Report D5.1, July 2016

User Guide for DCF Model in AURES WP5

AURES

European Commission

HORIZON 2020

Technical University of Denmark

Short about the project

Auctions for Renewable Energy Support: Effective use and efficient implementation options (AURES)

This project helps assessing the applicability of different auction types to renewable support under different market conditions. It also explores which auction types and design specifications suit particular requirements and policy targets in European countries. By establishing best practices and a knowledge sharing network, we contribute to informed policy decision-making and to the success of auction implementations across Europe.

Target-oriented analysis: Through analysis of empirical experiences, experiments and simulation, we will create a flexible policy support tool that supports policy makers in deciding on the applicability of auction types and certain design specifications for their specific situation.

Capacity building activities: We undertake specific implementation cases to derive best practices and trigger knowledge sharing amongst Member States. We strive to create a strong network with workshops, webinars, bilateral meetings, newsletters, a website that will serve as capacity building platform for both policy makers and market participants (including project developers, auctioneers,etc.). Wherever required, we can set up specific bilateral and multilateral meetings on specific auction issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals.

Project consortium: eight renowned public institutions and private firms from five European countries and combines some of the leading energy policy experts in Europe, with an impressive track record of successful research and coordination projects.

This user guide flanks the discounted cash flow (DCF) model developed for AURES WP5. With the model we intend to provide a tool for the simulation of necessary support levels of single investment projects under particular market conditions and assuming country and technology specific project characteristics as well as different auction designs. This document gives an explanation of the implemented calculation methods and provides assistance for interested users.

The DCF model and this user guide contribute to the first of three tasks in work package 5 of the AURES project:

T5.1 Cashflow-type model to analyse changes in private investment incentives

T5.2 Game theoretic modelling of renewable energy auctions

T5.3 Prospective renewable energy system modelling

Report D5.1, June 2016

User Guide for DCF Model in AURES WP5

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Project deliverable:
WP5 – Model based analysis: learning from simulation.
Task 5.1 – Cashflow-type model to analyse changes in private investment incentives

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NOMENCLATURE

Symbols

B- selected non-strategic bid price

b- non-strategic bid price

CF– free cash flow

f- placement factor

I- inflation index

i – inflation rate

l- share of balancing expenditures

m – annual OPEX per kW of production

n – project life time

$neg. CF$ – negative cash flows

p – case probability (p1 for base case, p2 for winning with delay, p3 for winning with non-compliance)

q – power production

R_m- revenues from power market

R_s – revenues from support

r- discount factor

s – support level

T – payable tax

x- corporate tax rate

π – achieved power price

Abbreviations

BEX – balancing expenditures

CAPEX – capital expenditures

OPEX – expenditures for operation and maintenance

WACC – weighted average cost of capital

Indices

t – year

min – minimum within non-strategic bid price range

max– maximum within non-strategic bid price range

Contents

Disclaimer

This document is the user guide for the discounted cash flow (DCF) model, which was developed in the course of task 5.1 of the AURES project. The main output of the model is a non-strategic bid price, indicating that it is mainly based on economic calculations and does not include profound game theoretic modelling. The cash flow model has been published separately to this document on the AURES webpage.

The model consists of four worksheets. The worksheet "Default Values" contains pre-defined values which allow an automatic fill-in of assumptions for a chosen configuration of technology and location for obtaining fast results. In the currently available version of the model, the default values are preliminary estimates and there is no guarantee for their reliability. The project consortium does not take any responsibility for the accuracy or validity of the provided data. It is always up to the user to update the input data according to the current and specific market environment and conditions.

All work on this model was conducted to the best of our knowledge. It is, however, only a simplified representation of reality and the factors involved when estimating bid prices. Individual firms might have very different approaches to formulating actual bid prices. Also, the estimates of total support costs are simplistic – this will depend highly on the specific design in a respective country. DTU takes no responsibility for the results or any activities or measures which possibly result from the application of the model.

1 Model Background

In the course of task 5.1 of the AURES project, we have developed a discounted cash flow (DCF) model intending to simulate the necessary support levels of single investment projects under particular market conditions and assuming country and technology specific project characteristics as well as different auction designs. The main output is a non-strategic bid price, indicating that it is mainly based on economic calculations and does not include profound game theoretic modelling. The cash flow model serves to provide insights for policy makers on how changes in cost structures may affect the necessary support levels of investors. Such insights are important for the designing of auctions and allow for inferences on the attractiveness of an investment project and possible risk premiums.

The cash flow model aims at developing an understanding for impacts on support levels under different design choices, yet, it is not intended to predict the actors' actual bid prices based on strategic behaviour simulations. This issue will be addressed in the subsequent task 5.2 where an agent based simulation method will be applied.

The output generated with the DCF model always represents a single investment project. The output will feed into tasks 5.2 and 5.3, where the perspective will be broadened to a multi-bidder market.

For the sake of simplicity the model is confined to some main features and does not include all design parameters which could possibly be implemented in RES auctions in the EU. If the implementation of specific features which are not included in the basic version of the model is needed, please feel free to contact Lena Kitzing (lkit@dtu.dk).

2 Used calculation methods

All calculations are made in the worksheet "DCF".

