UNIONE GEOTERMICA ITALIANA

Kenya Renewable Energy Bootcamp

Training sessions with Italian experts

Kenya, 10-14 July 2023

Long Term Strategy

for a Geothermal Project, from Exploration to Cultivation

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UGI-ETS

Long Term Strategy

Let's start answering the following question:

Is an Investment in Geothermal Energy profitable?

We must see the problem from the investor's point of view.

Among RES, Geothermal guarantees the maximum reliability and stability. But, mainly in Greenfield Projects, also high risks.

Under what conditions can it give even higher incomes?

Have a sight on *payback time*, *NPV* , …

Long Term Strategy

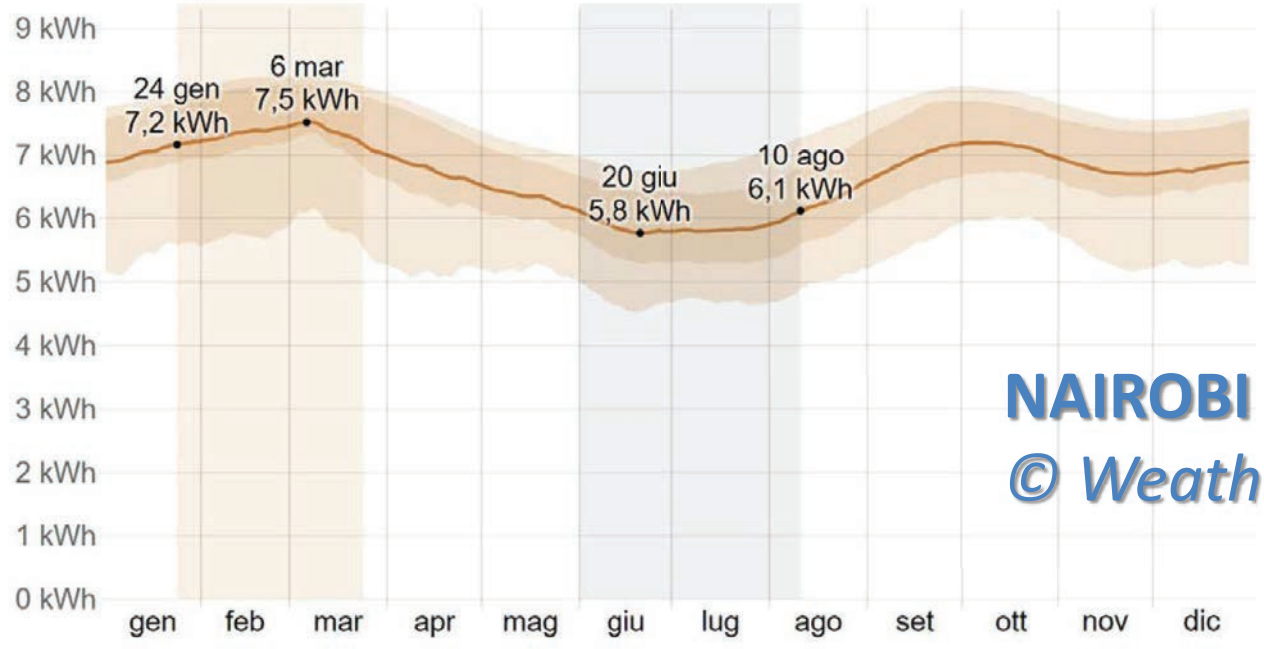
To face the risks of an investment in *renewable energies* it is necessary to know (to estimate) the *cost* and *profitability* of the investment.

The possible revenues depend on the production *forecast*; in other words: on the *future availability* of the resource.

Long Term Strategy

In the case of photovoltaics, estimating industrial and financial costs is easy.

Reliable measurements of solar radiation are available , for every season and for every place.



NAIROBI

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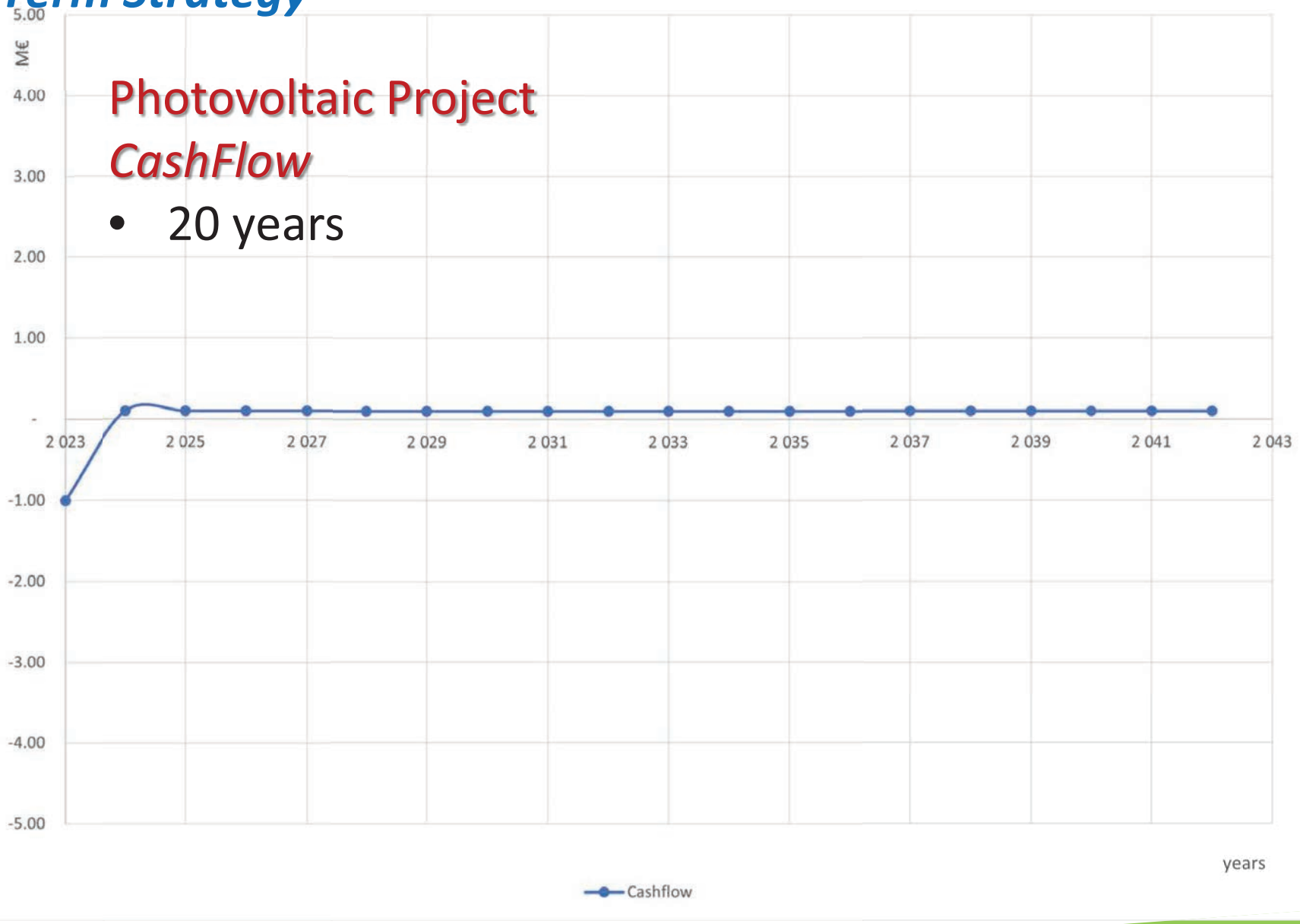
Long Term Strategy

