£000	OK		-	-	-
b/f interest capitalised	£000			-	-	-
Interest capitalised	£000		719	-	-	719
Depreciation	£000		(719)	-	-	(14)
c/f interest capitalised	£000	OK		-	-	706
b/f interest payable	£000			-	-	-
Interest charge	£000		(14,822)	-	(685)	(719)
Interest wrapped into debt (EoP)	£000		2,131	-	685	719
Interest payment	£000		12,692	-	-	-
c/f interest payable	£000	OK		-	-	-

These corkscrew accounts are used to populate the financial statements.

A debt service cover ration section calculates the overall debt service cover across the 8 loans. Additionally the user can toggle DSCR analysis that does include capex (Dashboard investor

analysis section). This would be most relevant for projects that have prolonged periods of capex and intend on using debt.

Additionally for periods of debt repayment if the DSCR falls below the user defined DSCR lock up value (<INP_General>: Overarching Debt Principles) then a flag is triggered for a dividend lock, whereby dividends are not made to shareholders in that period.

DEBT SERVICE COVER RATIO (DSCR)								
CFADS	£000	Real	FALSE		-	-	-	3,547
CFADS	£000	Nominal	FALSE		-	-	-	3,709
Principal repayment	£000				-	-	-	532
Principal drawdown	£000				-	-	(17,122)	-
Interest payment	£000				-	-	-	-
Debt service	£000				-	-	(17,122)	532
DSCR	Ratio	Real			-	-	-	6.67
DSCR	Ratio	Nominal			-	-	-	6.97
DSCR used for lock up	Ratio	Real		1	-	-	-	6.67
Dividend lock	Flag	1.00			-	-	-	-

The final section summaries the loans by the investor list in <INP_General>. This allows for investor analysis where they are both lenders to a project and equity investors.

4.7 RESERVES

The TFM allows for a maintenance reserve and a debt service reserve. The user can specify the number of periods lookahead. The look ahead for Operations & Maintenance (O&M) costs and Debt Service (principal + interest) for the maintenance reserve and debt service reserve respectively are calculated using an offset function.

Respective reserves will take and release monies to hold the carry forward balance for a given period at the lookahead value calculated. This is done in real and nominal terms for the maintenance reserve; however, as debt service is always nominal this is only done once. These accounts are held as "restricted cash" within the financial statements.

5. TAXES

The TFM calculates:

- Business rates for District Heat Undertakings;
- VAT;
- Corporation tax; and
- Deferred tax

It should be noted that Climate Change Levy is calculated in the project calculations (<CALC_Project_ANN>). Stamp duty is not calculated but, if land purchases are anticipated, can be incorporated through overheads by the user as a one off cost that they would calculate and enter.

5.1   BUSINESS RATES

Business rates calculations in the TFM are designed to adhere to the Valuation Office Agency (VOA)'s published guidance: *Rating Manual 6 part 3: Section 340: district heat undertakings*[1] which adopts the "Contractor's Method" of estimating the rateable value of a business.

If the operating company is set to own the generation side of the project then an important assessment is whether the generating plant is capable of electricity generation. Under the guidance, Electricity generating plant is exempt from inclusion; however, to the extent that electricity generation is used on site and not exported then that proportion of the cost of the asset is not permitted to be deducted. Calculations in "Electricity generating plant" establish this ratio and call up the carry forward value of each plant item.

The "Asset Valuation" section calls up the accounting carrying value of Property, Plant and Equipment. For real values these are updated in line with the frequency that valuation assessments are undertaken. Nominal calculations further rebase the carrying value in line with a user selected inflation index – default CPI. To the extent that electricity generating plant has been calculated to be permissible to be exempted these costs are removed.