The model uses a discounted cash flow approach. Starting from year one the free cash flows are calculated as given in the example in Table 1 for each year of the project lifetime. However, not all components occur in every year (see section 2.1). The free cash flow of year zero (year of contracting) includes only the capital expenditures (CAPEX).

Table 1: calculation of the annual free cash flows

	Revenues from power market
	+ Revenues from support
Total revenues	
	- OPEX
	- Balancing expenditures
EBITDA	
	- CAPEX
	- Payable tax
Free cash flow	

All free cash flows are then discounted using the assumed internal discount rate of the project specified by the user.

The used evaluation method is the net present value (NPV), which is the present value of the anticipated free cash flows generated by the project. The NPV is calculated in the following manner (Crundwell, 2008):

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

where CF_t is the free cash flow in year t, n is the project lifetime and r is the project specific discount rate. Here, the applied discount rae is the user defined weighted average cost of capital (WACC). The evaluation date is year 0, i.e. the year of contracting the project.

The model output includes two more evaluation parameters. These are the internal rate of return (IRR) of the project and the levelised cost of energy (LCOE). The IRR is defined as (Crundwell, 2008):

$$0 = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t}$$

The LCOE are defined as:

$$LCOE = \frac{PMT}{q}$$

where q is the annual power production and PMT are the levelised annual costs defined as:

$$PMT = \frac{r}{1-(1+r)^{-n}} \cdot NPV_{(neg.CF)}$$

with $neg.CF$ being the negative cash flows during the project lifetime. All cash flows in Table 1 with a negative sign are included in the negative cash flows except of the depreciation. It is assumed that the annual power production is constant during the whole operating time.

2.1 Components of the free cash flow calculation

The model includes no economies of scale effects for the simulated technologies. Therefore, all single components of the annual free cash flows are calculated per kW of installed capacity. Furthermore, the terminal value is assumed to be zero, i.e. the installation has no remaining value at the end of the project lifetime. The model uses nominal values for all components.

2.1.1 Revenues from power market

The revenues from power market (R_m) for each operational year t are calculated as:

$$R_{m,t} = q \cdot \pi_t \cdot I_t$$

where q is the annual power production, π_t is the achieved power price in year t and I_t is the inflation index. The inflation index for year t is calculated as:

$$I_t = I_{t-1} \cdot (1 + i)$$

with i being the inflation rate. The inflation index of the evaluation year (t=0) is set to 1.

2.1.2 Revenues from support

The revenues from support payments (R_s) occur in each year during the support period, starting with the first year of operation. Depending on the chosen remuneration type the revenues are calculated differently.

In case of sliding premium remuneration:

$$R_{s,t}^{sliding} = q \cdot (s - \pi_t \cdot I_t)$$

where s is the support level and q is the annual power production, π is the achieved power price and I_t is the inflation index of year t.

In case of fixed premium remuneration:

$$R_{s,t}^{fixed} = q \cdot s$$

where s is the support level and q is the annual power production.

2.1.3 CAPEX

The CAPEX is the total capital investment for the project. For the model it is assumed that the total CAPEX occurs in year 0.

2.1.4 OPEX

The costs for operation and maintenance occur yearly during the operating time of the project. It is assumed that they are constant in real terms, i.e. the respective user input is multiplied with the inflation index to result in the nominal value. Thus, the annual OPEX are calculated as:

$$OPEX_t = m \cdot q \cdot I_t$$

where m are the user defined annual OPEX per kW power production, q is the annual power production and I_t is the inflation index of year t. The balancing expenditures should not be included here.

2.1.5 Balancing expenditures

The balancing expenditures (BEX) are the expenditures associated with trades on the balancing market to compensate for errors in the power production forecast. For each year of the operating time they are calculated as:

$$BEX_t = l \cdot R_m$$

where l is the user defined share of balancing expenditures and $R_{m,t}$ are the revenues from power market in year t.

2.1.6 Depreciation

The model assumes linear depreciation, i.e. the total CAPEX is divided by the user defined depreciation time to result in the annual, nominal depreciation. The depreciation occurs during the depreciation period counting from the first year of operation. It is subtracted from the earnings before interests, taxes, depreciation and amortisation (EBITDA) to result in the earnings before interests and taxes (EBIT).

2.1.7 Payable tax

The payable tax (T) is calculated for each year of the operating time. It is calculated as:

$$T_t = x \cdot EBIT_t$$

where x is the corporate tax rate defined by the user.

2.1.8 Free Cash Flow

The free cash flow in the year of contracting (year zero) is calculated as:

$$CF_0 = -CAPEX$$

The free cash flow in all following years of the project lifetime is calculated as:

$$CF_t = EBITDA_t - T_t$$

with T_t being the payable tax.

2.2 Model outputs

The main output of the model is the selected non-strategic bid price. Under additional results, the model provides the project NPV and IRR when receiving the selected non-strategic bid price as support payment under different assumption scenarios. Furthermore, there is the possibility to change the support level and see the effect on the project NPV and IRR, the LCOE and the NPV of total support payments. Finally, a threshold analysis can be performed, which displays the threshold values for the capacity factor, the CAPEX and the WACC to result in a project NPV of 0 assuming the inserted support level.