Photovoltaic Project

CashFlow

- 20 years

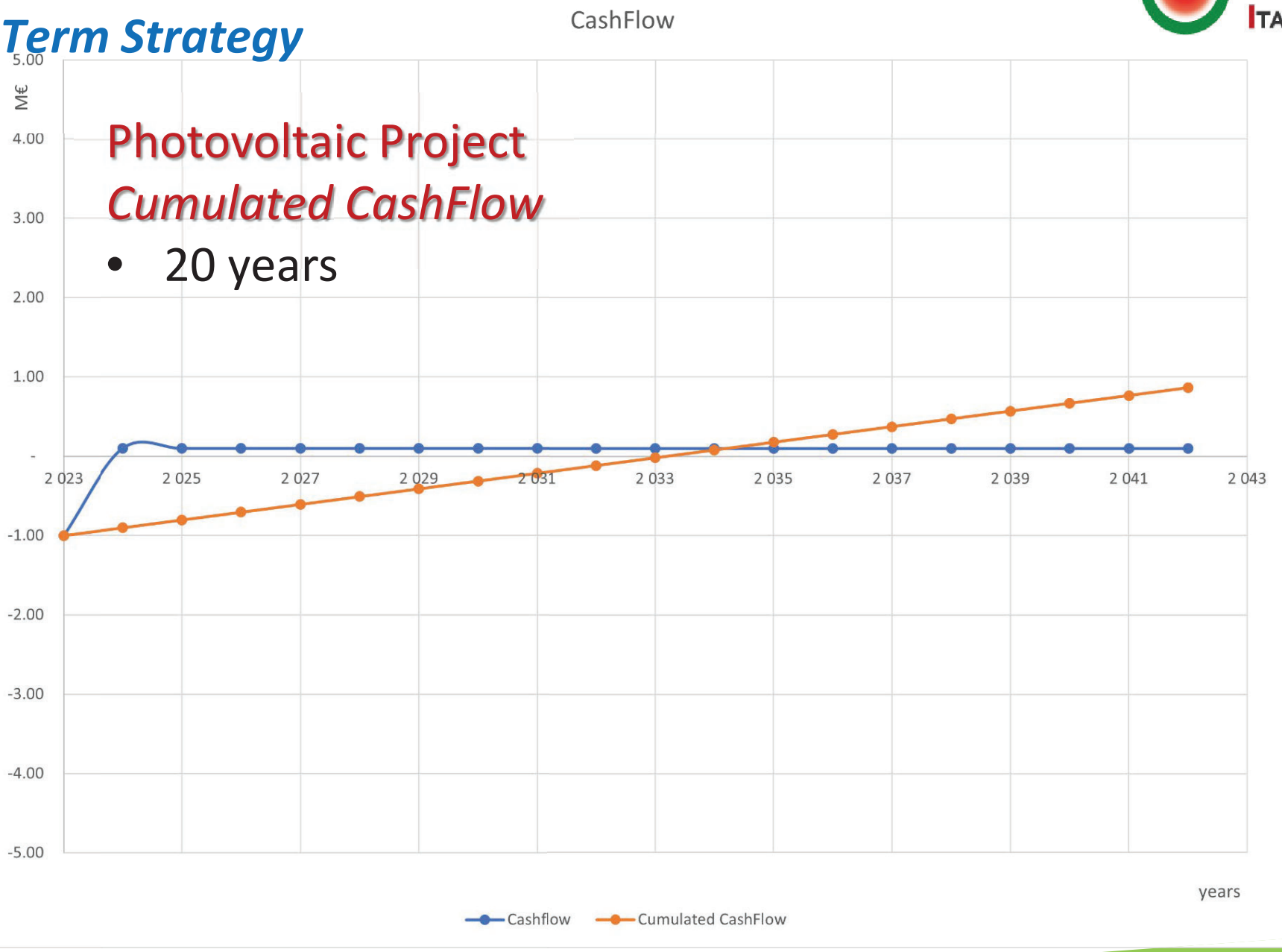


Long Term Strategy

Photovoltaic Project

Cumulated CashFlow

- 20 years

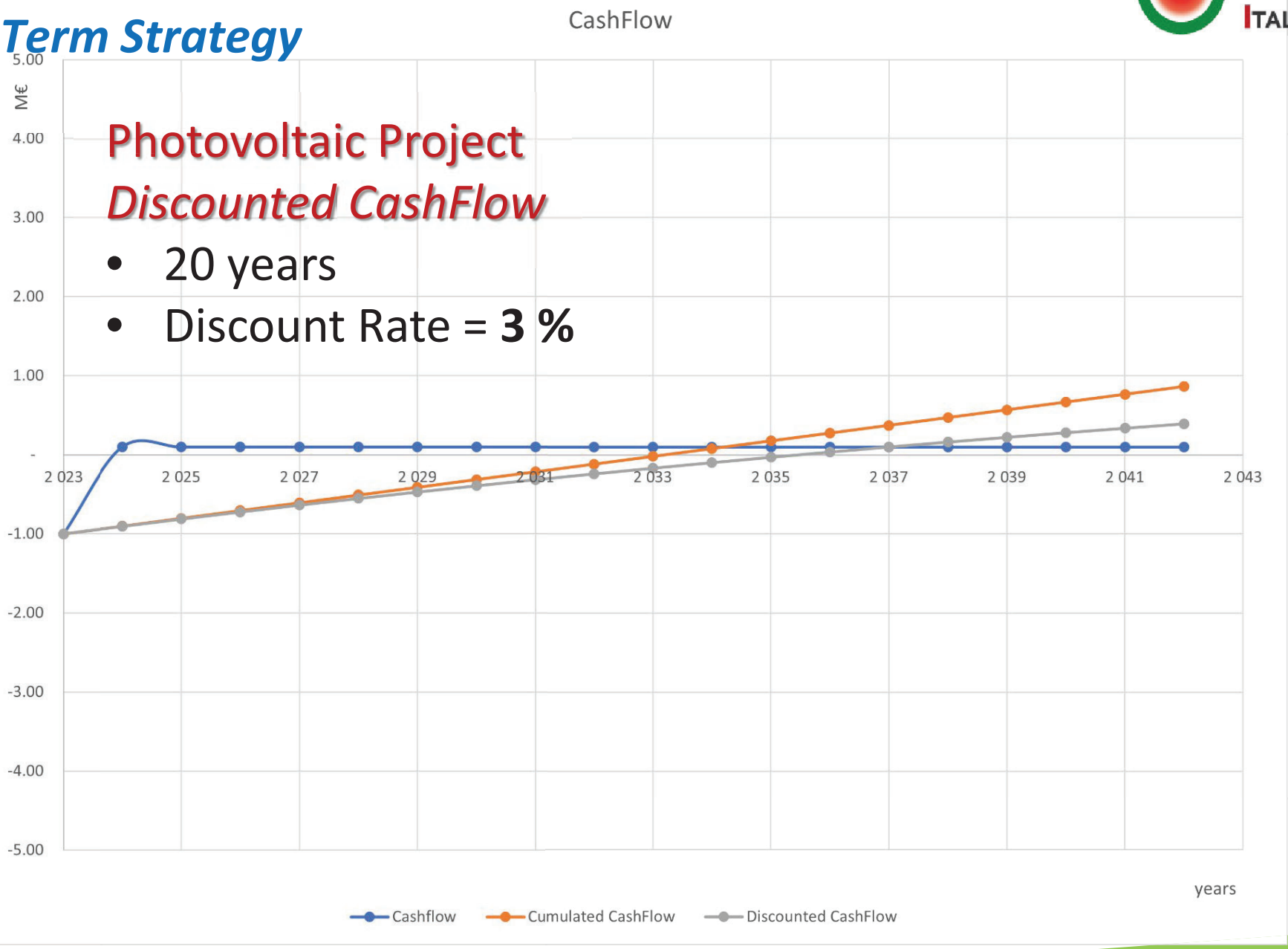


Long Term Strategy

Photovoltaic Project

Discounted CashFlow

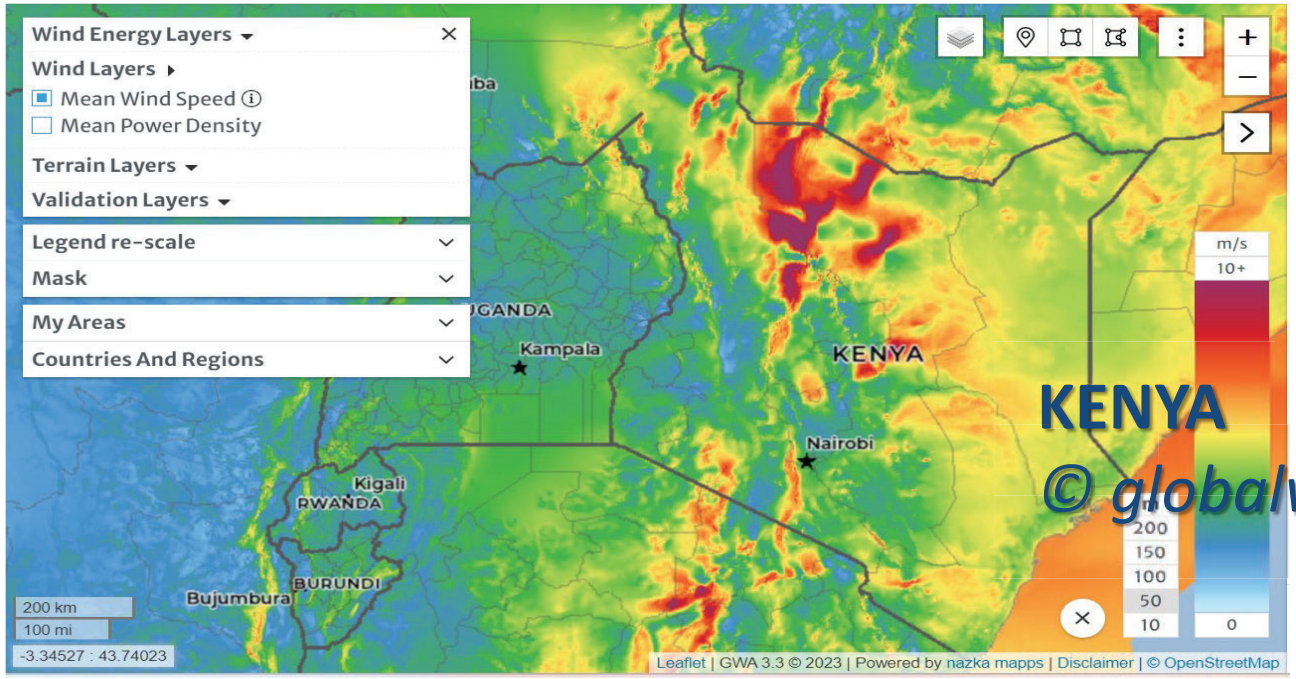
- 20 years
