Hydrogen Integrated Business Case Impact Tool

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Hydrogen Integrated Business Case Impact Tool
Manual v1.0

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## Glossary

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<th>Description</th>
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<tr>
<td>CAPEX</td>
<td>Capital Expenditure</td>
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<tr>
<td>CO₂</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>EBITDA</td>
<td>Earnings Before Interest, Depreciation and Amortisation</td>
</tr>
<tr>
<td>EBT</td>
<td>Earnings Before Tax</td>
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<tr>
<td>FCEV</td>
<td>Fuel Cell Electric Vehicle</td>
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<td>FCF</td>
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<td>HIBIT</td>
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<td>HRS</td>
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<tr>
<td>ICE</td>
<td>Internal Combustion Engine</td>
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<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
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<tr>
<td>NOₓ</td>
<td>Nitrogen Oxide</td>
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<tr>
<td>NPV</td>
<td>Net Present Value</td>
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<tr>
<td>OCF</td>
<td>Operating Cash Flow</td>
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<tr>
<td>OPEX</td>
<td>Operational Expenditure</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>Particulate Matter of less than 10 micrometres</td>
</tr>
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<td>WACC</td>
<td>Weighted Average Cost of Capital</td>
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1 HIBIT Functionality and General Controls

1.1 About HIBIT

HIBIT is a Hydrogen Refuelling Station (HRS) business case model and comes with the report 'HIT Corridors, Activity 3, Strategic Corridor Analyses and Plans'.

HIBIT assists governments, HRS owners, operators and financiers in making early HRS development bankable. Whereas other available HRS business case models (such as H2FAST) allow for detailed cost-related input, HIBIT focuses on HRS financial support mechanisms, including revenue support and funding support.

HIBIT is a user-friendly financial tool, supporting real time stakeholder discussions and negotiations by allowing for real time what-if analyses. HIBIT can also be used for the purposes of one specific stakeholder group. For example, governments can use HIBIT to evaluate new HRS financial support mechanisms or to develop new ones.

Note: HIBIT is copyright protected. Please read the copyright information in the 'Info and Copyright' worksheet before using HIBIT.

1.2 HIBIT Functionality

HIBIT evaluates HRS business cases by calculating and presenting basic business case parameters. HIBIT can be used by those with only basic business case expertise. However, if HIBIT is used in a decision-making process, we strongly advise consulting a financial expert.

HIBIT regards an HRS development as a stand-alone development, independent of its organisational context. This means that HIBIT evaluates an HRS on a project financing basis: each HRS is regarded as an individual company. Funding is assumed to be non-recourse which means that HRS cash flows are the only debt service source.

HIBIT simulates a specific HRS business case archetype. HIBIT uses assumptions to make the user interface straightforward and user-friendly. The most important assumptions are described in chapter 4. Working with these assumptions allow for quick business case impact evaluation of various support schemes. As such, HIBIT can also be used in the preliminary stage of specific HRS development. However, in the final deal-making and funding stages it is recommended that you use specific financial models allowing for HRS-specific input rather than assumptions.

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1 The cash that is required to cover the repayment of interest and principal on a loan.
1.3 System Requirements and Settings

HIBIT is a Microsoft Excel model. The following systems and settings are required:

- Microsoft Excel 2007 or higher,
- Visual Basic for Applications (VBA) enabled,
- macros enabled,
- ActiveX controls enabled.

VBA and ActiveX applications are only used to enhance the user experience, they are not used in HIBIT calculations.

1.4 General Screen Controls

HIBIT screen layout can be determined by using built-in Microsoft Excel controls as indicated in figure 1.

Figure 1: HIBIT general screen controls

Worksheets

HIBIT information is organised over seven worksheets. You can easily switch worksheets by
clicking on the relevant worksheet tab. Worksheet tabs can be found in the lower left corner of the HIBIT screen, indicated by A in figure 1. Worksheet tabs include:

- **Dashboard.** This is the HIBIT main screen and includes all major input parameters and summarised business case output both numerically and graphically.
- **Demand Aggregation Input.** This is the input screen for the definition of demand aggregation group composition.
- **Reference.** This worksheet contains a detailed financial overview of the HRS reference situation (autonomous developments, without external support).
- **Scheme 1.** This worksheet contains a detailed financial overview of the HRS support scheme 1 situation (situation including support as defined by you under support scheme 1).
- **Scheme 2.** This worksheet contains a detailed financial overview of the HRS support scheme 2 situation (situation including support as defined by you under support scheme 2).
- **Scheme 3.** This worksheet contains a detailed financial overview of the HRS support scheme 3 situation (situation including support as defined by you under support scheme 3).
- **Info.** This worksheet contains HIBIT version and contact details as well as copyright information.

**Collapse and Expand Information**

Information can be collapsed and expanded for ease of understanding. By clicking the ‘+’ or ‘−’ icons as marked by B in figure 1, the corresponding information can be collapsed or expanded.

**Zoom**

If the items on your screen are too small, you can zoom in by using Excel’s zoom slider, marked by C in figure 1. Alternatively, zoom options are available under the Microsoft Excel ‘View’ ribbon tab.

### 1.5 Information and Instruction Panes

Most of the HIBIT information and instructions are provided in real time in the information and instruction panes, available in the Dashboard and Demand Aggregation Input worksheets.

The Information and Instruction Pane on the Dashboard worksheet is marked by D in the HIBIT Main Dashboard Overview on page 2.

The Information and Instruction Pane on the Demand Aggregation Input worksheet is marked by E in the HIBIT Demand Aggregation Input Overview on page 3.

Information panes provide information on the selected input or output cell.
1.6 Warnings and Error Checking

HIBIT includes an extensive mechanism of real time warnings and error checking to ensure data reliability. This mechanism includes the following:

- **Drop-down Lists.** If possible information is presented in drop-down lists, allowing easy selection of one of the presented options.
- **Error Checking as You Type.** If the provided input is not correct, an error alert appears, explaining why the input is not correct.
- **Ex-post Error Checking.** Sometimes information that was entered correctly becomes incorrect when you change other input parameters. In such cases HIBIT gives an ex-post error message. These warnings appear in the HIBIT error panes, appearing as red boxes. The error pane on the Dashboard worksheet is indicated by  in the HIBIT Main Dashboard Overview on page 2. The error pane on the Demand Aggregation Input worksheet is marked by  in the HIBIT Demand Aggregation Input Overview on page 3. Fields containing incorrect information are indicated using red arrows.
- **Warnings.** If entered information is or becomes incorrect, HIBIT gives a warning in the error panes, which will appear orange. Fields containing potentially incorrect information are indicated using orange arrows.
2 Getting Started

2.1 General Instructions

Most information is in the Dashboard worksheet. This worksheet also gives key business case output in both numbers and graphs, allowing for real time what-if analyses. Demand aggregation fleet details can be entered in the Demand Aggregation Input worksheet.

The Reference, Scheme 1, Scheme 2 and Scheme 3 worksheets provide detailed business case information for the HRS business case under support schemes 1, 2 and 3.

