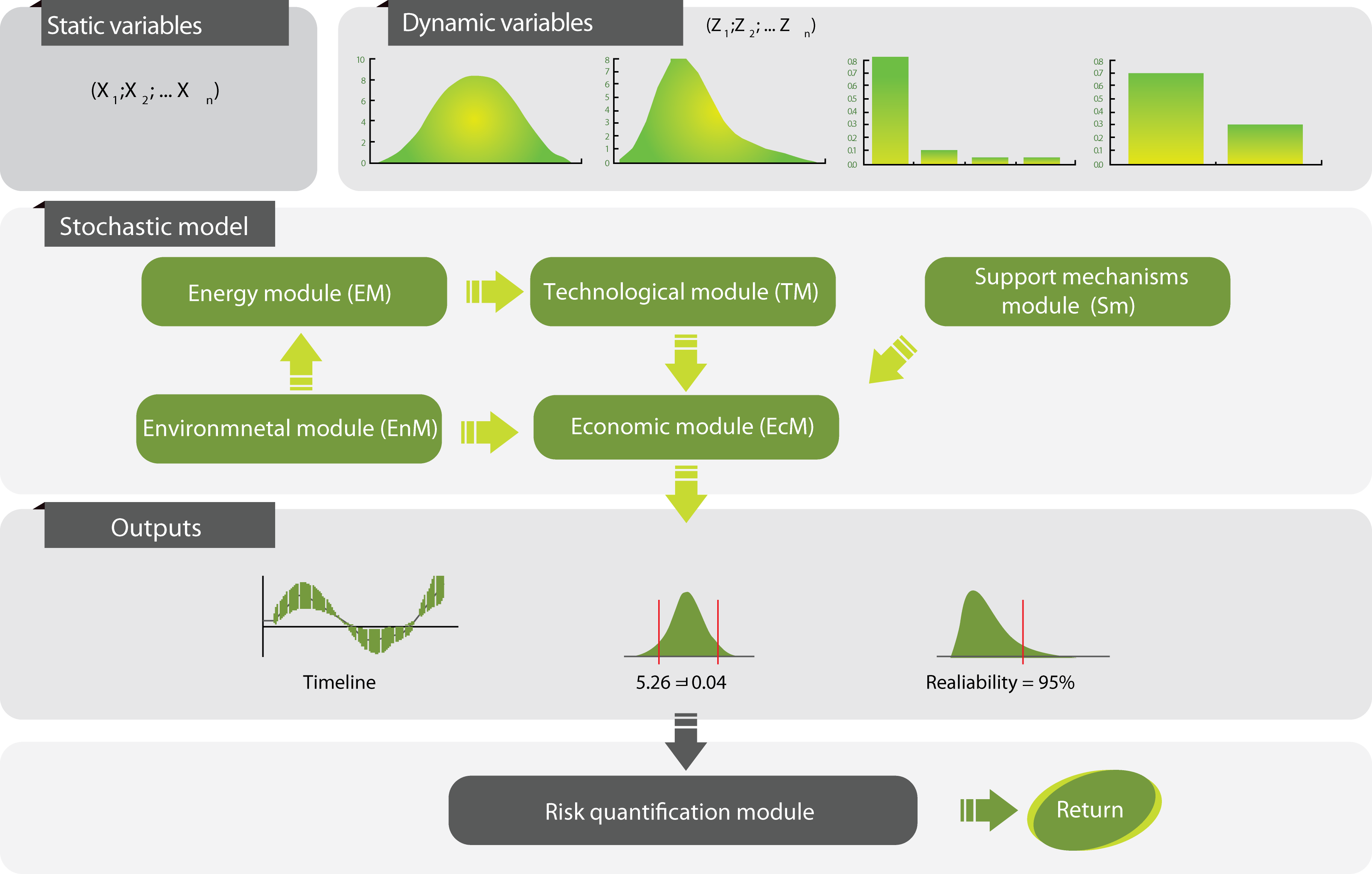
Specification of modules

**The model simulates the financial results & cash flow of an investment in a solar power plant. The aim is to make the model stochastic using Monte Carlo approach. The variability of sun irradiation, technical reliability and variability of economic parameters will be taken into account.**

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# General functioning

The model functions in this sequence:

1. Multiple results of cash flows are generated by running multiple times the linked modules EcM, EM, TM, SM – each time the final results are written to a database
2. The RM is run
3. Results are displayed

# Energy module (EM)

## Module description

Takes care of:

* prediction of daily availability of primary energy

## Key inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Input | type | Source | Comment |
| 1 | monthly solar insulation | matrix – float |  | averages for each month in the year |
| 2 | monthly average daily max T | matrix-float |  | averages for each month in the year |
| 3 |  |  |  |  |

## Outputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Output | type | To be used in | Comment |
| 1 | 30 years of daily solar insulation | matrix - float | Tm |  |
| 2 |  |  |  |  |

## Definition of functions

### initModule

### generatePrimaryEnergyAvaialbility

Parameters:start date

based on data from database creates the prediction

for each day of month ..insulation = average monthly insulation

# Technological module (TM)

## Module description

Takes care of:

1. conversion of primary energy into electricity

## Key inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Input | type | Source | Comment |
| 1 | 30 years of daily solar insulation |  |  |  |
| 2 |  |  |  |  |

## Outputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Output | type | To be used in | Comment |
| 1 | electricity in kWh for each day | float |  |  |
| 2 |  |  |  |  |

## Definition of functions

### initModule

Sets values to:

1. energyConversionFactor

### generateElectiricityProduction

based on insulation generates electricity production values fro each day

produced electricity = insulation \* energyConversionFactor

### getElectricityProduction

Parameters: dateStart, dateEnd

getElectiricityProduction = reading or sum of readings from the table

# Economic module (EcM)

## Module description

Calculates a series of monthly cash flows

## Key inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Input | type | Source | Comment |
| 1 | electricity market price | float | user input |  |
| 2 | expected growth of electricity prices | float | user input |  |
| 3 | amounts of investment | float | user input |  |
| 4 | electricity produced | float | TM |  |
|  |  |  |  |  |

## Outputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Output | type | To be used in | Comment |
| 1 | cash flow for 30x12 months |  | RM |  |
| 2 | cash flow for 30 years |  | RM |  |

## Definition of functions

### initModule

### getRevenue

parameters: dateStart; dateEnd

E:= getElectiricityProduction;

sum for all days in the period: E \* price + subsidies (E; date)

### getCosts

parameters: dateStart; dateEnd

sum of costs for all days in teh period = num of days \* costs per month/30

### calculateTaxes

net revenue in the year \* tax rate

enetered only in december

### getLoanPayment

parameters: dateStart; dateEnd,.....

calculate the payment for the payment based on standard procedures

### calculateInterests

((loans in previous period + loans in current period) /2) \* interest rate \* num of days/365

### calculateFCF

calculates the free cash flow based on IS nad BS

= net revenue + amortisation – investments in long term assests

### generateISandBS

parameters: dateStart; dateEnd

1. generate table – 30 years with 12 months
2. fill in revenues by get running getRevenues for each month
3. fill in costs by running getCosts for each month
4. fill in start positions for assets
5. fill in start positon of capital and loans
6. fill in loan by running getLoanRepayment for each period and decrease the loan for the specified amount
7. fill in depreciation by running getDepreciation for each month
8. fill in interest by running calculateInterests
9. calculate EBIT, EBT (earnings before taxes)
10. calculate taxes by running calculateTaxes
11. calculate net income
12. update the balance sheet (with net income, depreciation etc.)
13. if funds in a period are missing – increase short term loans; if excess cash, decrease short term loans

### calculateReturn

calculates IRR and writes it to the database

# Environmental module (EcM)

## Module description

1. Sets limits to production due to environment protection factors (e.g. for hydro – sets biological minimum)
2. Calculates the obligation at the end of the projetc (e.g. cost of disposal)

## Key inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Input | type | Source | Comment |
| 1 | cost of disposal per kW installed power |  |  |  |
| 2 |  |  |  |  |

## Outputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Output | type | To be used in | Comment |
| 1 | cash flow for 30x12 months |  | RM |  |
| 2 | cash flow for 30 years |  | RM |  |

## Definition of functions

### initModule

# Support mechanism module (SM)

## Module description

Takes care of:

1. defining the amount of subsidy for investment
2. defining the amount of subsidy for production
3. definition of tax relief/subsidy

## Key inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Input | type | Source | Comment |
| 1 | country | text | user input | used to define the subsidy system |
| 2 | amounts of investment | float | user input |  |
| 3 | electricity produced | float | EM |  |
| 4 | installed power | float | power |  |

## Outputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Output | type | To be used in | Comment |
| 1 | amount of subsidy for investment | float | economic module |  |
| 2 | amount of subsidy for energy |  |  |  |

## Definition of functions

### initModule

sets values for:

1. dateStartOfSubsidy
2. dateEndOfSubsidy
3. susbsidyPerKWh

### subsidyInvestment

Input parameters:

1. investment type (land, equipment)
2. amount of investment in EUR
3. nominal installed power in kW

Output: amount of subsidy = 0

### subsidyProduction

Input parameters: energy, date

Output: amount of subsidy = if date < dateEndOfSubsidy then energy \* subsidy/kWh else 0.

### subsidyTax

Input parameters:

Output: amount of tax decrease = 0

# Risk quantification module (RM)

## Module description

Takes care of:

* calculates the variability of return
* calculates VaR of internal rate of return
* calculates the average rate of return

## Key inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Input | type | Source | Comment |
| 1 | multiple series of cash flows for 30x12 months + returns |  | EM |  |
| 3 | factors for CAPM model |  | user input |  |
|  |  |  |  |  |

## Outputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | Output | type | To be used in | Comment |
| 1 | variability of return | histogram - table |  |  |
| 2. | average rate of return |  |  |  |

## Definition of functions

### initModule

### makeHistogram

calculates the values for the histogram

### outputHistogram

outputs histogram

### outputXYchart

outputs XY chart