- Discount Rate = **3 %**



Long Term Strategy

To help for a wind investment, wind Atlas' are available.

Anyway, due to local orography, it is needed to make measurements for at least 2 years.



KENYA

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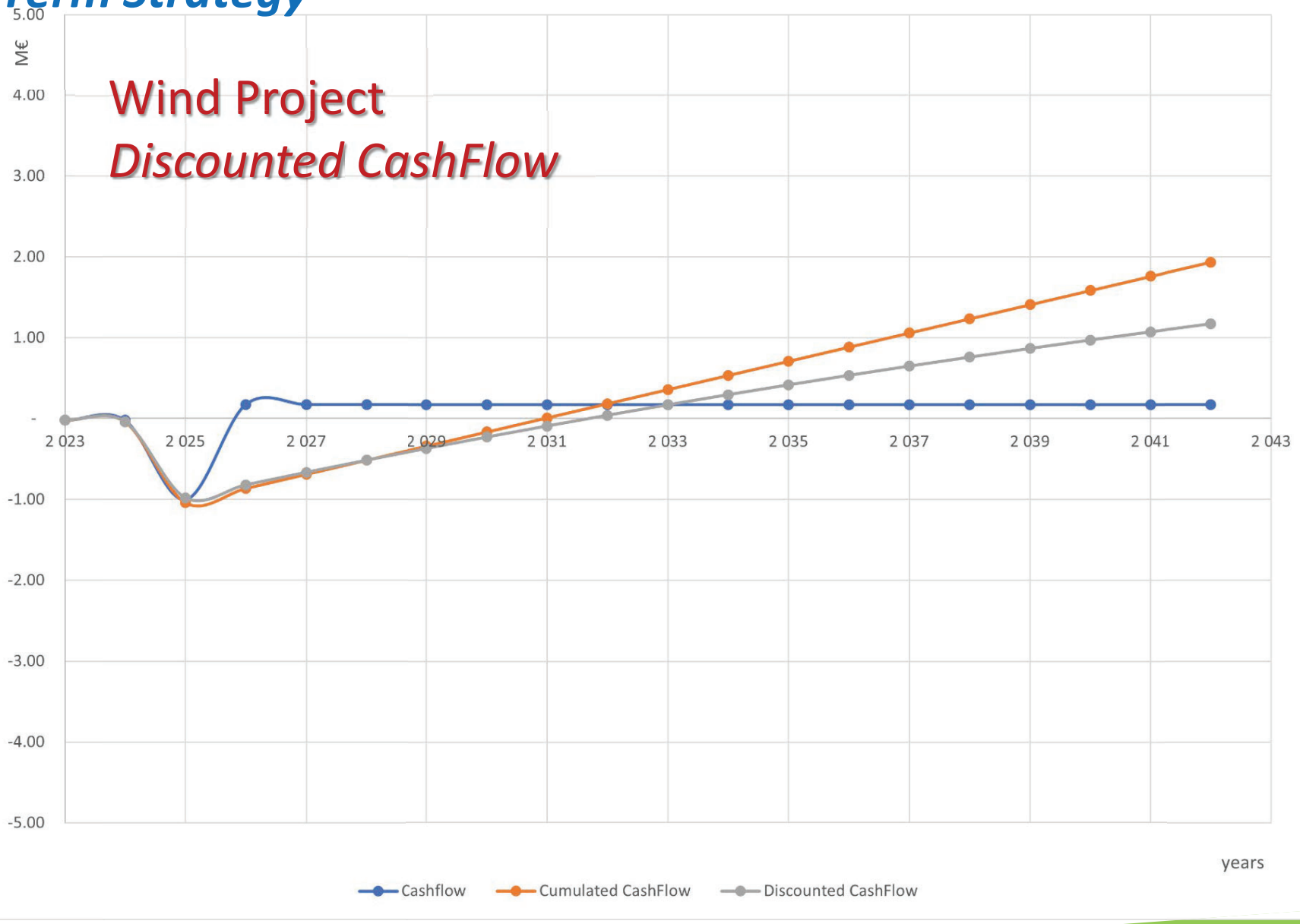
Long Term Strategy