HIBIT contains input cells and output cells:

- Input cells are only available in the Dashboard and Demand Aggregation Input worksheets – these input cells have a white background.
- Output cells in the Dashboard worksheet are cells with a dark grey background. For example, all cells indicated by \( \text{\color{gray}13} \) in the HIBIT Main Dashboard Overview on page 2 are output cells.
- All cells in the Reference, Scheme 1, Scheme 2 and Scheme 3 worksheets are output cells.

2.2 Dashboard Worksheet

2.2.1 Two Ways to Start: From Scratch or Jump-Start

You can choose to start either by defining HRS and support scheme specifications from scratch or by using predefined HRS archetypes as a jump-start after which you can adjust these data according to your wishes.

Starting from scratch is described in the following paragraphs. You can jump-start by clicking one of the HRS archetype buttons, marked by \( \text{\color{gray}4} \) in the HIBIT Main Dashboard Overview on page 2. Clicking one of the jump-start buttons will import data for one of the archetypes described in chapter 6 and Appendix C of the report ‘HIT Corridors, Activity 3, Strategic Corridor Analyses and Plans’. In order to make sure that HIBIT produces the same results as the archetypes described in the report, jump-start buttons will also (re)define the general input parameters as follows:

- share capital 20% of initial funding,
- 25% income tax,
- minimum cash position: 5% of initial capital expenditure,
- 2% interest on excess cash,
- 2% long-term inflation rate.
2.2.2 General Input Parameters

General input parameters are generally permanent parameters which only have to be set once. They include the following items:

*Currency*

The currency can be selected from the dropdown list and includes:
- Euro (EUR),
- Danish Krone (DKK),
- Pound Sterling (GBP),
- Norwegian Krone (NOK),
- Polish Zloty (PLN),
- Swedish Krona (SEK).

Selecting another currency will only change the HIBIT currency tags, it will not change the amounts presented. No exchange rate calculation will be made. Changing currencies will only impact amounts if a jump-start option is selected after a currency change. In this case the jump-start amounts will be translated from EUR to the currency of your choice.

*EUR Exchange Rate*

If a currency other than EUR is selected, an exchange rate can be entered. This exchange rate is only used to convert jump-start numbers (which are denominated in EUR) into the currency of your choice. You can either enter a recent exchange rate or the historic exchange rate at the time the jump-start archetypes were defined. These 1 December 2015 exchange rates are:
- EUR/DKK: 7.4602,
- EUR/GBP: 0.70360,
- EUR/NOK: 9.2015,
- EUR/PLN: 4.2679,

*Share Capital (% of Initial Funding)*

HIBIT assumes a share capital contribution at the start of the project. Initial funding is the total sum of money initially required. Initial funding equals total HRS CAPEX minus CAPEX grants. The amount of share capital required depends on the HRS risk and funding structure. Percentages between 5% and 50% are common.

*Minimum Cash (% of Initial CAPEX)*

A project needs working capital to fund its day-to-day operations. In HIBIT, a minimum cash level can be defined for workingcapital purposes. Minimum cash is the minimum amount of cash that should be available at all times. In case of a cash shortage, HIBIT will assume an additional long-term loan to provide extra cash. HIBIT will only use excess cash to pay off loans and to pay dividends up to the level where the remaining cash is equal to the minimum cash. Minimum cash

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2 1 December 2015 quotes from the European Central Bank
is defined as a percentage of initial CAPEX (which is equal to the initial HRS investment). The underlying assumption is that larger investments also require larger amounts of working capital for day-to-day operations.

Nominal Interest on Excess Cash
Cash also includes cash deposits. In case interest is expected to be received, the applicable interest percentage can be entered here.

Long-term Inflation Rate
The long-term inflation rate is used to calculate real interest rates. HIBIT calculates non-adjusted prices, without the effects of inflation. However, an interest rate is usually quoted as a nominal interest rate, including inflation. Calculation without inflation effects means that the inflation factor has to be removed from nominal interest rates. Usually a consumer price index is a good reference. Refer to Appendix A for a historical overview of the Harmonised Index of Consumer Prices.

2.2.3 HRS Definition
HRS can be defined in the HIBIT section marked by 2 in the HIBIT Main Dashboard Overview on page 2. The following parameters are included:

HRS Technical Capacity
Definition of the HRS technical capacity as maximum output in kilogrammes per day.

HRS Commercial Capacity Rate
Even in a mature market, HRS utilisation will not be 100%. The commercial capacity rate is equal to the HRS utilisation rate at maturity. Generally a commercial capacity rate of 70-80% is assumed.

Growth Curve Pattern
The exact development of the HRS revenue curve is hard to predict as it depends on many uncertain variables. Following the principle ‘it is better to be roughly right than to be exactly wrong’, HIBIT offers a ‘look and feel’ option to sculpt a market growth curve by choosing from a variety of market growth curves. Growth curve design is best done as follows:

1. Make sure support schemes 1, 2 and 3 are deactivated (refer to paragraph 2.2.4 for instructions).
2. Choose a growth curve from the dropdown list (very low, low, medium, high, very high) with a slope that best suits your HRS growth expectations.
3. Key graph 1 (HRS H2 Sales Volume Development, indicated by 3 in the HIBIT Main Dashboard Overview on page 2) shows what the selected growth curve looks like.
4. Use the slider to slide the curve to the left or to the right. There may be a small delay before you actually see the curve move.
**Average H2 Initial Pre-Tax Retail Price**
Enter the current hydrogen retail price exclusive of taxes and duties. Currently, hydrogen pre-tax retail prices are around EUR 10 per kilogramme. As pre-tax retail prices are expected to go down you should check retail price levels regularly.

**H2 Retail Price Reduction**
Hydrogen pre-tax retail prices are expected to go down. McKinsey\(^3\) expects pre-tax retail prices to go down to about EUR 4.40 per kg by the year 2045. However, Infram\(^4\) expects that a reasonable HRS retail margin requires a long-term hydrogen retail price of about EUR 6 per kg. In these fields you can enter:
- an expected hydrogen pre-tax retail price reduction percentage,
- a reduction period (in years) to which the reduction percentage applies.

HIBIT assumes a linear reduction pattern. For example, if a 15% price reduction is assumed over a period of 15 years, HIBIT assumes an average pre-tax retail price reduction of 1% per year.

**Average H2 Initial Pre-Tax Purchase Price**
In case of delivered hydrogen this is where to enter its pre-tax purchase price including transportation costs. As was mentioned, McKinsey\(^3\) expects hydrogen pre-tax to stabilise at around EUR 4.40 per kg. Enter 0 (zero) here in case of on-site hydrogen production.\(^5\)

**H2 Purchase Price Reduction**
Similarly, if hydrogen pre-tax purchase prices are expected to go down, you can enter:
- an expected hydrogen pre-tax purchase price reduction percentage,
- a reduction period (in years) to which the reduction percentage applies.

Again, HIBIT assumes a linear reduction pattern, so if a 15% price reduction is assumed over a period of 15 years, HIBIT assumes an average pre-tax purchase price reduction of 1% per year.