Asset valuation									
Period of operations	flag				-	-	-	1	1
Real									
Asset carrying value at calculation date	£000	Real			-	-	-	6,962	-
Asset carrying value for business rates	£000	Real			-	-	-	6,962	6,962
Adjustment for exempted capex	£000	Real			-	-	-	-	-
Asset carrying value for calculation purposes	£000	Real			-	-	-	6,962	6,962
Nominal									
Asset carrying value at calculation date	£000	Nominal			-	-	-	7,280	-
Indexation selected	factor		CPI	1	1.00	1.02	1.03	1.05	1.06
Indexation applied?	factor				1.00	1.02	1.03	1.05	1.06
Base index at last valuation	factor				-	-	-	1.05	1.05
Period to period factor	factor				-	-	-	1.00	1.02
Asset carrying value for business rates	£000	Nominal			-	-	-	7,280	7,280
Adjustment for exempted capex	£000	Nominal			-	-	-	-	-
Asset carrying value for calculation purposes	£000	Nominal			-	-	-	7,280	7,280
Adjusted carrying value for indexation	£000	Nominal			-	-	-	7,280	7,390

The decapitalisation rate is the rate set by MHCLG that essentially converts an asset's carrying value into an annual equivalent. At the time of writing that rate is 4.40% and therefore this assumption presumes that the average useful remaining economic life of assets is 22.7 years (100/4.4).

The decapitalisation rate is multiplied with the rateable value ("Adjusted carrying value…") to give the "Value subject to BRM" (BRM = Business Rates Multiplier). At the time of writing the BRM is 51.20%. The rateable value is multiplied by the BRM to give the business rats payable.

A final section sets out the accounting corkscrew accounts for business rates for the balance sheet payable (assumed to have no payable days – presumed payable on receipt), cash flow and P&L.

5.2 VAT WORKINGS

The VAT workings calculate VAT payable/receivable on all relevant cash flows in the TFM:

Income:

---

[1] https://www.gov.uk/guidance/rating-manual-section-6-part-3-valuation-of-all-property-classes/section-340-district-heating-undertakings

- Connection charges
- Domestic customer ("At risk") income: fixed + variable
- Non-domestic customer ("Not at risk") income: fixed + variable
- Intercompany sales

Costs:

- Capex
- Opex
- Fuel
- Inter-company purchases

The calculation method for each of the above is identical for each with the exception of irrecoverable VAT which is not relevant for income received from customers. The real and nominal costs are called up and multiplied by the VAT rate selected for that income/cost category in the VAT inputs section of <INP_General>.

The irrecoverable VAT assumption percentage is applied to VAT payable items. Irrecoverable VAT is then treated as a P&L expense in addition to the underlying project cost calculated in <CALC_Project_Ann>. This cost is separately shown within the financial statements.

Recoverable VAT is separately analysed as either VAT Payable or VAT Receivable depending on whether it is VAT on a cost or income respectively. The payable and receivable day assumptions attributed to the respective cost/income are applied for balance sheet treatment and timing of cash flow.

5.3 VAT RETURN, CAPX/O&M/FUEL/IC VAT EXPENSE SUMMARIES

This section presents the VAT return as would be expected – VAT received from sales is shown as payable to HMRC. VAT payable to suppliers that is treated as recoverable is offset against VAT owing to HMRC from sales. The net figure results in either a payment to or from HMRC to the project.

Irrecoverable VAT is called up for respective cost items and presented in summary corkscrew accounts which are taken to the financial statements.

5.4 CORPORATION TAX – WORKINGS

ASSET PURCHASES – TECHNOLOGY: This section calls up the real and nominal capex recognition for individual items of heat/electricity/cooling generating plant as calculated in <CALC_Project_ANN>.

The purpose of these call ups is to enable calculation of specific Enhanced Capital Allowances should the tax regime permit them. It should be noted that it is **incumbent on the user** to refer to the prevailing tax regime and assess the extent to which ECAs may or may not be available for certain types of generating plant.

NON-TECHNOLOGY ASSE PURCHASES: This section calls up all other capex and distinguishes between generation, distribution and retail assets. Additionally calculations show the split with and without assets that have been purchased by a lessor of assets (see lease finance section above). The relevance of this is that it may be possible to claim the capital

allowances for assets that are leased. To the extent that a project has assessed that it is possible to claim capital allowances against assets that are proposed to be leased (for example an energy centre) then it is necessary to distinguish between capex including lessor owned assets leased by the OpCo and capex excluding such assets.

ENHANCED CAPITAL ALLOWANCES: This section calculates the ECAs allocated by the user in the corporation tax section of <INP_General> in both real and nominal money terms. In the event that an ECA is less than 100% of the value of the capex then the user can specify if the balance should be taken to a standard capital allowance pool. It should be noted that in tax regimes where ECAs that are greater than 100% of the capex value the TFM does not take a negative value to a standard capital allowance pool.