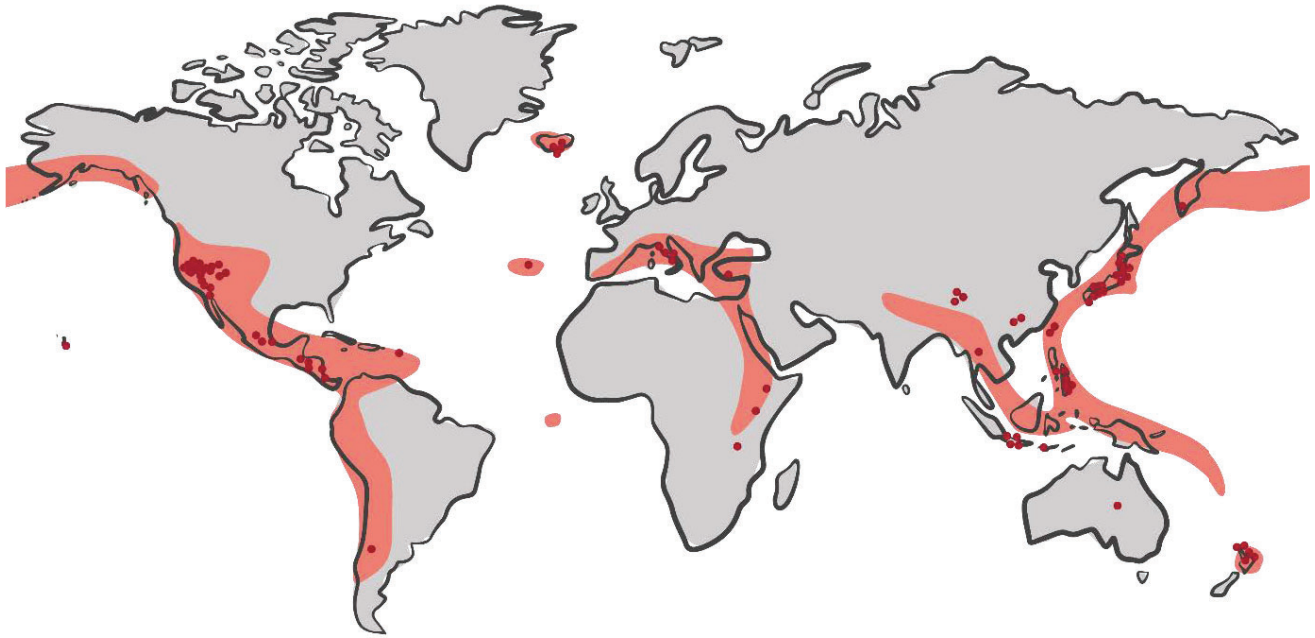
Wind Project
Discounted CashFlow



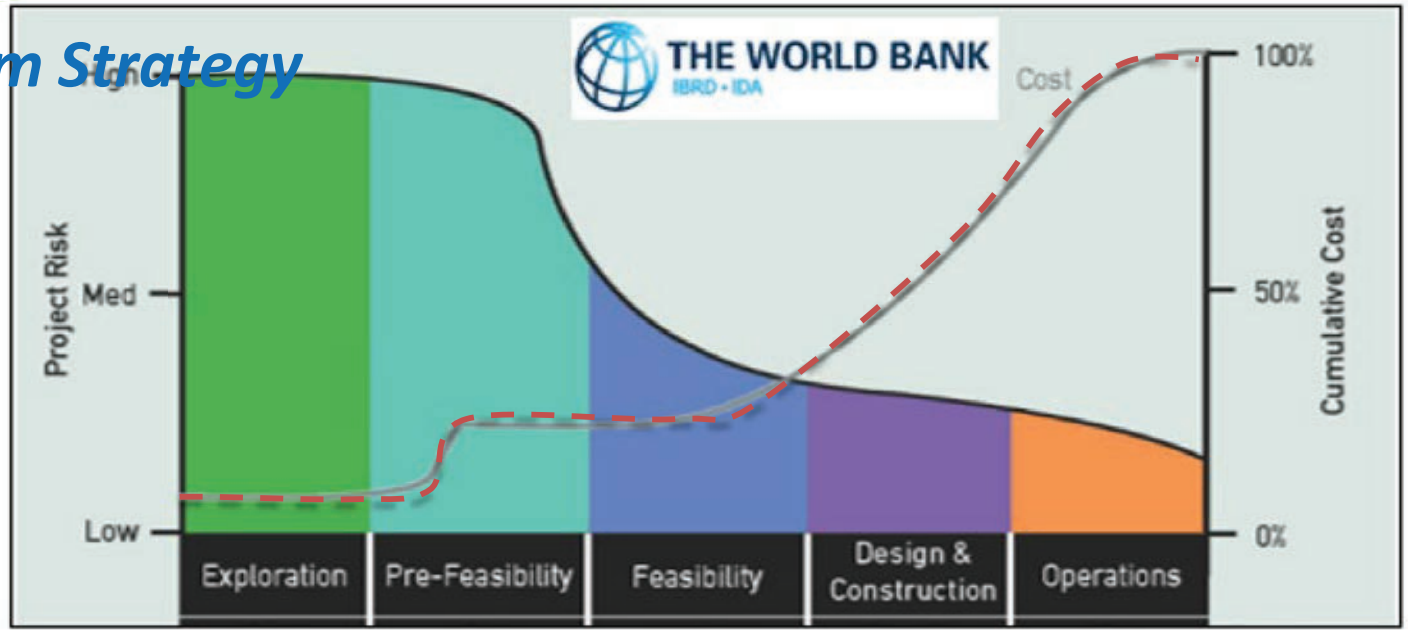
Long Term Strategy

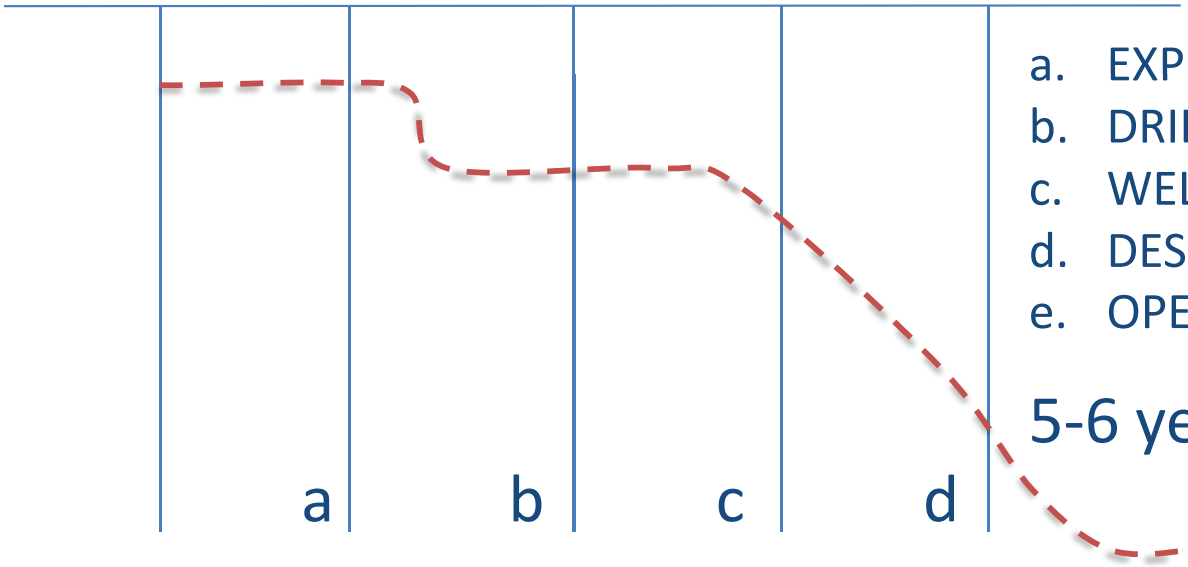
If you decide for a geothermal investment, no available information are detailed enough to indicate where to drill the first well without risks.

An accurate Surface Exploration must be done!