**HRS Capital Expenditure**
Enter the total expected HRS CAPEX. Please refer to paragraph 3.3 of the ‘HIT-2 Corridors, Activity 3, Strategic Corridor Analyses and Plans’ report\(^4\) for general reference on CAPEX levels. Make sure that in case of on-site hydrogen production, hydrogen production facility CAPEX is included.

**HRS Asset Life**
Enter the expected lifetime of the HRS assets. Asset life is the period after which replacement is necessary for technical or economic reasons. HIBIT assumes full asset replacement after the indicated HRS asset life period. Furthermore, HIBIT assumes a linear depreciation pattern. For


\(^5\) You may enter the purchase price of demineralised water required to produce one kilogramme of hydrogen, but as these costs are relatively low (cents per kg) they may also be ignored here.
example, if CAPEX is 1.5 million and HRS asset life is 15 years, HIBIT assumes a 0.1 million depreciation per year.

**HRS Capital Expenditure Reduction Percentage**
It is expected that HRS CAPEX will reduce by about 40% to 50% in the next 15 years (compared to 2015 CAPEX levels). You can enter such a percentage here. HIBIT will reduce CAPEX reinvestment levels accordingly. For example, if CAPEX equals 1.5 million and the assumed reduction percentage is 40%, CAPEX reinvestment levels will be equal to 0.9 million.

**Fixed Operational Expenditure**
Enter the expected fixed HRS OPEX. Please refer to paragraph 3.3 of the ‘HIT-2 Corridors, Activity 3, Strategic Corridor Analyses and Plans’ report for general reference on OPEX levels. HIBIT will include the entered amount as an annually recurring expenditure.

**Variable Operational Expenditure**
Enter the expected variable HRS OPEX as a percentage of total HRS revenues. HIBIT will process the resulting variable amount as an annually recurring expenditure.

**Nominal Market Interest Rate**
The nominal market interest rate is the interest percentage of required external funds. If no concrete interest quote are available you can simulate a benchmark rate by performing the following steps:

- Choose a benchmark swap rate as a reference basic interest rate applicable to the expected funding period. For example, SEB publishes EUR, SEK, DKK and NOK swap rates for various loan periods on a daily basis.
- Add a mark-up for assumed risks and a credit margin. The risk mark-up level depends on both HRS market risk and total funding structure robustness. Generally the following mark-ups apply:
  - 100 basis points (1.00%) for low risk investments,
  - 200 basis points (2.00%) for medium risk investments,
  - 300 basis points (3.00%) for higher risk investments,
  - 400 basis points (4.00%) and more for very high risk investments.

### 2.2.4 HRS Support Schemes and Controls
HRS support schemes are composed of one or more support instruments described in paragraphs 2.2.5 to 2.2.7 and explained in Appendix B. HIBIT allows for a maximum of three support schemes which can be compared to the reference and to each other.

Support scheme controls are indicated by 1 in the HIBIT Main Dashboard Overview on page 2:

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2.2.5 HRS Revenue Support Parameters

**HRS Free Capacity at End of Support Period**
This is an output cell. It shows the maximum free commercial capacity at the end of the support period, without demand aggregation effects. It is the maximum number of additional kilogrammes an HRS can sell before its commercial capacity limit is reached. This maximum serves as a reference for additional kilogrammes sold as a result of demand aggregation. HIBIT does not allow a higher demand aggregation hydrogen volume as this would require investment in additional commercial capacity.

**Demand Aggregation Group Composition**
Select the name of the demand aggregation group applicable to each support scheme. Such selections do not have any effect if demand aggregation volumes are zero. Refer to paragraph 2.3 for a definition of demand aggregation group.

**Demand Aggregation Initial H2 Volume**
If demand aggregation is part of a support scheme, you can enter the initial hydrogen volume you would like to add to HRS autonomous sales volume levels. This volume should be between zero and the indicated free capacity at the end of the support period (as HIBIT does not allow to HRS commercial capacity to be exceeded).

**Demand Aggregation End of Support Period H2 Volume**
Enter the hydrogen volume you expect to add at the end of the support period. This volume can be either higher (additional users are expected) or lower (some users are expected to drop out) than the initial demand aggregation volume. HIBIT assumes a linear pattern between initial and
end of support period volumes. For example, if the support period is 5 years, initial volume is 100 kg and end of support period volume is 200 kg, HIBIT will assume 100 kg per day additional demand aggregation volume in year 1, 125 kg in year 2, 150 kg in year 3, 175 kg in year 4 and 200 kg in year 5.

In the key output figures and ratios section (indicated by 13 in the HIBIT Main Dashboard Overview on page 2) HIBIT will show how many vehicles are required to reach such additional sales levels, given the selected demand group composition.

Demand Aggregation Effects after Support Period

HIBIT requires information as to what happens when demand aggregation initiatives expire at the end of the defined HRS support period. The following options are available:

- Zero. This option assumes that when demand aggregation initiatives end, all users switch (back) to a vehicle type other than an FCEV. Additional demand aggregation sales fall back to zero. This is a worst case scenario. Figure 2 illustrates this effect.

![Figure 2: Illustration of 'zero' demand aggregation effect after support period. Green line indicates total sales volume including demand aggregation (after) effects.](image)

- Decrease. This option assumes that the number of FCEV motorists that originated from a demand aggregation group slowly decreases. Some FCEV motorists may switch to other vehicle types and other may increasingly fill up at other HRS. This is translated into HIBIT by keeping the total hydrogen sales volume level at the end of the support period constant until the autonomous growth curve exceeds this constant volume level. Figure 3 illustrates this.
Figure 3: Illustration of ‘decrease’ demand aggregation effect after support period. Green line indicates total sales volume including demand aggregation (after) effects.

- **Constant.** This option assumes that the hydrogen volume sold by this HRS to FCEV motorists originating from a demand aggregation group remains constant after the support period. In this case, HIBIT will take total hydrogen volume at the end of the support period as a reference, adding autonomous sales growth to this total volume. Figure 4 illustrates this effect.

Figure 4: Illustration of ‘constant’ demand aggregation effect after support period. Green line indicates total sales volume including demand aggregation (after) effects.

- **S-curve.** This option ceases to identify demand aggregation participants as a separate group. It simply takes the total sales volume at the end of the support period as a reference and assumes a growth pattern similar to the autonomous growth curve (S-curve) from that particular volume. This is done in the following four steps:
  - Step 1. HIBIT considers the total hydrogen sales volume at the end of the support period.
  - Step 2. HIBIT calculates when the total hydrogen sales as referred to in step 1 would have been reached in the autonomous growth curve (S-curve).
  - Step 3. HIBIT adopts the S-curve growth pattern starting from the point referred to in step 2.
Step 4. HIBIT assumes a similar growth pattern for the period following the end of the support period. This is a best case after effect scenario. Figure 5 illustrates this.

Figure 5: Illustration of ‘S-curve’ demand aggregation effect after support period. Green line indicates total sales volume including demand aggregation (after) effects. Numbers indicate steps 1 to 4.

Take-or-Pay Initial H2 Threshold
Take-or-pay contacting is described in Appendix B. Enter the initial volume (at the beginning of the support period) to be guaranteed by take-or-pay provisions.