2.2.1 Non-strategic bid price range

A non-strategic bid price equals the support level, which sets the project's expectation value to 0. The expectation value is calculated by the sum product of the NPV of three possible expectation cases and their respective case probability as illustrated in Figure 1:

$$exp = NPV_{base} \cdot p1 + NPV_{del} \cdot p2 + NPV_{nc} \cdot p3$$

where $p1$ is the probability of the basic expectation case(winning in the auction and operate the project as scheduled), $p2$ is the probability of the expectation case of winning in the auction with delayed operation start ("Winning With Delay") and $p3$ is the probability of the expectation case of winning in the auction with non-compliance, i.e. not constructing the project at all ("Winning and Non-compliance"). $p2$ and $p3$ can be defined by the user, while p1 is adjusted automatically, so that $p1 + p2 + p3 = 1$.

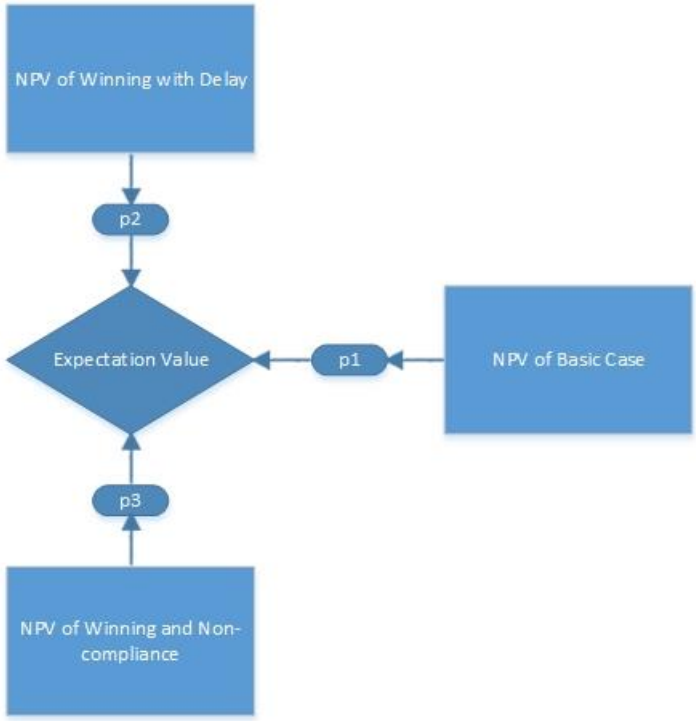

Figure 1: calculation of the project's expectation value

The non-strategic bid price ranges are based on different scenarios, namely the "low", "medium" and "high" scenario. Table 2 shows which assumptions are used for the parameters capacity factor, achieved price, CAPEX and OPEX under the different scenarios. All other parameters are the same among all of them. The non-strategic bid price range consists of all possible non-strategic bid prices between the "low" and the "high" scenario.

Table 2: definition of the different scenarios

Scenario	Capacity factor	Achieved price	CAPEX	OPEX
low	high	high	low	low
medium	medium	medium	medium	medium
high	low	low	high	high

The non-strategic bid price range can be further limited by the factors inserted under “Investor’s Risk Averseness”. The full range uses the data inserted by the user under “Assumptions” in the section “Project Characteristics”. The full range is then limited on the upper and lower part by the percentages inserted by the user (see also section 3.2).

2.2.2 Placement factor

The placement factor (f) is calculated as the product of the individual placement factors corresponding to the chosen states of the parameters under “Market Conditions” and “Market Position”. The factors are defined in the worksheet “Placement Factors” together with all possible combinations of the parameter states and the resulting placement factor.

2.2.3 Selected non-strategic bid price

The selected non-strategic bid price (B) is calculated as:

$$B = b_{max} + f \cdot (b_{high} - b_{min})$$

where b_{max} is the maximum non-strategic bid price within the non-strategic bid price range and b_{min} is the minimum non-strategic bid price within the non-strategic bid price range. f represents the placement factor. b_{max} and b_{min} also take into account the inserted values under “Investor’s Risk averseness”, i.e. they are the non-strategic bid prices for the scenario “high” and “low” respectively shifted by the user defined values (see also section 3.2).

The non-strategic bid price range, the placement factor and the selected non-strategic bid price are shown in the section “Main Results”. Figure 2 shows an example of the main model outcomes. The black bar shows the whole non-strategic bid price range (when the investor’s risk averseness is not taken into account) and the red dot marks the selected non-strategic bid price. The exact numbers for the placement factor and the selected non-strategic bid price are given below the chart. The red triangles represent the range limits according to the inserted investor’s risk averseness. Mind that the placement of the non-strategic bid price is within this limited range. In the example in Figure 2 the red dot is exactly in the middle between the two triangles according to the placement factor of 0.5 (selected in this example), *not* in the middle of the whole non-strategic bid price range.