The calculation of the ECA is the ECA percentage set by the user multiplied by the capex value multiplied by the TRUE/FALSE switch as to whether an ECA should be applied to the technology.

CAPITAL ALLOWANCE POOLS: The TFM allows for four capital allowance pools that can be defined by the user. The default pools are:

- Main pool – 18% annual writing down allowance assumed
- Special Rate pool – 8% annual writing down allowance assumed
- Single Asset Pool – higher – 18% annual writing down allowance assumed
- Single asset pool – lower – 8% annual writing down allowance assumed

The user is only able to allocate the broad asset categories of generation, distribution and retail assets to the CA pools available. This is a substantial simplification of the management of an asset register for tax calculation purposes. The intention is not to establish an exact calculation for capital allowances but rather provide a high level estimate such that a reasonable estimate can be established and thereby identify the extent to which such assumptions do or do not materially impact returns forecast. To the extent that they do a rationale for allocating resources to further tax analysis can be justified.

Th calculation for establishing capital allowances is as follows:

- Call up the technology additions as per the ECA residual balance workings;
- Call up all other capex additions. If leased assets have been set by the user to be eligible for capital allowances then the relevant call up is made from the NON-TECHNOLOGY ASSET PURCHASES section above
- The capital allowance for the pool is calculated on a reducing balance basis whereby the brought forward carrying balance of the pool plus in period additions are multiplied by the annual writing down allowance allocated by the user to the CA pool

The ECAs and CAs calculated for each period are summarised in CAPITAL ALLOWANC SUMMARY in both real and nominal terms.

PROFITS CHARGEABLE TO CORPORATION TAX: This section calculates the corporation tax payable and manages carried forward losses. A full bridging reconciliation between the P&L profit multiplied by the prevailing tax rate and the PCTCT multiplied by the prevailing tax rate is provided at the bottom of each of the OpCos' financial statements.

The calculation for PCTCT calls up all taxable income and eligible expenses for deduction. One area that would require careful thought by the user is the extent to which shareholder loan interest would or would not be eligible for tax deduction. Thin capitalisation rules can be switched on within the TFM; however, the treatment specifically of shareholder loan interest as a tax deductible item is a complex area that would most likely require professional advice. The TFM can be used to establish the extent to which such a consideration would or would not be material to investment decisions and if so further professional advice sought. If debt cap rules are applied by the user then interest and lease charges are added back. As mentioned above this is intended to provide a materiality check rather than providing an exact computation of debt cap rules for thinly capitalised legal entities.

In the event that asset leasing is modelled, and the useful economic life of leased assets is greater than the lease period then in the event there is a P&L loss on repurchasing the assets this is reflected in the Model as deductible for corporation tax purposes in the period of the repurchase. In reality a capital loss pool would be established, and those losses offset against any future capital gains. The approach taken is therefore a simplification and is done so as such scenarios are somewhat theoretical and would overcomplicate the calculations.

A further simplification is the treatment of interest payable on the overdraft facility should such a facility be switched on within the Model. Interest payable on an overdraft would be expected to be tax deductible and therefore included within the PCTCT calculation. This is not done in the Model to avoid the need for a macro to solve tax: there is an inherent circularity in that the overdraft's size is influenced by corporation tax payable and corporation tax payable is influenced by the level of interest payable. To avoid this circularity interest on the overdraft was simply removed on the basis that with current low interest rates and an expectation of few projects seeking large overdrafts to be used, this simplification was considered immaterial.

Having established the in period PCTCT the TFM then logs the number of years of consecutive losses before capital allowances are applied. The purpose of this is because certain tax regimes will not permit losses to be carried forward if a certain number of years of consecutive taxable losses have occurred. The TFM's default value is 5 years but the user would need to confirm the appropriateness of this assumption based on prevailing UK (or relevant country's tax regime). To switch this logic off simply set the number of permitted years to 60 – the TFM's number of years.