Take-or-Pay End of Support Period H2 Threshold
Enter the volume to be guaranteed by take-or-pay provisions at the end of the support period. HIBIT assumes a linear pattern. For example, if the support period is 5 years, initial take-or-pay volume is 100 kg and end of support period take-or-pay volume is 200 kg, HIBIT will assume 100 kg per day take or pay volume in year 1, 125 kg in year 2, 150 kg in year 3, 175 kg in year 4 and 200 kg in year 5.

Take-or-Pay Penalty Price
This is the price the HRS counterpart will have to pay for not ‘taking’ the agreed take-or-pay volume levels. Usually this penalty price should cover the HRS costs that cannot be otherwise covered due to a shortfall in hydrogen sales. The penalty price is normally lower than the sales price, as hydrogen that isn’t sold also doesn’t have to be purchased or produced.

Performance-based Payment
Performance-based payments are described in Appendix B. Enter the amount the HRS operator will receive annually during the support period if the HRS performance meets the agreed achievement level.
2.2.6 HRS Expenditure Support Parameters

*Capital Expenditure Grant*
Enter the capital expenditure grant as a percentage of total HRS capital expenditure. For example, if total capital expenditure is 100 and the capital expenditure grant is 60%, the capital expenditure grant equals 40. Capital expenditure grants improve HRS financial performance as such grants are subtracted from the initial capital expenditure, leading to a lower (net) capital expenditure, leading to lower depreciation, hence improving HRS profitability. Furthermore, capital expenditure grants lead to a need for lower financing, allowing the HRS operator to avoid expensive external funding.

*Operational Expenditure Grant*
Enter the operational expenditure grant as a percentage of total HRS operational expenditure. HIBIT subtracts this grant from total operational expenditure on a recurring basis during the support period.

2.2.7 HRS Funding Support Parameters

*Total Required Initial Debt Funding*
This is an output cell. It shows the level of external funding required, given the total net capital expenditure (after capital expenditure grants are subtracted – as discussed in paragraph 2.2.6 under 'Capital Expenditure Grant') and the share capital brought in by investors (as discussed in paragraph 2.2.2 under 'Share Capital'). This output can be used as a reference for soft loan decision-making. HIBIT assumes that the part of the required initial debt funding not provided by soft loans, will be provided by commercial senior debt.

*Soft Loans*
Soft loans are described in Appendix B. Enter the total soft loans volume here. Obviously, the total soft loans volume should not exceed the total required initial debt funding level. HIBIT assumes that soft loans will be outstanding during the entire support scheme period and paid back as a (one-off) bullet payment at the end of this support period.

*Soft Loan Nominal Interest Rate*
Enter the soft loan interest percentage. This percentage could be lower than, equal to or higher than the senior debt interest rate. A lower percentage leads to lower interest costs compared to the senior debt and could be seen as direct financial support. However, soft loans sometimes come at a higher interest than senior debt. Because of their junior position, soft loans are considered higher risk than senior debt. On the other hand, soft loan availability reduces risks for senior debt providers as soft loans serve as a financial buffer in case of default. Higher risk usually means a higher price. However, by offering soft loans below market rates, HRS operators receive a double advantage: cheap money serving as buffer for senior debt providers leading to lower senior debt costs.
2.2.8 Common Warnings and Errors

All warning and errors are shown in the error/warning pane, indicated by indicated by 🚨 in the HIBIT Main Dashboard Overview on page 2.

**Warning: Interest < Inflation**

As explained in paragraph 2.2.2 under ‘Long-term Inflation Rate’, inflation will be deducted from all interest rates. If the assumed inflation percentage is higher than the nominal interest rate this leads to a negative real interest rate. Negative real interest rates do exist in times of very low nominal interest rates and relatively high inflation, but are generally regarded as undesirable.

**Demand Aggregation and Take-or-Pay Volume Errors**

These errors usually occur when you include demand aggregation and take-or-pay instruments in a support scheme and bring the maximum HRS production capacity down to a lower volume afterwards. If the original demand aggregation and take-or-pay volume levels exceed the adjusted HRS commercial capacity, HIBIT will show an error message. Such errors can be resolved by adjusting the incorrect volumes (marked with a red arrow) to levels not exceeding the HRS free capacity at end of support period, as described in paragraph 2.2.5.

**Demand Aggregation Group Composition Errors**

These errors generally occur for one of the following reasons:

- You have assumed a demand aggregation sales volume without having selected a demand aggregation group. HIBIT therefore cannot calculate demand aggregation effects. You can resolve this error by selecting a (valid) demand aggregation group.
- You have selected an invalid demand aggregation group. Paragraph 2.3 describes how to define valid demand aggregation groups. Groups can be invalid for one of the following reasons:
  - The demand aggregation group name is not unique. In this case, HIBIT cannot identify the correct demand aggregation group.
  - The sum of shares in a composition group does not equal 100%, leading to incorrect demand aggregation calculations.

You can resolve these errors in the Demand Aggregation Input worksheet.

**Demand Aggregation Effect after Support Period Errors**

This error occurs if you have assumed a demand aggregation sales volume without selecting an after effect option. You can resolve this error by selecting one of the after effects described in paragraph 2.2.5 under ‘Demand Aggregation Effects after Support Period’.

**Take-or-Pay Penalty Price Errors**

Take-or-pay penalty prices should be lower than the hydrogen pre-tax retail price. An error occurs if you change the hydrogen retail price to a level below the entered take-or-pay penalty price. You can resolve this error by changing either the hydrogen retail price or the take-or-pay penalty price.
Soft Loan Errors
These errors occur if the total soft loan amount exceeds the total required initial debt funding volume. You can resolve this error by adjusting the soft loan volume.

2.3 Demand Aggregation Input Worksheet

HIBIT allows for a maximum of four demand aggregation groups. Each demand aggregation group can consist of up to ten motorist profiles. For example, you can define a demand aggregation group that is dominated by government vehicles, a demand aggregation group dominated by taxis or a mixed demand aggregation group. You can define groups according to expected participation by various user groups.

HIBIT uses demand aggregation group information to calculate the number of vehicles involved, given the target demand aggregation hydrogen sales volume, and to calculate demand aggregation CO₂ and NOₓ effects.

2.3.1 Group Composition

Demand Aggregation Group Composition Name
You can enter a name for each demand aggregation group. These names can be entered in the fields indicated by 22, 26, 29 and 33 in the HIBIT Demand Aggregation Input Overview on page 3. Make sure every name is unique, otherwise HIBIT will not be able to identify the correct demand aggregation group.

Share in Composition
Each demand aggregation group consists of up to ten motorist profiles. Each motorist profile consists of the same reference vehicle and FCEV characteristics. Enter the share of each motorist profile in the sections indicated by 19, 23, 27 and 31 in the HIBIT Demand Aggregation Input Overview on page 3. Make sure that the sum of all shares equals 100%. You will have to define at least one demand aggregation group composition if one or more support schemes include demand aggregation.