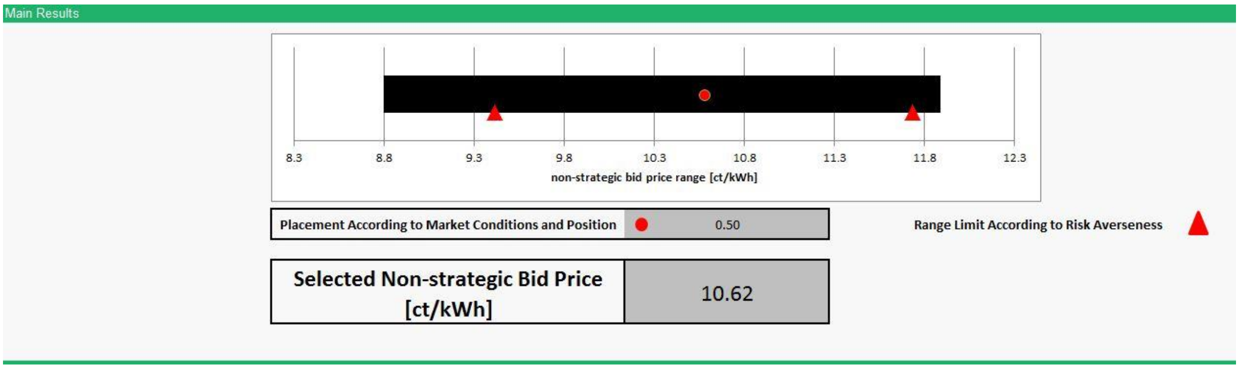

Figure 2: example for "Main Results". The lower limit is increased by 20% and the upper limit is reduced by 5% due to the investor's risk averseness

2.2.4 NPV and IRR

The project NPV and project IRR are the respective values for the basic expectation case when the project receives the selected non-strategic bid price as support. The project NPV and IRR are displayed for the "low", "medium" and "high" scenario.

2.2.5 Support analysis

In the result section "Support Analysis" it is possible to change the support level the project actually receives. The button "calculate necessary support" automatically inserts the selected non-strategic bid price as received support. When the value is changed, the output fields below show the new project NPV and IRR (for the basic expectation case and "medium" scenario), the LCOE and the NPV of the support payments.

2.2.6 Threshold analysis

When clicking the button "calculate threshold values" the threshold values for the capacity factor, the CAPEX and the WACC are displayed. The threshold value is the value which sets the NPV of the basic expectation case to 0 in the scenario "medium" and with the received support inserted above.

3 User Inputs

3.1 Project Characteristics

All input data in this section relates to the simulated project. The evaluation year of the project starts in year 0. The lead time starts with year 1 and the operating time starts directly after the lead time.

For example, if the lead time is defined as two years, and the operating time is defined as 25 years, the evaluation date would be year 0, and the operating time would start in year three and last until and including year 27. The maximum project lifetime (i.e. lead time + operation time) which can be simulated is 35 years. For example, if the operation time is defined as 30 years, the maximum lead time, which can be inserted, is 5 years.

The length of delay cannot be more than the maximum project lifetime (35 years) minus the defined project lifetime (lead time + operation time). Figure 3 shows the time line of an example project as defined with the shown project parameters.

The depreciation time has to be given in whole years and linear depreciation starting with the first year of the operating time is assumed.

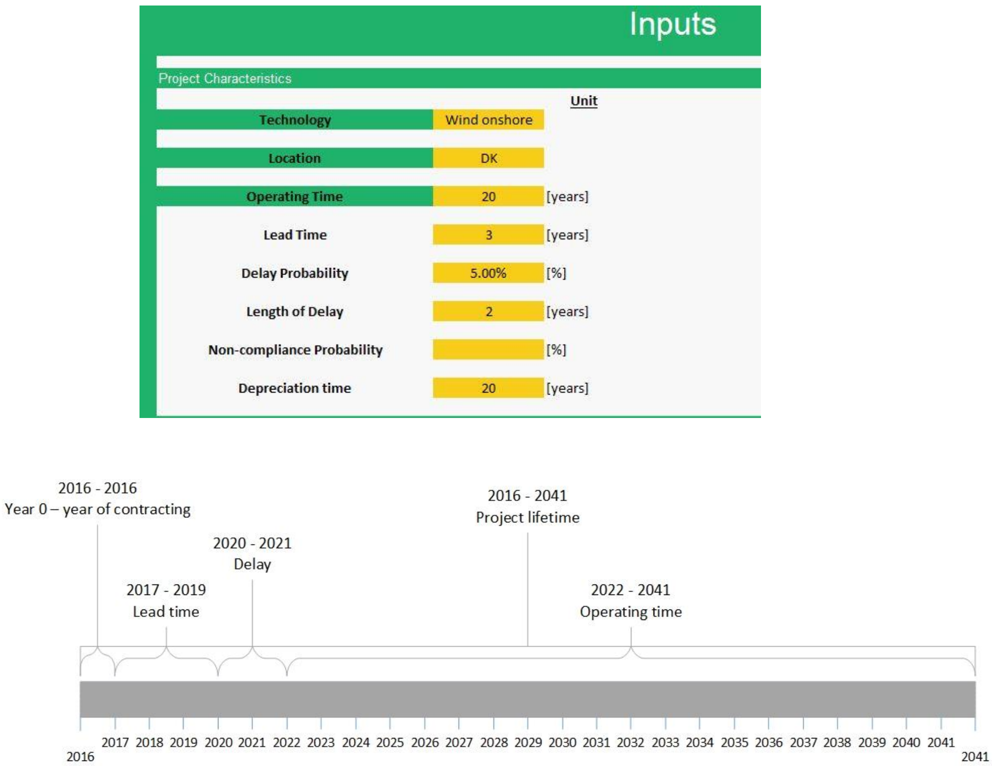

Figure 3: example time lime for a project with evaluation date 01.01.2016 in the expectation case "Winning with Delay" as defined in the "Project Characteristics" above. In the basic expectation case, the delay period does not occur and the project lifetime ends in year 2039.