Number of pre-CA years @ consecutive loss	years		-	-	-	-
Has max. # consecutive losses years been exceeded'	t/f	5	-	-	-	-
Can losses be taken in period?	t/f		1	1	1	1

Capital allowances are then deducted from the PCTCT calculated. If the PCTCT less the CA is less than 0 then the losses are taken to the carry forward losses corkscrew account if losses can be taken in the period (see previous paragraph). If the PCTCT less the CA is positive and there are carry forward losses then the lesser of the losses carried forward available and the profit recognised are subtracted against the PCTCT less CA value:

PCTCT - after capital allowances	£000	Real		-	-	-	2,171	(1,975)
b/f losses	£000	Real		-	-	-	-	-
Losses recongised	£000	Real		-	-	-	-	1,975
Losses utilised	£000	Real		-	-	-	-	-
c/f losses	£000	Real		-	-	-	-	1,975
PCTCT - after utilisation of losses	£000	Real		-	-	-	2,171	-

If corporation tax logic has been applied in the TFM then the "PCTCT – after utilisation of losses" is multiplied by the TFM's prevailing rate of corporation tax. Tax is presumed paid in the period in which they arise and as such no cross financial year working capital assumptions are applied to the calculated payable.

5.5 CORPORATION TAX – SUMMARY

This section calls up the real and nominal corporation tax summary corkscrew accounts that capture the P&L, cash flow and balance sheet treatment of corporation tax calculations. These values are taken to the respective OpCo's financial statements.

5.6 DEFERRED TAX – WORKINGS

BALANCE SHEET ACCOUNTING VALUE: this section calls up the technology capex additions and checks that the called up values plus other capex items are internally consistent with the OpCo's capex additions. Due to the availability within the TFM for Enhanced Capital allowances <u>and</u> standard capital allowances this creates the possibility of permanent timing differences between capital allowances and accounting depreciation across two assumptions (the ECA percentage and the CAs writing down value). This section provides sufficient analysis to allow for that peremanent different to be established.

PERMANENT TIMING DIFFERENCS: this section establishes the permanent timing difference for each item of generating plant. It does so by establishing whether an ECA has been applied and the % of the residual balance taken to a capital allowance pool. To the extent that the combined ECA + CA is less than 100% then that would give rise to a permanent timing difference. Per IAS 12: deferred tax, a deferred tax asset/liability should only be shown with regards temporary timing differences. As such the calculated permanent timing difference asset carrying values need to be deducted from the accounting carrying value of assets in order to calculate the deferred tax asset/liability.

5.7 DEFERRED TAX – SUMMARY

The carrying value of the Operating Company's fixed assets for tax computation is the sum of the carrying value of the capital allowance pools (see Corporation tax workings above). The carrying value of the Operating Company's fixed assets for accounting purposes is as per the financial statements less the carrying value of assets assessed to represent permanent timing differences.

To the extent that the carrying value of the tax base of the assets is greater than the accounting base then a deferred tax asset would be recognised as this would suggest that the financial accounts have recognised a greater expense through the P&L than has been deducted through CA's through the tax computation. As such the financial statements, in a period where a deferred tax asset is recognised on balance sheet, anticipate a future surplus in capital allowances reducing corporation tax payable relative to the depreciation recognised in the financial accounts.

The inverse of this applies where the carrying value of the tax base of the assets is less than the accounting base, where a deferred tax liability would be recognised as this would suggest that the financial accounts have recognised a lesser expense through the P&L than has been deducted through CA's in the tax computation. As such the financial statements, in a period

where a deferred tax liability is recognised on balance sheet, anticipate a future deficit in capital allowances increasing corporation tax payable relative to the depreciation recognised in the financial accounts.

The deferred tax asset/liability is calculated by multiplying the difference of the two asset carrying values by the prevailing tax rate. Deferred tax income/charge is recognised in the P&L as the year-on-year movement between the balance sheet carrying value of deferrd tax.

6. POST-TAX FINANCE

This section calculates finance that is impacted by taxes payable. In the TFM this is specifically an overdraft facility (if applied) and share capital. It should be noted that the TFM treats share capital the source of capital that will make up any shortfall in cash flows. However, the TFM will raise a model warning if an investor's committed and contingent equity available is breached.

6.1 CASH WATERFALL
This section calls up all of the project, financing and tax related cash flows for the OpCo. #

6.2 OVERDRAFT FACILITY
Each OpCo can have an overdraft facility set by the user. In periods where there are negative cash movements the calculations allow the lesser of the maximum facility less the opening balance of the overdraft and negative cash movement.

Repayment of the overdraft is based on the percentage cash sweep of cash flows available (i.e. post-tax post-finance pre-equity). The lesser of the % of free cash and outstanding balance is selected.