Long Term Strategy



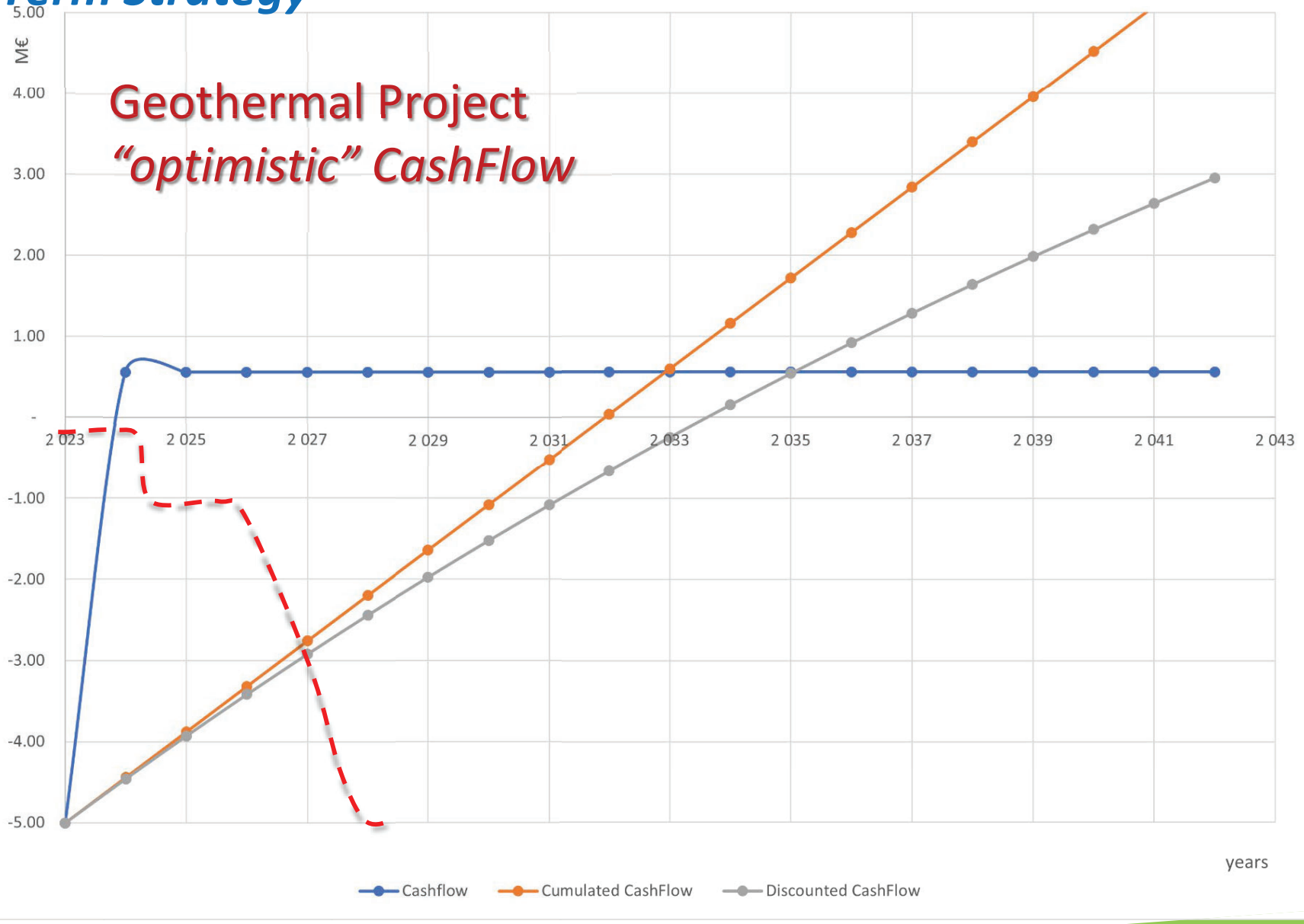


a. EXPLORATION
b. DRILLING
c. WELL TESTING
d. DESIGN & CONSTRUCTION
e. OPERATION & MAINTENANCE

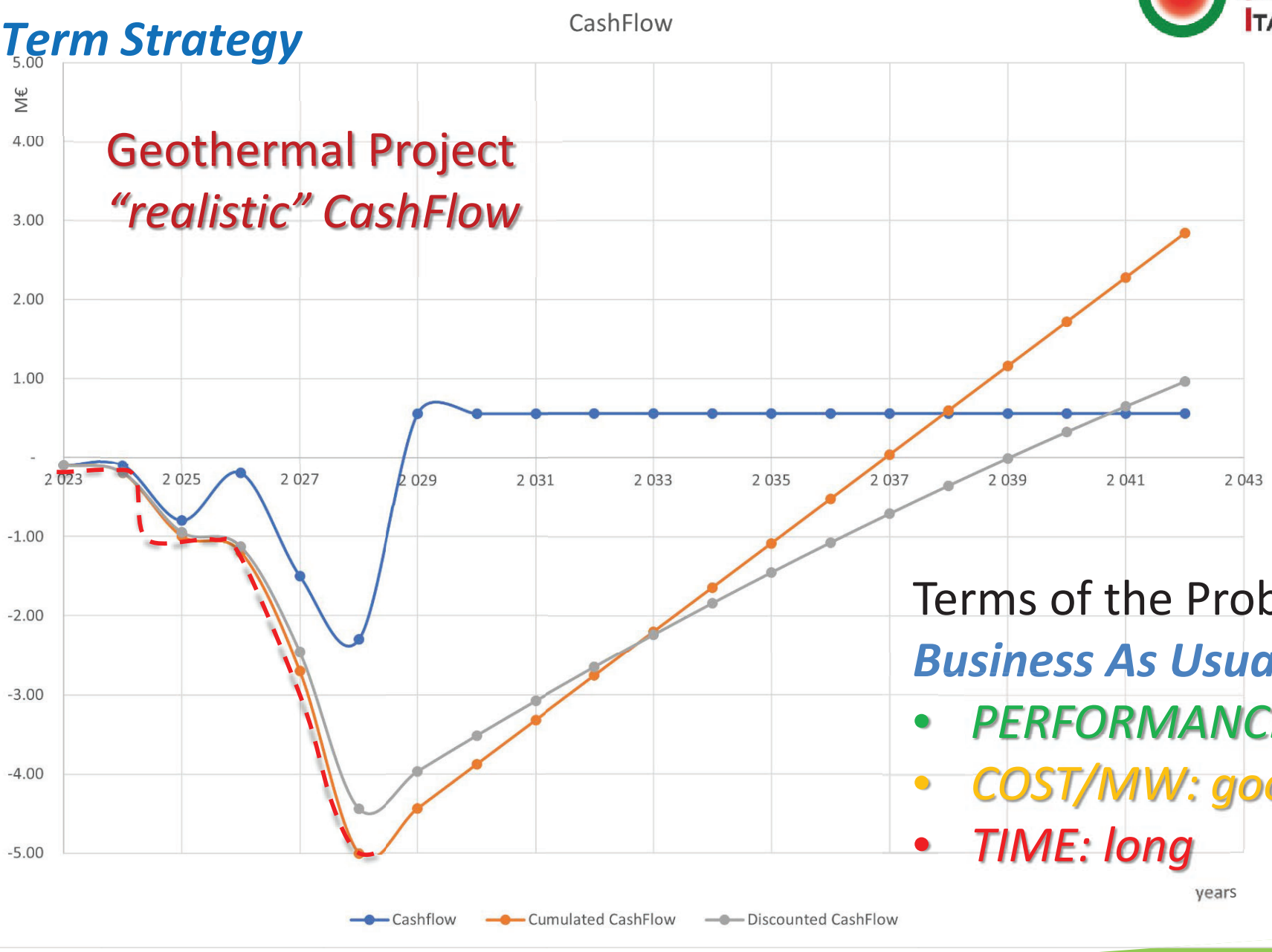
5-6 years

Long Term Strategy

Geothermal Project
"optimistic" CashFlow



Long Term Strategy



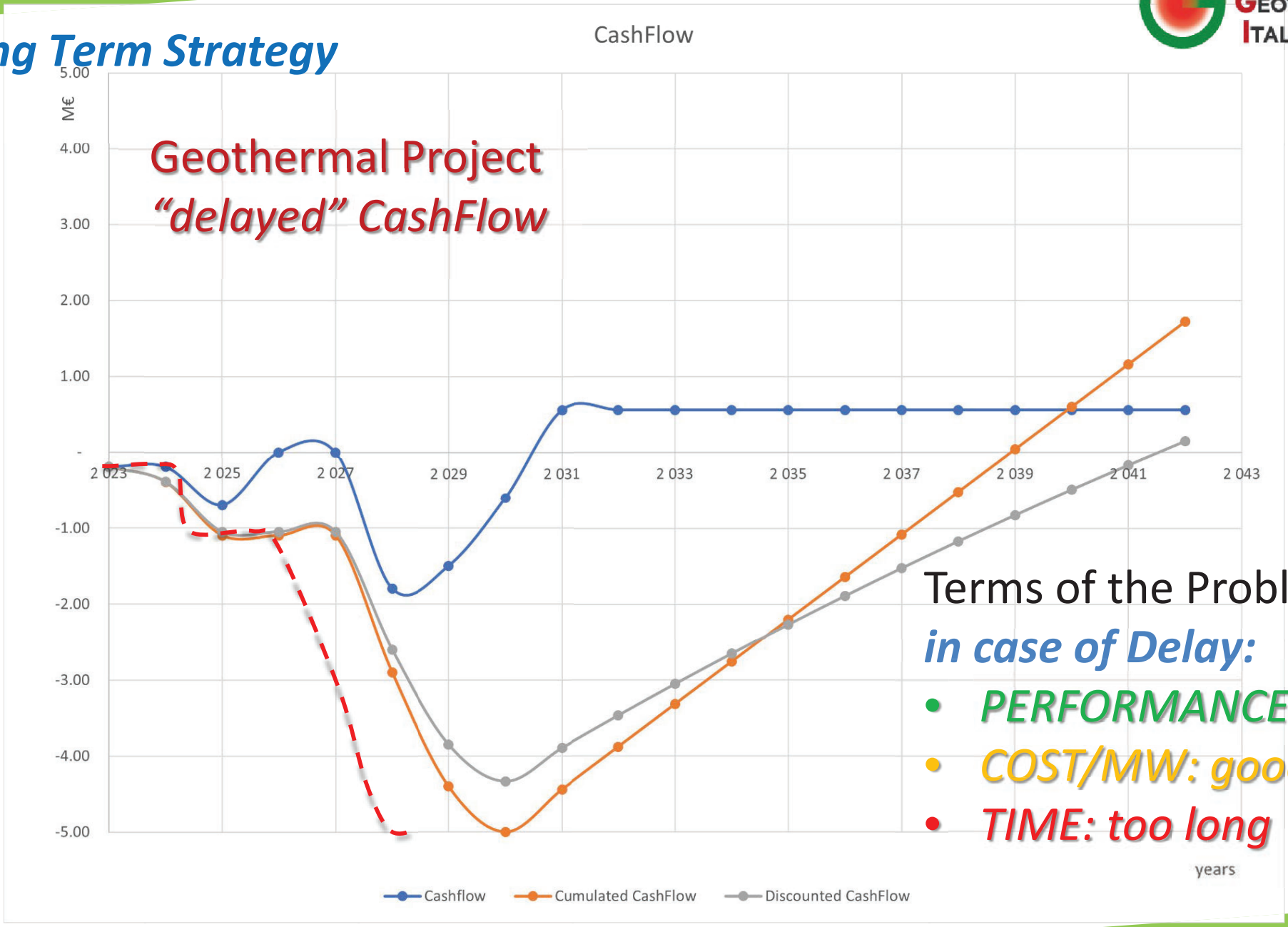
Geothermal Project
"realistic" CashFlow

Terms of the Problem:

Business As Usual

- *PERFORMANCE: best*
- *COST/MW: good*
- *TIME: long*

Long Term Strategy



Geothermal Project
"delayed" CashFlow

Terms of the Problem:

in case of Delay:

- *PERFORMANCE: best*
- *COST/MW: good*
- *TIME: too long*

Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the MAIN CONCERN in ***all*** Phases:

a. EXPLORATION
b. DRILLING
c. WELL TESTING
d. DESIGN & CONSTRUCTION
e. OPERATION & MAINTENANCE

Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

a. EXPLORATION

TARGET is:

- to ***mitigate*** drilling risks
- to ***detect*** the Reservoir location and its thermodynamic characteristics
- to create a ***3D model*** of the subsoil

Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

a. EXPLORATION
b. DRILLING

TARGET is:

- to ***connect the Reservoir*** with the surface in the shortest time and at the minimal cost
- To ***adapt*** operation to the new information collected (***Well Logging***)
- To ***increase the knowledge*** on the subsoil

Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

a. EXPLORATION
b. DRILLING
c. WELL TESTING

TARGET is:

- to verify the ***thermodynamic characteristic*** of the resource and its availability
- to ***collect reliable data*** useful for the Plant Design and identify its best Working Point

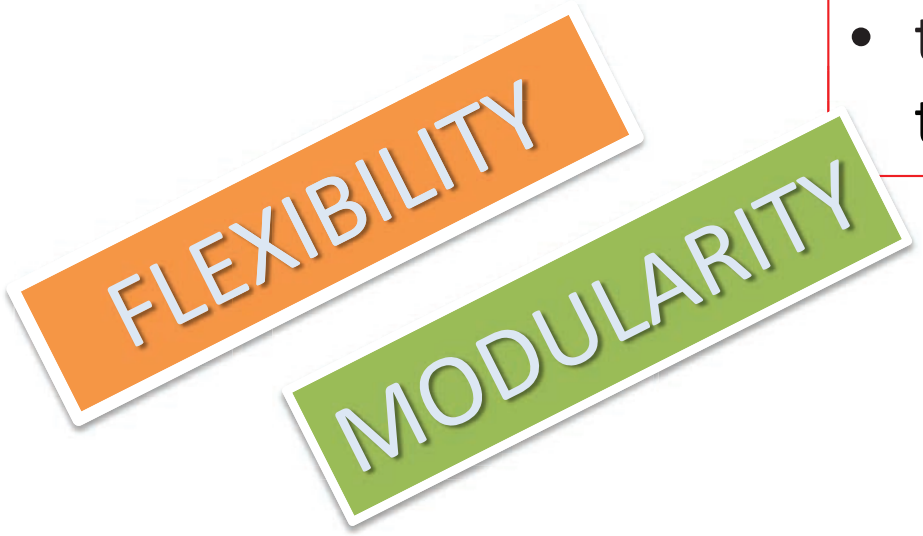
Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

a. EXPLORATION
b. DRILLING
c. WELL TESTING
d. DESIGN & CONSTRUCTION

TARGET is:

- to ***select*** the most appropriate technology
- to ***erect*** the Gathering System and the Power Plant in the shortest time



Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

a. EXPLORATION
b. DRILLING
c. WELL TESTING
d. DESIGN & CONSTRUCTION
e. OPERATION & MAINTENANCE

TARGET is:

- to ***increase*** availability
- To ***reduce*** O&M costs

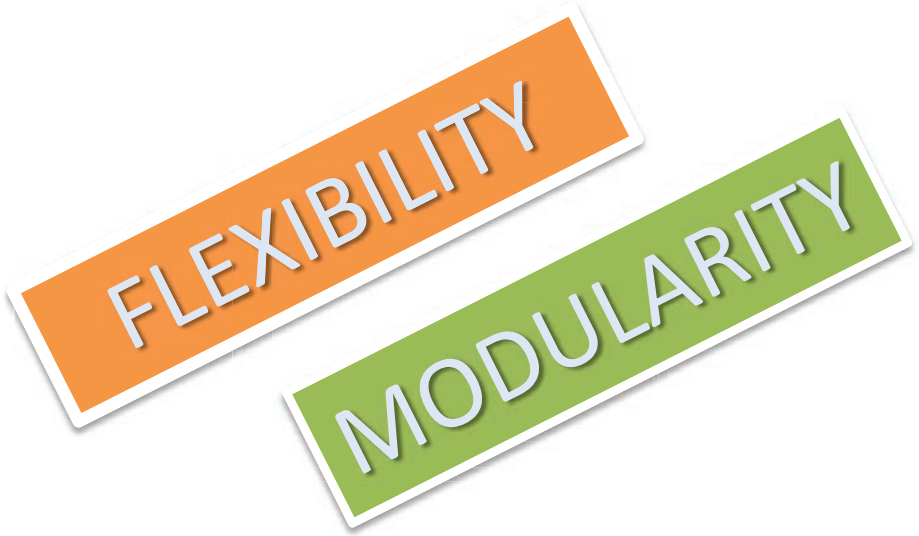
MODULARITY

SUPERVISE

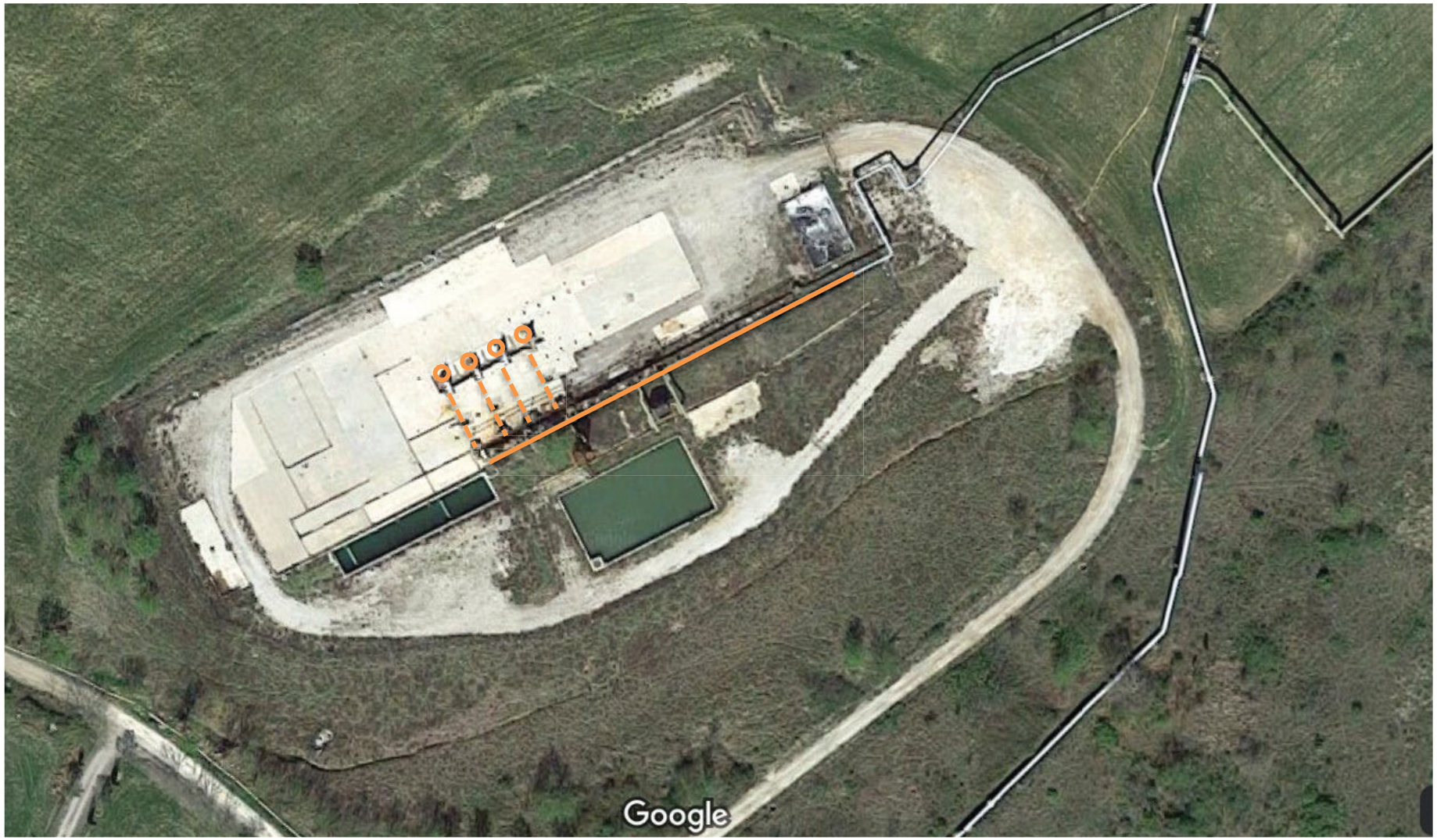
Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

a. EXPLORATION
b. DRILLING
c. WELL TESTING
d. DESIGN & CONSTRUCTION
e. OPERATION & MAINTENANCE



Long Term Strategy in DRILLING



Long Term Strategy

Managing *TIME*, *COST*, *PERFORMANCES*
is the FRAME in ***all*** Phases:

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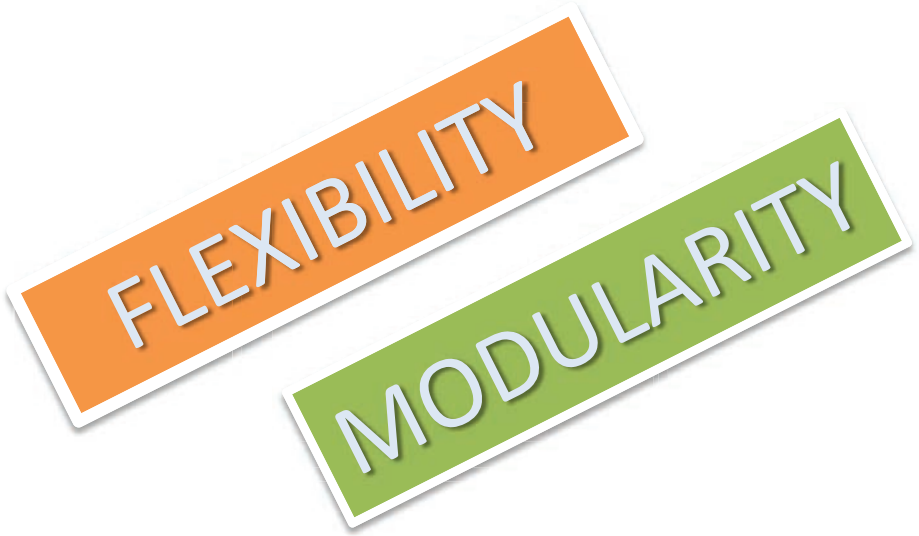

Long Term Strategy in DESIGN & CONSTRUCTION

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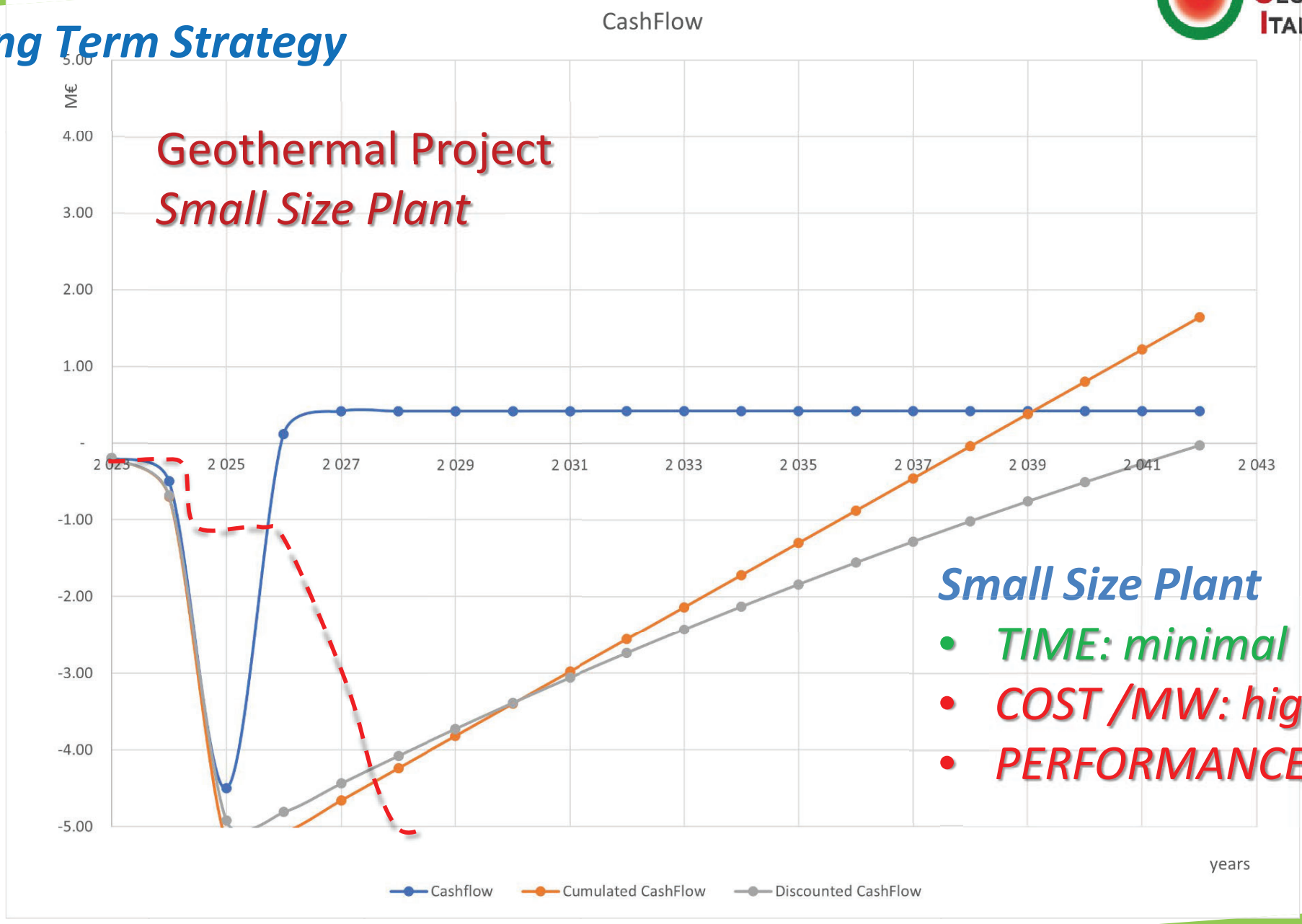
Time, *Cost* and *Performance* are the keywords.

But in a Geothermal Project we must reach a compromise.

Infact:

- Low COST/MW → Large Size → high number of wells
  → long TIME
- High PERFORMANCE → accurate Resource Assessment
  → long TIME
- Short TIME → Small Size & lower Accuracy
  → Higher COST/MW & Lower PERFORMANCE

Long Term Strategy



Geothermal Project
Small Size Plant

Small Size Plant

- *TIME: minimal*
- *COST /MW: high*
- *PERFORMANCE: low*

Long Term Strategy in DESIGN & CONSTRUCTION

Different Strategies to reach the best COMPROMISE

1. “Italian Way”
2. “Two Steps”
3. “Step by Step”

Long Term Strategy in DESIGN & CONSTRUCTION

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1.

The Italian Way is based on *time-optimization* and *Flexibility*

In the 80's has been developed a "*Unified Design*" based on steam turbines in 3 different Sizes:

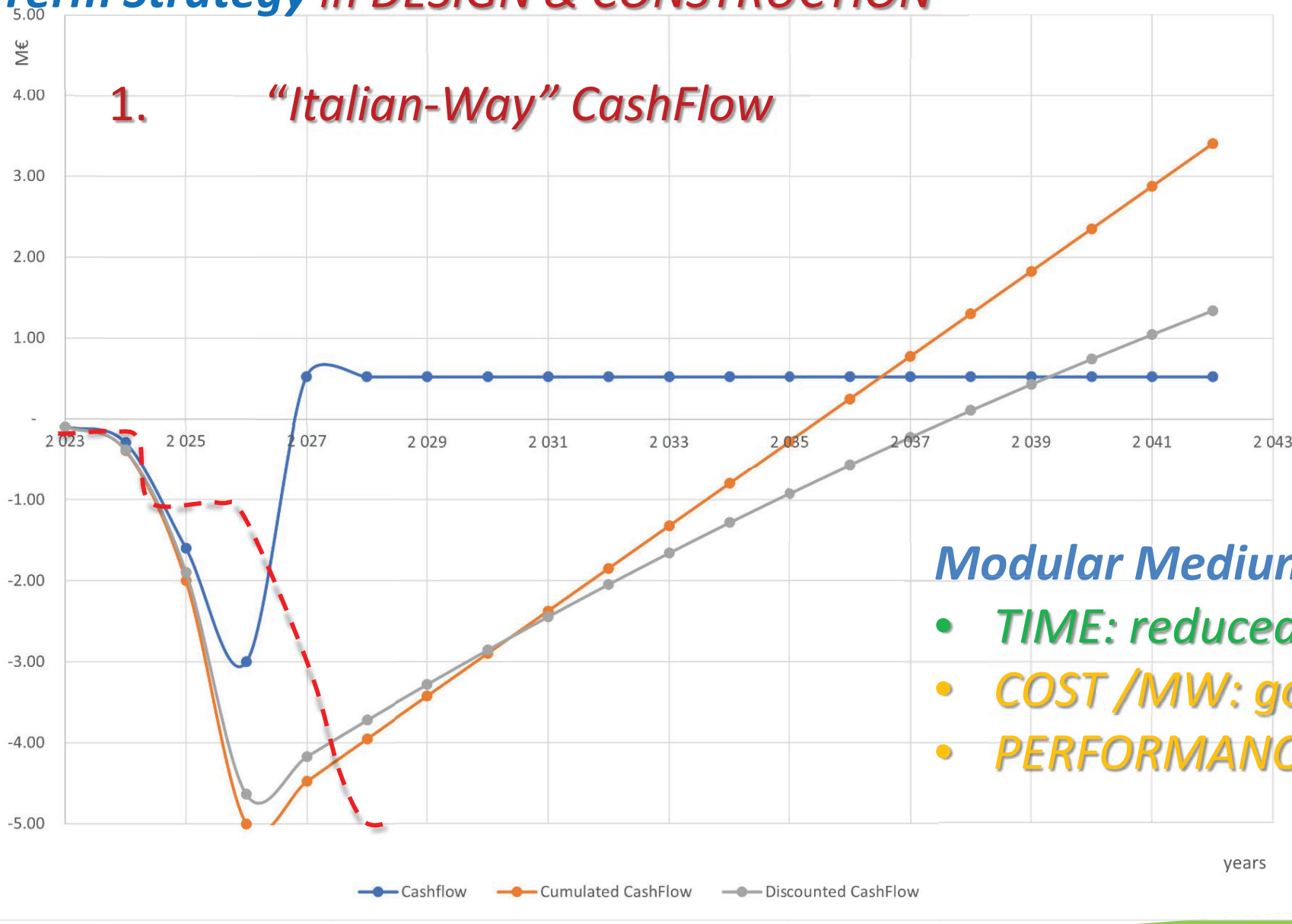
a. 20 MW "nominal", lateral exhaust
b. 40 MW "nominal", axial exhaust
c. 60 MW "nominal", bottom exhaust