3.1.1 Assumptions

The section "Assumptions" defines the main assumption data for the project. For the capacity factor, the achieved power price, the CAPEX and OPEX the model needs assumptions for the three scenarios (see Table 2). In case of only one assumption, this value should be inserted in all three cells (Low, Medium and High).

The achieved price is the power price specifically valid for the simulated technology (i.e. possible up-lift or down-lift effects should be included[1]). The market price is simulated with a linear development. An example is shown in Figure 4. The price inserted under "Start" is the price in project year 1. The prices inserted for the different scenarios are the prices in project year 25 (represented by the black squares in Figure 4). All prices should be defined in real terms at valuation date.

For the balancing expenditures, the corporate tax rate, the inflation rate and the internal discount factor (WACC) only one basic assumption is used. The balancing expenditures are defined as a percentage of the annual revenue on the power market (not including the revenue from support payments) and will occur annually during the operating time.

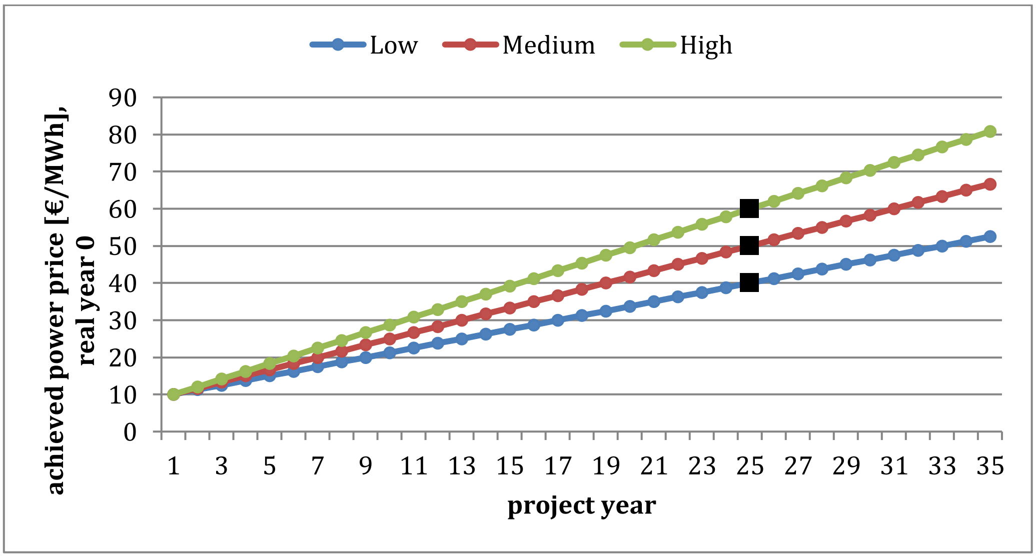

Figure 4: example of simulation of achieved power price. Inserted achieved prices: "Start" at 10€/MWh, "Low" at 40€/MWh, "Medium" at 50€/MWh and "High" at 60€/MWh

3.2 Investor's risk averseness

The section gives the opportunity to simulate different levels of risk averseness of the simulated investor by limiting the non-strategic bid price range resulting from the assumption data. The limitation can be applied both on the upper and lower end. The input parameters are defined in % and can only be between 0% and 50%.

If for example 5% is inserted in "Increase Lower Limit by", the resulting non-strategic bid price range will be limited by shifting the minimum non-strategic bid price of the range up by 5% of the total range size. The shift will be qualitatively displayed by the left red arrow in the black bar above as shown in Figure 5. Under this

[1] Up-lift and down-lift effects occur when the technology does not receive the average power price over a year, but a higher (up lift) or a lower (down lift) one. Those effects are caused by the technology specific production profiles combined with the fluctuations of the power price in the specific market area.

configuration, the resulting non-strategic bid price range in the section “Main Results” will not start with the non-strategic bid price in scenario “low” on the lower end, but with the up-shifted non-strategic bid price.

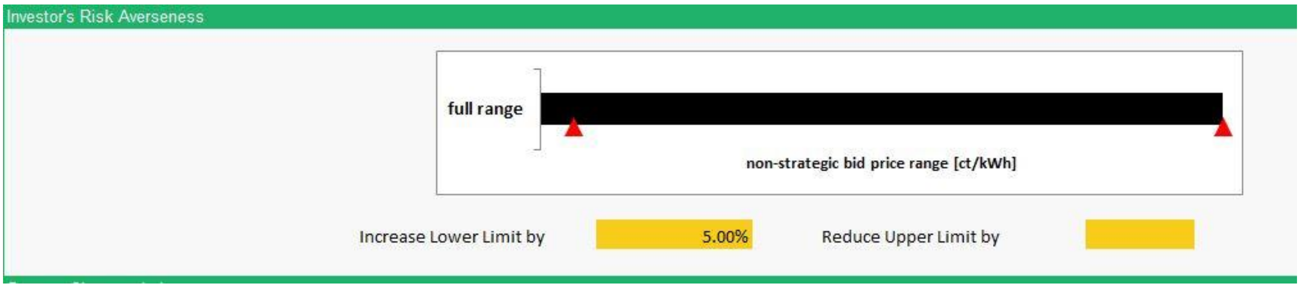

Figure 5: example 1 of a configuration of the “Investor’s Risk Averseness”