Interest payable on the brought forward balance plus additions in the year is calculated by multiplying with the user defined annual o/d interest rate. It should be noted that interest calculated is not included within the PCTCT computation. This is a simplification to avoid an inherent circularity. Such an approach is adopted (rather than employing a copy/paste value macro for the PCTCT computation) on the basis that an overdraft interest is expected to form an immaterial source of finance. If substantial sums are anticipated then it is recommended to model the overdraft using the loan instruments available.

6.3 OVERDRAFT FACILITY
FUNDING: This section calculates the share capital drawn down to meet OpCo funding deficits. It also calls up distributions (dividends) made to shareholders calculated in the subsequent section.

A corkscrew account is used to monitor free cash to equity, cash injections by equity and distributions made to equity. In essence this is a summary of the OpCo's cash flow statement:

b/f internal cash reserve available for funding	£000	Real		-	-	-	-	-
Cash to / (required from) equity	£000	Real		-	-	-	5,897	(7,020)
Equity drawn down	£000	Real		-	-	-	-	7,020
Distributions made to equity	£000	Real		-	-	-	(5,897)	-
c/f internal cash reserve available for funding	£000	Real		-	-	-	-	-

A second corkscrew account is used to monitor the cumulative share capital invested by all investor's in the OpCo. This corkscrew account therefore represents the OpCo's share capital.

In th final period of operations it is assumed the company is wound up and the share capital is recycled to the P&L.

b/f share capital	£000	Real		-	-	-	-	-	7,020
Additions	£000	Real		-	-	-	-	7,020	2,646
Final write off of share capital	£000	Real		-	-	-	-	-	-
c/f share capital	£000	Real		-	-	-	-	7,020	9,666

Subsequent calculations analyse the individual shareholder investment into the OpCo and the extent to which committed/available equity and contingent equity have been utilised. If the total required exceeds these two values added together then a model warning will show in the top left of the screen.

SHARE OF RETURNS: This section calculates the maximum cash dividend that could be awarded and assesses how the dividend is split between the OpCo's investors. The maximum cash dividend is essentially periods where there is cash available (i.e. positive cash flow).

The P&L account including distributions to equity is presented in a corkscrew account:

b/f distributable reserves	£000	Real		-	-	-	-
In period Profit / Loss (P&L)	£000	Real		-	-	-	2,868
Dividends made	£000	Real		-	-	-	(5,897)
c/f distributable reserves	£000	Real		-	-	-	(3,029)

If the user has selected that the TFM should adhere to the Companies' Act requirement that dividends should be limited to the lesser of cash available and distributable reserves, then this logic is applied when assessing the distribution to equity to be made. If this logic is switched off then the TFM will allocate the full cash available multiplied by the user defined % of cash available that should be distributed.

> *The rationale for switching off the Companies' Act requirement would be to allow the user to see evaluate the materiality of any potential dividend traps and consider, with professional advice, capital structuring options that may legally liberate cash available to investors.*
>
> *The rationale for applying a manual % adjustment in <INP_General> could be for a number of reasons, one being that while cash might be available in an early period (e.g. due to a large connection fee) it might not be prudent / permitted to liberate those funds if further capex is required in the short term. The user can therefore adjust the cash taken to equity to reflect project specific requirements that could not be reasonably modelled.*

The calculations also check whether a dividend lock has been applied as a result of the loan covenant on DSCR having been breached in a given period.

6.4 INVESTOR ANALYSIS

This section summarises the equity cash flows across share capital drawn down, contingent equity drawn down, shortfall equity drawn down and dividends attributable to the investor. These are for the purpose of investor summary analysis on the dashboard.

7. RETURNS ANALYSIS

7.1 KEY CASH FLOWS

This section calls up the key cash flows:

- Pre-tax OpCo project cash flows
- Pre-tax post grant OpCo project cash flows
- Post-tax post grant OpCo project cash flows
- Post-tax post grant post finance OpCo cash flows

The final item should reconcile fully to the cash waterfall in section 6.1 above. An integrity check is provided to ensure this occurs.

7.2 OPCO WEIGHTED AVERAGE COST OF CAPITAL

This section calls up all forms of finance that bear a charge:

- Lease finance
- Debt finance
- Share capital

The real and nominal weightings are calculated and a weighted average cost of capital calculated. This is presented on the investor section of the dashboard.