2.3.2 Reference Vehicle Input

It is assumed that demand aggregation group participants exchange their current ICE vehicle for an FCEV. In order to calculate the demand aggregation’s financial and environmental effects, HIBIT needs information on both current reference vehicles as well as the fuel cell replacement vehicle. Reference vehicle input can be entered in the sections indicated by 20, 24, 28, 32 in the HIBIT Demand Aggregation Input Overview on page 3.

Vehicle Type
Enter the current ICE vehicle type for each motorist profile, such as car, bus or van. You may
also enter a concrete reference vehicle type such as ‘Volvo V40’ or more general 'A-segment' or 'D segment’, whatever is the clearest and most convenient for you. The information entered here will only be used for explaining vehicle details in demand aggregation summaries.

*Vehicle Fuel Type*

Enter the current ICE vehicle fuel type for each motorist profile, such as petrol or diesel. The information entered here will only be used for explaining vehicle details in demand aggregation summaries.

*Type of User*

Enter the type of user for each motorist profile, such as business, private or taxi. The information entered here will only be used for explaining vehicle details in demand aggregation summaries.

*Mileage*

Enter the average annual mileage for each motorist profile. HIBIT uses this information to calculate demand aggregation effects.

*Reference Cost*

Enter the reference (ICE) vehicle’s total cost per kilometre. HIBIT uses this information to calculate cost difference between the reference vehicle and the FCEV replacement vehicle. Total cost of ownership provides the most complete information but may be difficult to obtain. Alternatively you can include only those categories where the reference vehicle and FCEV have different costs per kilometre. HIBIT calculates on the basis of cost differences, not absolute cost levels. Reference costs can be roughly estimated using a simple calculation framework, as demonstrated in figure 6.

| Mileage | 20,000 |
| Depreciation | Retail Price 50,000 |
| Second-Hand Value after 5 Years | 25,000 |
| Depreciation | 25,000 |
| Insurance | 0.00 |
| Road tax | 0.00 |
| Maintenance | 0.00 |
| Fuel l/100km | price/l | 0.32 |
| Total Costs per Kilometre | |

**Figure 6: Example of a simple total cost per kilometre calculation.**

This example assumes cost difference between ICE vehicles and FCEVs in terms of depreciation and fuel costs. As insurance, road tax and maintenance are assumed to be equal for both vehicle types, in this example these costs are left out. An important factor to be included in such calculations is value added tax (VAT) deductibility. Generally private persons have to assume
VAT as a cost. Corporate users may be able to deduct VAT, so in these cases cost calculations should be made exclusive of VAT.

\( \text{CO}_2, \text{NO}_x \) and \( \text{PM10} \)

Enter the reference vehicle’s \( \text{CO}_2, \text{NO}_x \) and \( \text{PM10} \) emissions per kilometre. There are several sources available providing such emission data per vehicle, for example http://www.nextgreencar.com/tools/emissions-calculator.

2.3.3 FCEV Replacement Vehicle Input

\textbf{FCEV Cost}

Enter the FCEV’s total cost per kilometre. HIBIT uses this information to calculate cost differences between the reference vehicle and the FCEV. A similar approach as illustrated in figure 6 could be used.

\textbf{H2 Consumption}

Enter the FCEV’s fuel consumption in kilogrammes per 100 kilometres. This information is available from OEMs’ websites. For example, the average fuel consumption of the Hyundai ix35 Fuel Cell is 0.95 kilogrammes per 100 kilometres. This information is used to calculate how many vehicles it takes to match the required additional hydrogen sales from demand aggregation.

\textbf{HRS Loyalty}

HRS loyalty answers the question ‘What percentage of all refuelling is done at this specific HRS?’.

The percentage entered represents the share of this HRS in all refuellings per motorist profile. As the number of HRS is very limited in early market phases, the HRS loyalty percentage is expected to be close to 100%.

2.3.4 Common Warnings and Errors

All warning and errors are shown in the error/warning panes, indicated by  in the HIBIT Demand Aggregation Input Overview on page 3.

\textbf{Demand Aggregation Group Composition Name Errors}

This error occurs if a demand aggregation group name is not unique. In this case, HIBIT cannot identify the correct demand aggregation group. You can correct this error by changing one of the duplicate names.

\textbf{Total Share Errors}

This error occurs if the sum of shares in a composition group does not equal 100%, leading to incorrect demand aggregation calculations. You can correct this error by changing one or more motorist profile shares.
3 HIBIT output and evaluation

3.1 Key Output Figures, Ratios and Graphs in the Dashboard Worksheet

3.1.1 Key Output Figures and Ratios

The key output figures and ratios section is indicated by 📊 in the HIBIT Main Dashboard Overview on page 2.

Discounted Payback Period
The discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure including capital costs related to the initial expenditure’s funding. For the following cases, the discounted payback period shows as not applicable (‘n.a.’):

- The discounted payback period is longer than 30 years, or
- The discounted payback period cannot be calculated. This is the case for example if you have defined a support scheme including a 100% capital expenditure grant. In such cases the initial expenditure is zero and obviously a payback time cannot be determined.

Structural Profit After
This figure gives the number of years it takes the HRS operator to reach a level of structural profitability, meaning that HRS profits remain positive.

Net Present Value (NPV)
NPV shows the present value of the HRS investment based on the expected income from that investment in future years minus the cost of the project. A positive NPV indicates that the HRS Return on Investment (ROI) exceeds the HRS capital costs. A negative NPV means that HRS ROI is not enough to cover its capital costs. A positive NPV usually means that the project gets through to the next round of decision making. A positive NPV alone does not necessarily mean that a project is bankable (refer to paragraph 3.3).

Nominal IRR after Tax
Internal Rate of Return (IRR) is the interest rate at which the net present value of all the HRS after tax cash flow (both positive and negative) equals zero. IRR can be compared to the HRS capital costs. An IRR lower than the assumed capital costs means that the project does not produce enough cash to cover all costs, including capital costs. An IRR higher than the assumed capital costs means that the project produces (more than) enough cash to cover all costs, including capital costs. An IRR higher than the HRS capital costs alone does not necessarily mean that a project is bankable (refer to paragraph 3.3). The IRR cannot be determined if all cash flows are positive or negative. This is the case for example if your HRS operating cash flows are positive and a 100% capital expenditure grant is assumed. In such cases all cash flows are positive.
Direct Support Costs
This figure shows the total cost of the support schemes as defined by you in the support scheme input section. The 'Direct Support Costs' graph, indicated by 3 in the HIBIT Main Dashboard Overview on page 2, shows a breakdown of these support costs.

# Demand Aggregation FCEVs
This figure shows how many FCEVs are required to participate in demand aggregation initiatives, given the desired additional hydrogen sales from demand aggregation and the motorist profiles defined in the Demand Aggregation Input worksheet.

3.1.2 Graphs

HRS H2 Sales Volume Development
This graph is indicated by 3 in the HIBIT Main Dashboard Overview on page 2. It shows the sales volume development in kilogrammes per day. The grey curve is the reference curve, which is the result of your input in the Growth Curve Pattern section (refer to paragraph 2.2.3). The support scheme 1 (pink), support scheme 2 (green) and support scheme 2 (blue) lines show the sales volume development including additional sales from demand aggregation initiatives as defined in the demand aggregation input section (refer to paragraph 2.2.5).