Both limitations can be used independently from each other. If 20% is inserted in “Increase Lower Limit by” and 5% is inserted in “Reduce Upper Limit by”, the resulting non-strategic bid price range will start with the non-strategic bid price in scenario “low” up-shifted by 20% of the total range size and end with the non-strategic bid price in scenario “high” down-shifted by 5% of the total range size. The shift of the upper limit is qualitatively displayed by the right red arrow as shown in Figure 6.

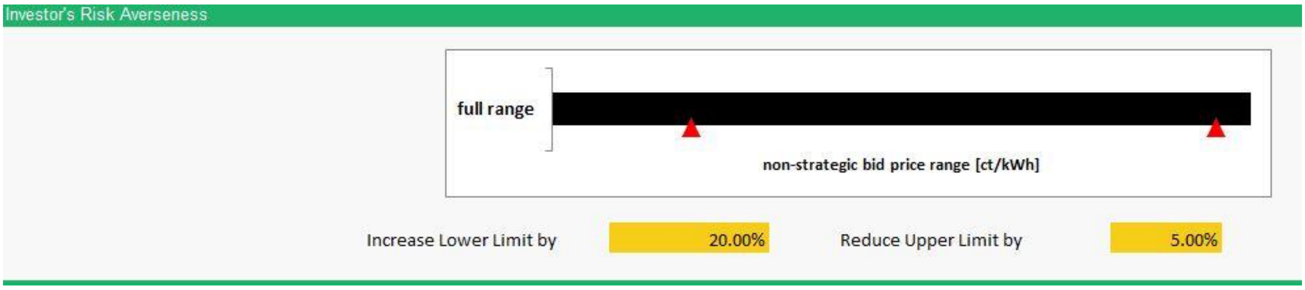

Figure 6: example 2 of a configuration of the “Investor’s Risk Averseness”

3.3 Support Characteristics

All information under “Support Characteristics” refers to the auction design. The duration of support starts with the first year of the operation time. The prequalification cost/sunk cost are a fraction of the CAPEX which have to be paid by the developer even in the expectation case “Winning and Non-compliance” (see Figure 1). Since they are a part of the CAPEX, they should not exceed any value for the CAPEX inserted in the section “Project Characteristics”, where the prequalification cost/sunk cost should already be included.

In the expectation case “Winning and Non-compliance” only the prequalification cost/sunk cost occur in year 0, while in the other expectation cases the total CAPEX occur.

3.3.1 Penalty for delay

First of all the definition for delay according to the simulated auction design should be inserted under “in year __ after contracting”. The model will then check whether the expected delay inserted in the section “Project

Characteristics" will induce penalties for delay. This is the case if the lead time plus the delay is greater or equal the definition for delay in the auction design. If this is not the case, the cells for the different delay penalties appear red and the inserted numbers will not be applied in the calculations. If the cells appear yellow, the penalties apply in the calculations. Mind that the number inserted for the definition of delay should not be higher than the number inserted for the definition of non-compliance (see next paragraph).

It is possible to simulate three kinds of penalties for delay: a one-off payment, a reduced support level and a reduced support duration. They can be used all simultaneously or one by one. If a type of penalty should not be applied in the simulation, the respective cell must be left blank.

It is assumed that the negative cash flow related to the one-off payment will occur in the first year of delay, i.e. the year inserted under "in year __ after contracting". The reduced support level will occur over the whole duration of support.

3.3.2 Penalty for non-compliance

The definition of non-compliance according to the simulated auction design should be inserted under "in year __ after contracting". The model will then check whether the non-compliance probability in "Project Characteristics" is greater than zero. If this is not the case, the cell for penalty for non-compliance appears red and the inserted number will not be applied in the calculations. If the cell appears yellow, the penalty applies in the calculations.

It is assumed that the negative cash flow related to the penalty for non-compliance will occur in the year inserted under "in year __ after contracting".

Figure 7 shows an example of a possible penalty configuration. The lead time plus the delay will induce a penalty for delay, but no penalty for non-compliance applies since the non-compliance probability is not defined. Therefore, the reduced support level will apply in the calculations in the expectation case "Winning with Delay". The one-off payment for non-compliance will not apply.

Figure 7: example for penalty configuration

3.4 Market conditions and market position

Under the section "Market Conditions" the level of competition in the auction, the sunk cost and the secondary benefits can be defined, using pre-defined stages in the drop-down list. Here, the sunk cost refer to the perception of the sunk cost defined under "Support Characteristics" relating them to the investors overall financial capability. It addresses the question "How much do the sunk cost hurt the investor in case of not winning in the auction?". Secondary benefits describe the possible (strategic) advantages for the investor from winning a specific simulated project. This could be for example an increase in market share or expected synergy effects with adjacent sites.