7.3 PRE-TAX PROJECT CASH FLOW

The IRR, NPV and simple & discounted payback are calculated on the pre-tax project cash flows

7.4 PRE-TAX POST-GRANT PROJECT CASH FLOW

The IRR, NPV and simple & discounted payback are calculated on the pre-tax post-grant project cash flows

7.5 POST-TAX POST-GRANT PROJECT CASH FLOW

The IRR, NPV and simple & discounted payback are calculated on the post-tax post-grant project cash flows

7.6 LEVERED EQUITY RETURN

The IRR, NPV and simple & discounted payback are calculated on the post-tax post-grant post-finance cash flows

7.7 SOCIAL EQUITY

In order to attribute the social returns calculated in <CALC_PROJECT_ANN> to the equity investor in the project it is necessary first to establish:

- The OpCo's asset value as a percentage of total project assets (relevant only when the user has unbundled generation/distribution/retail);
- Equity as a shar of total capital

The social cash flows as calculated in < CALC_PROJECT_ANN> are called up and multiplied by the percentage adjustments discussed in the bullets above. The equity cash flows (post-tax post-grant post-finance) are added to the adjusted social cash flows. The IRR, NPV and simple & discounted payback are calculated on these cash flows.

OpCo Shared

This tab calls up values across the three OpCo workings sheets.

- Section 1 enables relevant call ups of intercompany purchases and sales
- Section 2 calls up real and nominal P&L movements from the financial statements for the purpose of standardising call ups from respective financial statements in the share capital distribution calculations
- Section 3 calls up real and nominal net assets and fixed from the financial statements for the purpose of standardising call ups from respective financial statements in the social equity calculations

SYSTEM WORKSHEETS

SYS_Admin

This worksheet stores the majority of the workbooks stored range names, cell styles and shared label names.

Additionally it allows the user to:

- Manage the change log;
- Set the model name
- Create new sheets in the same format
- Apply workbook protection

CHANGE CONTROL

The TFM has the option to require the user to store changes on each save and provide summary descriptions of what changes were undertaken. To apply this the user should select "TRUE" as highlighted below:

When saving, a dialog box will appear:

The user can increment the major version or the minor version number by one, depending on the extent of changes made and conventions agreed on change control, or not adjust the

version number. If a version number is changed by the user then this will give rise to a "Save As" event. In such an event the TFM will save a new version of the TFM in the same followed with the file name being "[PROJECT NAME]" & " – " & [MAJOR VERSION NUMBER] & "." & [MINOR VERSION NUMBER]. The "Project Name" is the user defined "Model Name" entry cell in this section.

All green cells are macro populated. However, if the user wishes to manually change the major/minor version control shown in the dialog box he/she can amend these figures.

The "RESET LOG" book clears the change log (see <SYS_LOG>).

2 SHEET CALIBRATION				
Annual - number of periods	*number*	60	ANNUAL	▼
Semi-Annual number of periods	*number*	120	**CREATE NEW SHEET**	
Quarterly number periods	*number*	180		
Monthly number of periods	*number*	720		

The sheet calibration section allows the user to create additional worksheets that are consistent with the TFM's styles and timeline. The user should select the periodicity of the worksheet (Annual, semi-annual, quarterly or monthly) and press "CREATE NEW SHEET". A dialog box will appear:

New Sheet

Sheet Name:

Sheet Type:

CANCEL   GENERATE

The user should enter a name (not using any special characters) and select whether the sheet is an input, calculation, output or system sheet and then press "GENERATE".

This will take up to a minute to generate and will be located towards the front of the workbook for the user to move to where he/she wants.

3 WORKBOOK PROTECTION			
Apply workbook protection	*bool*	FALSE	**TOGGLE PROTECTION**
Workbook passord	*text*		

If workbook protection is required then it is necessary to use the workbook protection toggle button. If additional macros are to be developed then the user should bookend all VBA routines with "Unlock_If_Need" and "Lock_If_Need" respectively.

SYS_Timeline

This worksheet calculates the timelines (annual, semi-annual, quarterly and monthly) over a 60 year period. The default TFM worksheets are all annual; however, the user is able to create new worksheets (see <SYS_Admin>) with a different periodicity if so required (e.g. if a monthly construction period cash flow analysis was required) and as such calculations for these periodicities are included.