Direct Support Costs
This graph is indicated by 3 in the HIBIT Main Dashboard Overview on page 2. It shows total direct support costs per support scheme and provides a cost breakdown in the following categories:

- Demand Aggregation Costs. This is the total cost of demand aggregation, based on the desired additional hydrogen sales from demand aggregation, the number of FCEVs required and the money it takes to compensate each participant for additional FCEV costs per kilometre compared to the (ICE) reference vehicle.
- Take-or-Pay Penalties. If the actual hydrogen sales volume falls below the agreed take-or-pay threshold, the agreed penalty will have to be paid. This area shows the total amount of penalties during the support period, based on the forecasted sales levels versus the take-or-pay threshold.
- Performance-based Payments. This area shows the total amount of performance-based payments, assuming that all performance criteria are met. The total amount equals the entered annual performance-based payment multiplied by the total support period in years.
- Capital Expenditure Grants. This area shows the total amount of capital expenditure grants. This amount equals the entered capital expenditure grant percentage multiplied by the total capital expenditure.
- Operational Expenditure Grants. This area shows the total amount of operational expenditure grants. This amount equals the entered operational expenditure grant percentage multiplied by the total operational expenditure during the support period.
• Soft Loan Interest Discount. If soft loans are provided at a below-market interest rate, this area shows the total value of the discount.

Demand Aggregation Emission Cuts
This graph is indicated by [10] in the HIBIT Main Dashboard Overview on page 2. It shows total CO₂, NOx and PM10 tailpipe emission reductions as a result of demand aggregation. These reductions are based on the entered demand aggregation details in the Dashboard worksheet and the motorist profile information in the Demand Aggregation Input worksheet. This graph only shows the emission reduction effects of demand aggregation as there is a causal link between demand aggregation efforts and emission reduction. Emission reduction from autonomous development are not included as they lack such causal link.

Multi Output Graph
This graph is indicated by [11] in the HIBIT Main Dashboard Overview on page 2. By clicking on one of the option buttons below 'Choose Graph', HIBIT will show one of the following graphs:

• EBITDA. EBITDA means Earnings Before Interest, Taxes, Depreciation and Amortisation. EBITDA is a measure of the HRS’ ability to produce income on its operations in a given year. It is calculated as HRS’ revenues less most of its expenses but not subtracting its tax liability, interest paid on debt, amortisation or depreciation. EBITDA is usually used by investors to compare operational profitability of projects without considering their differences in capital expenditure, funding structure or taxation. Investors usually require a positive EBITDA at all times as each HRS should produce enough income to at least cover its operating costs.

• Earnings Before Taxes (EBT). EBT is an indicator of the HRS financial performance calculated as total revenues minus total expenses but excluding tax. EBT is also a line on the HRS income statement that shows how much the company has earned in a year.

• Operating Cash Flow (OCF). OCF is a measure of the amount of cash generated by the HRS’ normal business operations. It is calculated as total revenues minus operating costs minus interest expenditure minus changes in working capital. Investors usually require a positive OCF at all times. However, in the first years of operation OCF may be (slightly) negative as there may be no revenues yet while operating expenditure and interest have to be paid.

• Annual Free Cash Flow (FCF). Annual FCF is a measure of how much cash an HRS generates after accounting for capital expenditure. Annual FCF is calculated by subtracting capital expenditure from OCF. Investors are interested in FCF development, as a positive FCF means that the HRS has the capacity to pay out dividends, to reduce debts or to fund additional investments.

• Cumulative Free Cash Flow (Valley of Death). Cumulative FCF is the total sum of annual FCFs. Cumulative FCF is usually shaped like a bathtub: after a period of negative FCFs (mainly as a result of required early investments and operating expenditure exceeding early revenues) the cumulative FCF line reaches a turning point and starts to move upwards. In the year it crosses the zero line all expenditure has been earned back. The
lower the bottom of the bathtub and the longer it takes to cross the zero line, the more risky the investment is usually considered to be.

_Funding Sources and Application_
This graph is indicated by  in the HIBIT Main Dashboard Overview on page 2. It shows, for each support scheme, which funding sources are used and the expenditure they are used for. The period considered is the total support scheme period (which you specify). Funding application usually consists of capital expenditure and negative cash flow. Important funding sources are: capital expenditure grants (if selected), soft loans (if selected), available excess cash flow, share capital (refer to paragraph 2.2.2 under ‘Share Capital’) and regular loans (explained in further chapter 4). This provides an overview of where funds come from and how they are spent at a glance. It helps investors to compare the robustness of the financial structure of the defined support schemes.

_HRS Income Breakdown per Support Scheme_
These graphs are indicated by  and  in the HIBIT Main Dashboard Overview on page 2. They specify all sources of HRS income during its first 15 years of operation. These graphs show income differences between capital expenditure grant support scheme versus, for example, support schemes based on demand aggregation. These graphs can be used to evaluate the quality and robustness of HRS revenues. Revenues from hydrogen sales are considered to be more robust that revenues from grants.

### 3.2 Detailed Reference and Support Scheme Output

_Detailed Output Overviews and Controls_
You can switch to detailed output calculations and overviews by clicking one of the support scheme worksheet tabs in the area indicated by  in figure 1 (page 5). You can collapse or expand individual items by clicking either (expand) or (collapse) anywhere in the left margin, for example in the area indicated by  in figure 7.
Figure 7: Collapse/Expand controls in support scheme worksheets.

Key Data

The Key Data section provides information on the following hydrogen volume levels:

- **Reference H2 Sales (kg)**. The hydrogen reference sales level is equal to the autonomous sales level (without support scheme effects).

- **H2 Sales from Aggregated Demand & After Effects (kg)**. Shows the total additional annual sales volumes from aggregated demand, including its after effects. These effects originate from your input in the demand aggregation section of each support scheme (refer to paragraph 2.2.5).

- **Total H2 Sales (kg)**. The sum of reference and aggregated demand sales.

- **H2 Take-or-Pay Threshold**. Shows the annual take-or-pay threshold: if total sales are below this threshold, Take-or-Pay penalty payments apply.

- **H2 Take-or-Pay Penalty Level**. Shows the difference between the actual total sales volume and the threshold – this is the volume to which the penalty payment applies.

Profit and Loss Statement

This statement shows the HRS profits and losses, assuming that the HRS is a stand-alone entity. It specifies HRS revenue sources, operating costs, depreciation, interest costs and income tax.

Cash Flow Statement

This statement shows HRS cash flow in the following categories:

- **Cash Flow from Operating Activities**. This is cash flow from everyday HRS operations. It includes revenues, expenses, interest, taxation and changes in working capital.
• Cash Flow from Investing Activities. This part shows annual capital expenditure and capital expenditure grants.
• Cash Flow from Financing Activities. This part shows equity and debt contributions and repayments. It includes a soft loans overview, based on your soft loans input per support scheme (refer to paragraph 2.2.7).