The section "Market Position" expresses the individual investor's position in the market compared to the competitors. The chosen state for market position relates the overall project costs of the simulated investor to the mean costs on the market. If it is assumed, that the project costs of the individual investor (e.g. the CAPEX) are lower compared to the average market level, e.g. due to high experience and a highly developed supply chain, the state "strong" should be chosen here. If the opposite is the case, "weak" should be chosen.

The "Ambition to Win" expresses the investor's willingness to win a contract in exactly this simulated auction round. Considerable circumstances here could be if the auction is a one-shot auction or if it is organised in many consecutive rounds (and the bidder could accept to wait for the next round in case of losing). Additionally, it should be considered whether the investor has many alternatives to participate with the project.

4 General advice and assumptions

Some of the calculations in the model update automatically when changing an input, others do not. Generally, it can be said that the "Support Level Ranges" and "NPV and IRR" do only change when clicking on the button "calculate necessary support" using the current inputs. The placement factor, however, is calculated directly when changing the stages of the market conditions and the market position. It is therefore recommended to always click the button "calculate necessary support" again, when doing any changes in the inputs.

Furthermore, the button "new project" clears all input cells. It is recommended to use the button before defining a new project to not confuse old and new user inputs.

The "Support Analysis" does not require a new calculation of necessary support. When the button is used, the received support is filled automatically with the result under "Chosen Support in Limited Range".

In case of simulating sliding premium remuneration, the revenues from support are calculated as:

$$R_{sp} = q \cdot (s - \pi \cdot I)$$

where q is the annual power production, s is the support level, π is the achieved power price and I is the inflation index.

In this way it is assumed that the reference price used by the public authority to calculate the support payments per kWh (difference between support level and reference price) equal the inserted achieved price. Depending on national regulation this does not have to be the case for an individual producer due to different averaging approaches (see for example Germany[2]).

The tax calculations used in the DCF do not include any balance sheet calculation. Therefore, the shown tax payments will most likely not occur in exactly those amounts in reality where the investor settles them with the overall balance sheet. The model does not include any loss carryforwards in the tax calculation.

The factors building the placement factor corresponding to the stages of the market conditions and market position are not based on profound game theoretic modelling. They only give a general indication in order to choose one bid price within the simulated non-strategic bid price range. Further investigations on the strategic placement of the bids in an auction will be done in the subsequent work in task 5.2 and 5.3 of AURES work package 5.

The NPV of the support payments is calculated using the same discount rate as for the calculation of the project NPV, i.e. the one inserted under "project characteristics".

[2] https://www.netztransparenz.de/de/Marktwerte.htm

5 Q&A

5.1 What is the difference between the sunk cost under "Support Characteristics" and the sunk cost under "Market Conditions"?

The sunk cost under "Support Characteristic" are part of the calculation of the overall project expectation value (see Figure 1) in the expectation case "Winning and Non-compliance". They do directly influence the non-strategic bid price range.

The stage chosen for sunk cost under "Market Conditions" only influences the placement factor, i.e. it does not influence the non-strategic bid price range. Here, the focus is on the placement of the necessary support within the range. If the sunk cost are perceived high from the simulated investor's point of view the stage "high" should be chosen, which will lead to a lower placement of the non-strategic bid price. The reasoning behind this is to avoid losing in the auction (i.e. not being awarded a contract) due to a too high bid price. However, the corresponding factor is not based on profound game theoretic modelling and gives only an indication.

5.2 Why is there an additional limitation of the assumption range?

The idea behind the possibility of limiting the assumption range is to include the possibility to simulate different levels of risk averseness under the same overall assumption ranges. For example, the capacity factor could be generally defined as P90[3], P50 and P20 case for the "Low", "Medium" and "High" scenario. Afterwards, two different investors could be simulated, where investor one is more risk averse than investor two. When simulating investor one, the lower limit of the non-strategic bid price range could be limited by 5%, corresponding to a lower capacity factor than the one inserted under the "High" scenario. Investor two, in contrast, is less risk averse and wants to include also the P20 case as possible best case for the capacity factor. This will in the end lead to a higher level of required support for investor one than for investor two, even if all other inputs and assumptions are the same.

5.3 Why is the project NPV for the scenario "medium" negative even if the placement factor is 0.5?

The strategic placement factor works linearly (see section 2.2.2). Therefore, 0.5 does not necessarily correspond to the "medium" scenario, since the "medium" scenario is not always "in the middle" between "low" and "high" scenario.

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[3] P90 corresponds to a level of annual power production, where the probability is 90% that the actual power production in a year will be more or equal than this level. P50 and P20 express the same for a probability of 50% and 20% respectively.