Importantly the user is able to change both the start year and start month of the TFM. This is for presentational purposes only. It should be noted that the TFM does **not** make adjustments for mid-year cash flows (e.g. user enters a specific date for a loan drawdown) and instead, for discounting purposes, assumes cash flows occur at the end of each period.

SYS_Checks

This worksheets summarises all of the TFM's model integrity checks, warnings and dashboard sensitivity macros having been run.

An integrity check is classed as a check that should never fail (except when the TFM has not been populated).

A warning is a check that might fail but that the user should be aware of and potentially take action to rectify the issue. For example, if there is insufficient equity allocated to an OpCo and the equity requirements are exceeded the TFM a warning error, not integrity error, will show.

A macro not having been run error will arise when the dashboard sensitivities have not been run. As these take some time to run (5-10 minutes) it is recommended that the user only runs the sensitivities when he/she is satisfied that the scenario modelled has been appropriately calibrated.

The user can see where individual checks have failed within a given sheet to save time navigating to where the error has been identified:

SYS_Log

This worksheet stores all changes that that have been logged by the system (see <SYS_Admin>). The live area calls up some key project metrics that are then stored in the log allowing for a reviewer to understand where changes made resulted in material changes in outputs. The user can change the call ups if he/she deems other single cell values to be more relevant:

#	Model	User	Project IRR (pre-grant) pre-tax real	Project NPV (pre-grant) pre-tax real	Project IRR (pre-grant) post-tax nominal	Project NPV (pre-grant) post-tax nominal	LCOH (40 YR)	Integrity	Warnings	Macros
LIVE AREA										
	[PROJECT NAME] - 001.001	Robinson,	n/a	-	n/a	-	-	Error	OK	OK

SYS_Sensitivity

The sensitivity tab is the worksheet used to apply sensitivities to relevant cashflows within the TFM via macro solvers on the Dashboard. With the exception of calibrating the Project Model Solver (see below) it is not expected that a standard user would typically use this worksheet, relying instead on the pre-calibrated sensitivities used by VBA routines used by the Dashboard model solvers.

The overarching principles of the sensitivity manager are as follows:

- A single cell, "dcSensitivity", is changed until such point that a target outcome has been achieved, within the model's tolerance ("dcTolerance"), within 30 iterations (lngMaxLoop within VBA routine – "Solve_Model";
- Scenarios in <SYS_Sensitivity> allow the user to calibrate which assumptions are amended by the sensitivity adjustment:

    The scenario selected is called up in column Q as either a TRUE or FALSE value depending on the scenario calibrated. Column O multiplies the sensitivity applied with the TRUE/FALSE value called up.

- A VBA routine "Run_Sensitivity" copies the line items to be sensitised across to column G. Values in these cells are called up by individual calculations where a sensitivity is applied.

- The TFM has three model solvers focusing on adjusting the tariff, adjusting values set by the user and adjusting sources of capital. Each model solver allows the user to select which model output is to be targeted and the target value sought (typically NPV=0).

- The TFM's Model solve macros adjust the sensitivity, paste the values (as described above) and re-calculate the TFM (in case manual rather than automatic calculation has been set) until such point that the previous iteration's target output value was lower than the target value and thee current iteration's target output value is higher than the target value (or vice-versa). In such an event a solution can now be found and the VBA routine, like a goalseek function, will take the mid-point between the current and previous sensitivity adjustment guess until the target output is between 0 and the model tolerance. A positive (as opposed to absolute) solution is required so that discounted payback calculations will solve.

If the user wishes to calibrate a specific sensitivity then the Dashboard's Project Model Solver should be used:

This solver is using sensitivity scenario 10 in <SYS_Sensitivity>:

By selecting which areas of the TFM are to be adjusted in the sensitivity, the user can effectively develop his/her own sensitivity to which the model can solve on an NPV=0 basis. Areas that can be adjusted either on their own or in combination are:

- Individual connection fees
- Individual variable tariffs
- Individual fixed fee tariffs
- Individual fuel costs
- Capex (generation/distribution/retail)
- Opex/Overheads
- Individual grants
- Individual loans (only relevant for equity investor returns model solves)
- Adjusting the share of dividends (only relevant for equity investor returns model solves)

Having calibrated the Project Model Solver scenario the user can then select what should be solved to on the Dashboard. The user can solve to the following NPV=0 outcomes. See returns section in Dashboard section.

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