**Balance Sheet**
The balance sheet is a specified annual statement of the HRS assets, liabilities and capital.

**Key Financial Ratios**
Here you will find the same ratios as specified in the Key Output Figures and Ratios section of the Dashboard worksheet. Refer to paragraph 3.1.1.

**Annual Financial Ratios**
This section includes a number of financial ratios used by investors to evaluate an HRS business case. It includes ratios in the following categories:
• Rating. Includes ratios indicating operating results versus applied capital.
• Income Statement. Includes operating performance ratios.
• Financial Structure. Includes ratios indicating HRS financial health.
• Debt Service Capacity. Includes ratios indicating HRS capacity to pay interest and repay principle loans amounts.

Note: Annual financial ratios may appear as uncommon numbers in specific years as the HRS business case has not yet been sculpted or optimised. However, the total set of ratios should give you a good general impression of the HRS financial health.

**Demand Aggregation Details**
Scheme 1, 2 and 3 worksheets include a Demand Aggregation Details section. This section specifies all information related to demand aggregation, based on your demand aggregation inputs (refer to paragraph 2.2.5). It includes the following categories:
• Number of Vehicles per Reference Vehicle Type During Pilot Period. Shows the annual number of vehicles included in the demand aggregation group.
• H2 Sales per Reference Vehicle Type During Pilot Period. Shows the number of kilogrammes the HRS sells per motorist profile group (each motorist profile is indicated by its reference vehicle).
• Cost Difference Reference Vehicle and FCEV. Shows the total cost difference amount between the reference vehicle and the FCEV per motorist profile group.
• CO2 Reduction per Reference Vehicle Type. Shows the total level of CO₂ reduction per motorist profile group.
• NOX Reduction per Reference Vehicle Type. Shows the total level of NOₓ reduction per motorist profile group.
• PM10 Reduction per Reference Vehicle Type. Shows the total level of PM10 reduction per motorist profile group.
3.3 When is an HRS Business Case Bankable?

It requires an expert eye to evaluate HRS bankability. However, HIBIT provides key information giving a general insight into HRS bankability based on the following rules of thumb.

Discounted Payback Period

The discounted payback period should always be smaller than HRS asset life. In other words: the investment including all related costs should be earned back before the asset has to be replaced. Most investors require a buffer, meaning that the discounted payback period should be at least a few years shorter than HRS asset life. Some investors additionally assume absolute payback time limits, for example five or ten years. Such limits apply if investors consider HRS income beyond this limit to be highly uncertain.

Net Present Value

The NPV should always be positive.

Internal Rate of Return (IRR)

The IRR has to exceed assumed capital costs. Assumed capital costs can be determined by calculating the Weighted Average Cost of Capital (WACC) as follows (example):

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Debt</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Share in Funding</td>
<td>100%</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>b. Required Return (after Tax)</td>
<td>6.20%</td>
<td>4.00%</td>
<td>15.00%</td>
</tr>
<tr>
<td>c. WACC (=a*b)</td>
<td>6.20%</td>
<td>3.20%</td>
<td>3.00%</td>
</tr>
</tbody>
</table>

a. Determine the share of debt and equity funding - refer to the information entered in the general input parameters section, paragraph 2.2.2 under ‘Share Capital’.

b. Determine the required return on debt (equal to the nominal market interest rate you entered in the HRS definition section – refer to paragraph 2.2.3 under ‘Nominal Market Interest Rate’).

c. Multiply the shares of debt and equity with the required returns. The WACC is the sum of the two.

Demand Aggregation

Obviously, the number of vehicles required to meet required hydrogen sales from demand aggregation has to be realistic and manageable. If you have doubts about this required number you may have to reduce demand aggregation volumes and increase other support parameters to improve HRS business case bankability.

Financial Structure

Debt investors not only require sufficient cash flow, but also sufficient comfort from the HRS financial structure. Guarantee capital (equity + soft loans) serves as a buffer for debt investors. Therefore, debt investors usually require a minimum level of guarantee capital. The required level depends on HRS risk and could generally be anywhere between 10% and 50%.
4 HIBIT Assumptions and Functional Description

4.1 Main Assumptions

Cash Flow Timing
All cash flows in a year are assumed to occur on 31 December. Balance sheet overviews also represent assets and liabilities on 31 December.

Investments and Reinvestments
HIBIT assumes that initial investments occur one year before HRS operations start. This moment is defined as 31 December of year 0. HIBIT assumes all capital expenditure occurs at this moment. In other words, there is no phased investment approach. Furthermore, HIBIT assumes that after the asset life period has expired, asset reinvestment occurs as one single payment at one moment.

Dividends
Dividend payments are assumed in years where the sum of all past earnings is positive. Dividend payments are equal to the total level of retained earnings unless the total amount of available cash is lower. In that case, dividend payout is limited to the level of available cash. Available cash is defined as total cash minus the minimum cash level as defined in the general input section - refer to paragraph 2.2.2 under ‘Minimum Cash (% of Initial CAPEX)’.

Regular Loans
If in any year total available cash is less than total cash expenditure, HIBIT assumes regular loans to match the difference. In years where excess cash is available, HIBIT assumes repayment of these regular loans.

Tax Loss Carry-forward
HIBIT assumes no limit on the tax loss carry-forward period. In other words: all tax losses can be deducted from future profits without any limitations.

4.2 Functional Description

Inflation
HIBIT performs all calculations in constant prices, meaning that inflation effects are not considered. Therefore HIBIT also uses real interest rates in its calculations, calculated as follows:

\[ \text{RI} = \frac{(1 + NI)}{(1 + Inf)} - 1 \]

with:

\text{RI} = \text{Real Interest Rate},
\text{NI} = \text{Nominal Interest Rate as provided by the user},
\text{Inf} = \text{Inflation Rate as provided by the user}.
S-Curve Simulation
The Data_Sheet worksheet contains the S-curve simulation calculations. This worksheet is hidden and can be displayed by using the standard Microsoft Excel option 'unhide worksheet'. The S curve is equal to an accumulated normal distribution. The normal distribution reference curve is based on the following dummy values:
- X value range from -6 to +10,
- X value average equals 2,
- standard deviation equals 2,
- Z value range from -4 to +4.

Z values are equally distributed. The S-curve slope is determined by the user growth curve input - refer to paragraph 2.2.3 under 'Growth Curve Pattern', using the following parameters:
- a 'very high' growth curve means that Z values are distributed across a 10-year period,
- a 'high' growth curve means that Z values are distributed across a 16-year period,
- a 'medium' growth curve means that Z values are distributed across a 23-year period,
- a 'low' growth curve means that Z values are distributed across a 33-year period,
- a 'very low' growth curve means that Z values are distributed across a 40-year period.