5.4 How can I implement another type of remuneration?

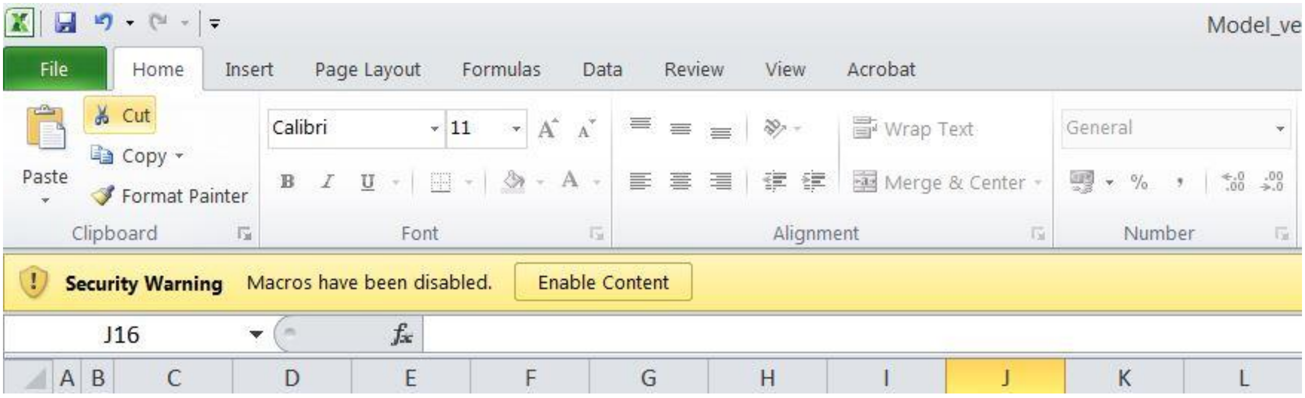
For the sake of simplicity the model is confined to some main features and does not include all design parameters which could possibly be implemented in RES auctions in the EU. If the implementation of specific features which are not included in the basic version of the model is needed, please feel free to contact Lena Kitzing (lkit@dtu.dk).

You can also contact us if you need other calculation methods to be implemented such as a loss carryforward calculation in case of high penalties and a ring fenced project.

Activate the buttons

All calculations in the model are initiated by clicking on the buttons in the sheet "Control and Results". After you have clicked on the button, a VBA code will run in the background. In order to use this feature, you have to enable macros in the model file. If you try to use the buttons without enabling macros before, the following message will appear on your screen (referring to the respective macro the button uses):

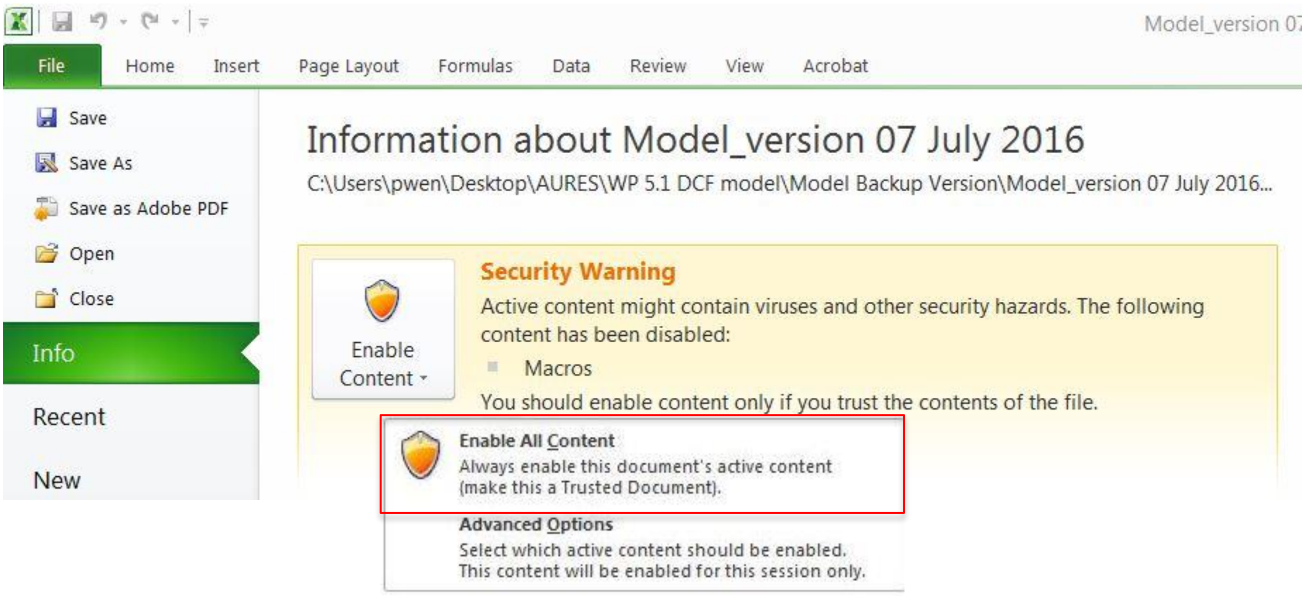
Normally, a yellow message bar should appear, when you open the document as shown in the picture below:



Here, you have to click on "Enable Content" in order to activate the buttons.

If the message bar does not appear or if you have closed it without clicking on the "Enable Content" button, you have to enable the macros in the backstage view. To do so, please execute the following steps (as also shown in the pictures below):

1. Click the **File** tab
2. In the **Security Warning** area, click on **Enable Content**
3. Choose **Enable All Content, Always enable this document's active content (make this a Trusted Document).**



For further information concerning the macro security settings, please also refer to the official office support under Microsoft (2016).

6 Sources

Crundwell, F. K. (2008). *Finance for Engineers*. Springer.

Microsoft. (2016). Enable or disable macros in Office files. Retrieved July 11, 2016, from https://support.office.com/en-us/article/Enable-or-disable-macros-in-Office-files-12b036fd-d140-4e74-b45e-16fed1a7e5c6

AURES is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

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