You can move the resulting distribution up to five years forward, meaning that the curve will start in year 1 at its original six-year value and will reach its maximum Z value five years earlier than originally indicated. You can also move the resulting distribution up to five years backwards, meaning that the curve will reach its maximum Z value five years later than originally indicated. Z values are calculated as follows:

\[ Z(t) = Z(\text{min}) + \frac{Z(\text{max}) - Z(\text{min})}{n} \times t \]

with:
- \( t = \) Any year between 0 and n
- \( Z(t) = \) Z value in year t,
- \( Z(\text{min}) = \) Minimum Z value (= -4),
- \( Z(\text{max}) = \) Maximum Z value (= 4),
- \( n = \) Period corresponding with the selected growth curve period (10 to 40 years as indicated above).

Z values are translated into X values as follows:

\[ X_t = \bar{X} + Z_t \times \sigma \]

with:
- \( X_t = \) X value in year t,
- \( \bar{X} = \) Average X value (= 2)
- \( Z_t = \) Z value in year t as described above,
- \( \sigma = \) Assumed standard deviation (= 2).
X values are translated into a cumulative percentage distribution as follows:

\[ F(x_t) = \int_{-\infty}^{x_t} \frac{e^{-x^2/2}}{\sqrt{2\pi}} \]

with:

- \( F(x_t) \) = Cumulative percentage in year t,
- \( x_t \) = X value in year t,
- \( e \) = fundamental constant (≈2.718281828459)

The cumulative percentage distribution is multiplied by the HRS commercial capacity, returning the HRS sales per year.

**Calculations**

HIBIT performs automated business case calculations using two items as the business case’s ‘valve’:

- If in any year total available cash is less than total cash expenditure, HIBIT assumes regular loans to match the difference. In years where excess cash is available, HIBIT assumes repayment of these regular loans.
- If in any year total available cash exceeds total cash expenditure and all regular loans have been repaid, HIBIT assumes dividend payments. If dividend payment criteria are not met, HIBIT adds such excess cash to the Total Cash balance sheet item.

This method guarantees a balancing balance sheet at all times. However, HIBIT does not evaluate if possible additional regular loans are realistic – this is part of the user business case evaluation.
Appendices
## A HICP Historical Rates

<table>
<thead>
<tr>
<th>UNIT</th>
<th>All-items HICP</th>
<th>Annual rate of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Union</td>
<td>1.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.8</td>
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<tr>
<td>Bulgaria</td>
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<tr>
<td>Czech Republic</td>
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<tr>
<td>Denmark</td>
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<td>2.6</td>
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<tr>
<td>Germany</td>
<td>0.8</td>
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<td>Ireland</td>
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<tr>
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<tr>
<td>Average</td>
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</tr>
</tbody>
</table>

Table 1: Harmonised Index of Consumer Prices (HICP), annual rate of change, January 2010-2015 and per month 2015. Source: Eurostat.
B  HRS Financial Support Instruments

Capital Expenditure Grants
CAPEX grants are the most common form of HRS financial support at this time. CAPEX grants, usually one-off payments, reduce the HRS depreciation costs and external funding needs. CAPEX grants stimulate HRS development, not HRS use. Therefore, CAPEX grants are the best financial support option for establishing a basic HRS infrastructure in a period of limited FCEV availability.

Operational Expenditure Grants
OPEX grants cover fixed operational expenditure in periods of underutilisation. As is the case with CAPEX grants, OPEX grants are focused on bringing HRS operators’ costs down rather than stimulating HRS revenues. This is most effective in periods of limited FCEV availability.

Performance-based Contracting
Performance-based contracting is a type of contracting where recurring payments are made in return for an agreed HRS performance level. The grant giver and HRS operator agree on a set of HRS performance criteria such as HRS back-to-back capacity, response times in case of HRS default, customer satisfaction et cetera. The certified HRS management system and customer surveys could be used for measuring performance. The HRS operator receives full payment if all performance criteria are met. Payment deductions apply in case of non-compliance. The system may also allow for bonus payments, for example if the HRS is compliant over a longer period or in case of outstanding customer satisfaction. Performance-based contracting stimulates HRS performance rather than just HRS availability and is a good alternative for CAPEX and OPEX grants, especially when utilisation rates increase. Scaling up HRS use may lead to technical performance issues. Performance-based payments are a funding source for the HRS operator while they offer the grant giver HRS performance certainty. Performance-based payment mechanisms are common practice in Design-Build-Finance-Maintain PPP projects, where public authorities pay contractors for infrastructure performance rather than just construction. In (road) infrastructure projects the term ‘availability payment’ is used, where ‘availability’ also includes performance criteria. Performance-based contracting requires more extensive contract management as performance has to be evaluated regularly, corresponding payment levels have to be set and possible disputes may need to be resolved.

Take-or-Pay Contracting
Take-or-Pay contracting is a contracting mechanism frequently used in situations that require large investments while there is only a small client base. The seller depends on just a few buyers to generate income to recover expenditure. Such business cases are usually not bankable without provisions that ensure a minimum level of revenues. HRS operators and its counterparty agree on realistic HRS sales volumes for a period of time (for example: the HRS S curve). If sales fall below the agreed volume, the counterparty will pay a penalty price per kilogramme of hydrogen below the agreed level. The penalty price should at least cover fixed HRS expenditure (debt service and fixed OPEX). The HRS operator gets income certainty and the counterparty...
only has to pay if sales stay below the agreed level. The counterparty (could be a government) participates in the HRS risk. The risk is capped (to the agreed sales volume) and the counterparty will only pay if the risk occurs – which is different from a CAPEX grant where unrecoverable lump sum payments are made. Take-or-Pay contracting can be volume based, price based or both. Take-or-pay contracting is an effective and efficient way to support HRS development in a period where FCEV volume growth is critical in the sense that HRS may become financially self-supporting unless FCEV volumes lag behind. Take-or-Pay contracts are not effective if the forecasted volume is low. In that case a CAPEX grant is a better alternative. Take-or-pay contracts have proved their value especially in energy projects with just one buyer.

**Demand Aggregation**
Demand aggregation shifts the focus from supporting HRS with grants to supporting FCEV procurement, leading to HRS revenues from actual HRS use. A demand aggregation strategy prevents the situation where HRS burn money as a result of underutilisation. A key success factor in organising demand aggregation is local knowledge of user groups and car fleets that are potentially suitable to make the transition to FCEVs in the current situation with low HRS network coverage. Early private demand aggregation participation can be organised as follows:

- Identification of car fleet owners with a substantial fleet that is mainly used on a local/regional basis – preferably companies with a special interest in promoting themselves as green companies that care about the environment.
- Identification of individual potential early adopters: local regional drivers within the HRS catchment area.

**Soft Loans**
The abovementioned HRS financial support tools are cash flow tools, leading to additional HRS income or reducing HRS expenditure. This improves HRS bankability in an indirect way. However, it is also possible to improve bankability by direct participation in the HRS funding. A soft loan is basically a loan on lenient terms and conditions compared to regular senior debt. Soft loans can improve bankability in two ways:

- their junior position\(^7\) offers senior debt investors extra comfort which improves senior debt options and conditions,
- a lower interest rate provides ‘cheap money’, bringing debt service volumes down.

Soft loans are funding capital, meaning that the lender receives interest payments and eventually repayment of the principal amount.

\(^7\) A junior position means that the loan has a lower repayment priority than other debts in the event of HRS financial default.
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