All capable to Adapt to a wide range of thermodynamical characteristics of Steam.

Three Italian large Turbine Manufacturers were qualified

Long Term Strategy in DESIGN & CONSTRUCTION

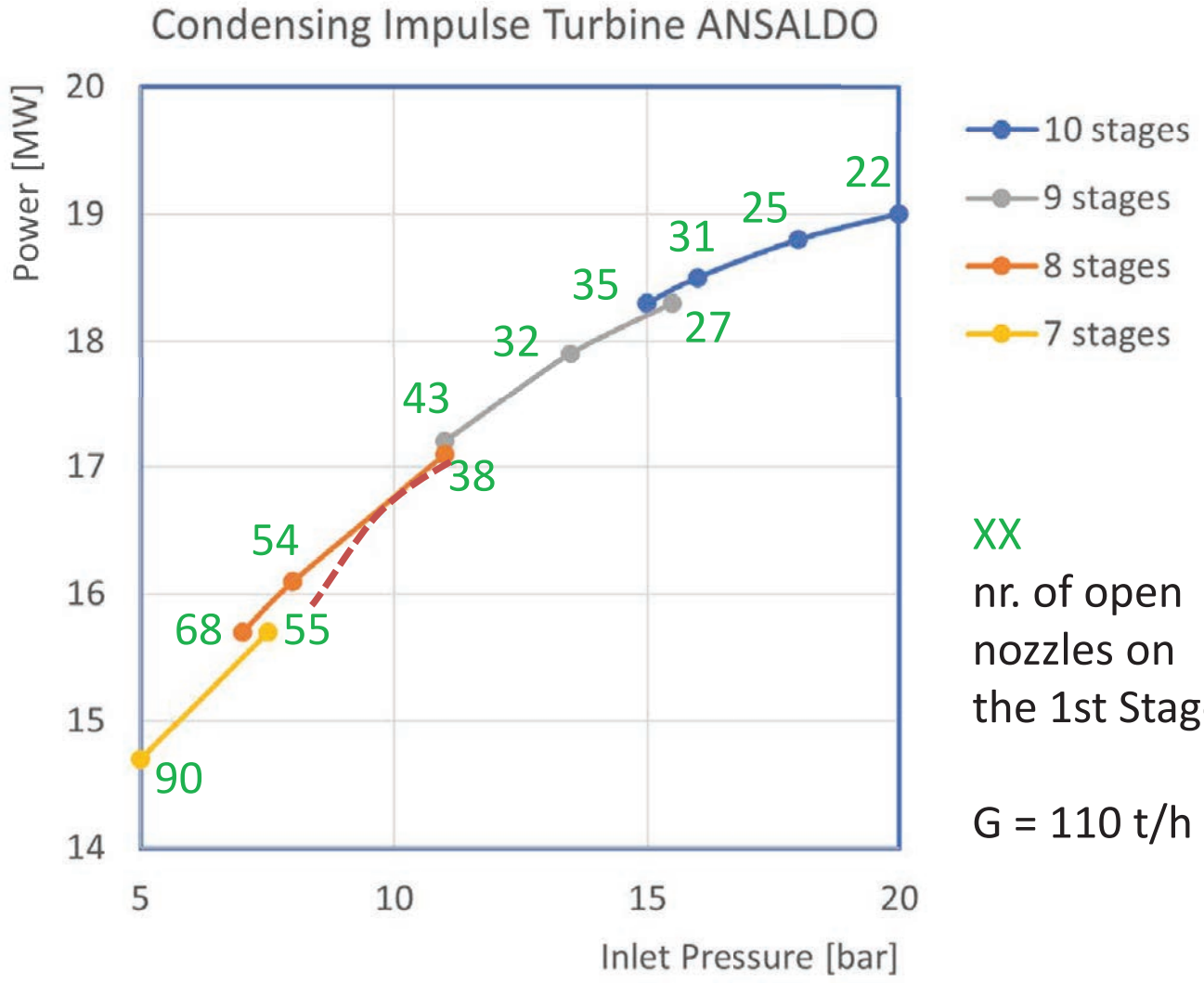
1. "Italian-Way" CashFlow



Modular Medium Size

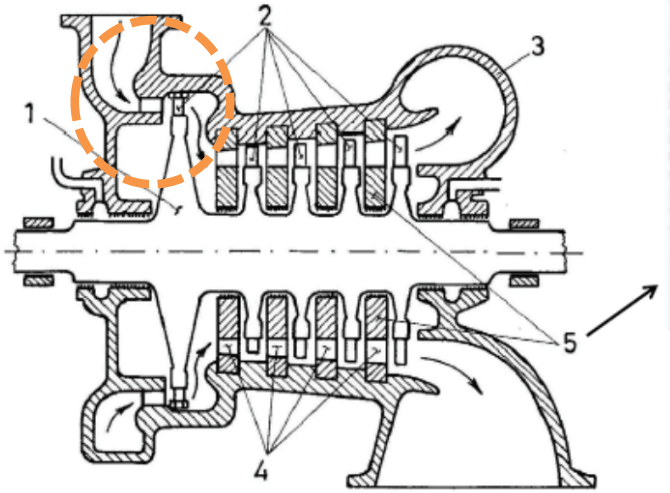
- TIME: reduced
- COST /MW: good
- PERFORMANCE: med

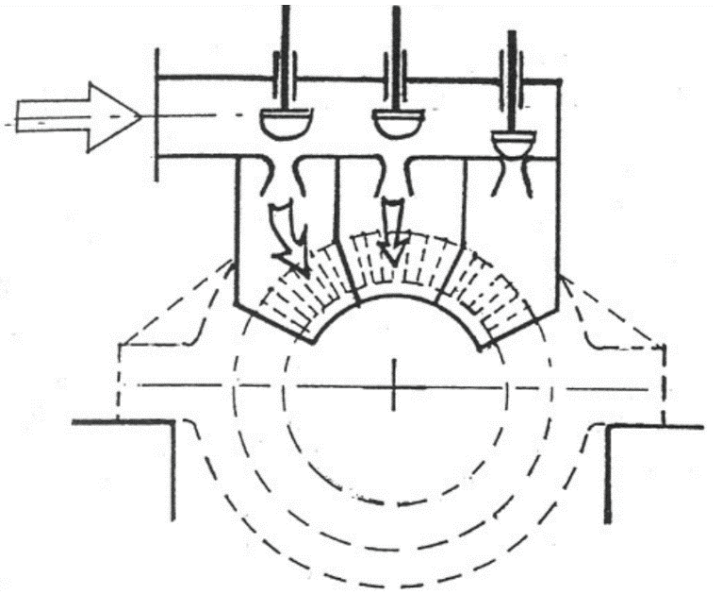
Long Term Strategy - Flexibility in PLANT DESIGN



XX
nr. of open nozzles on the 1st Stage

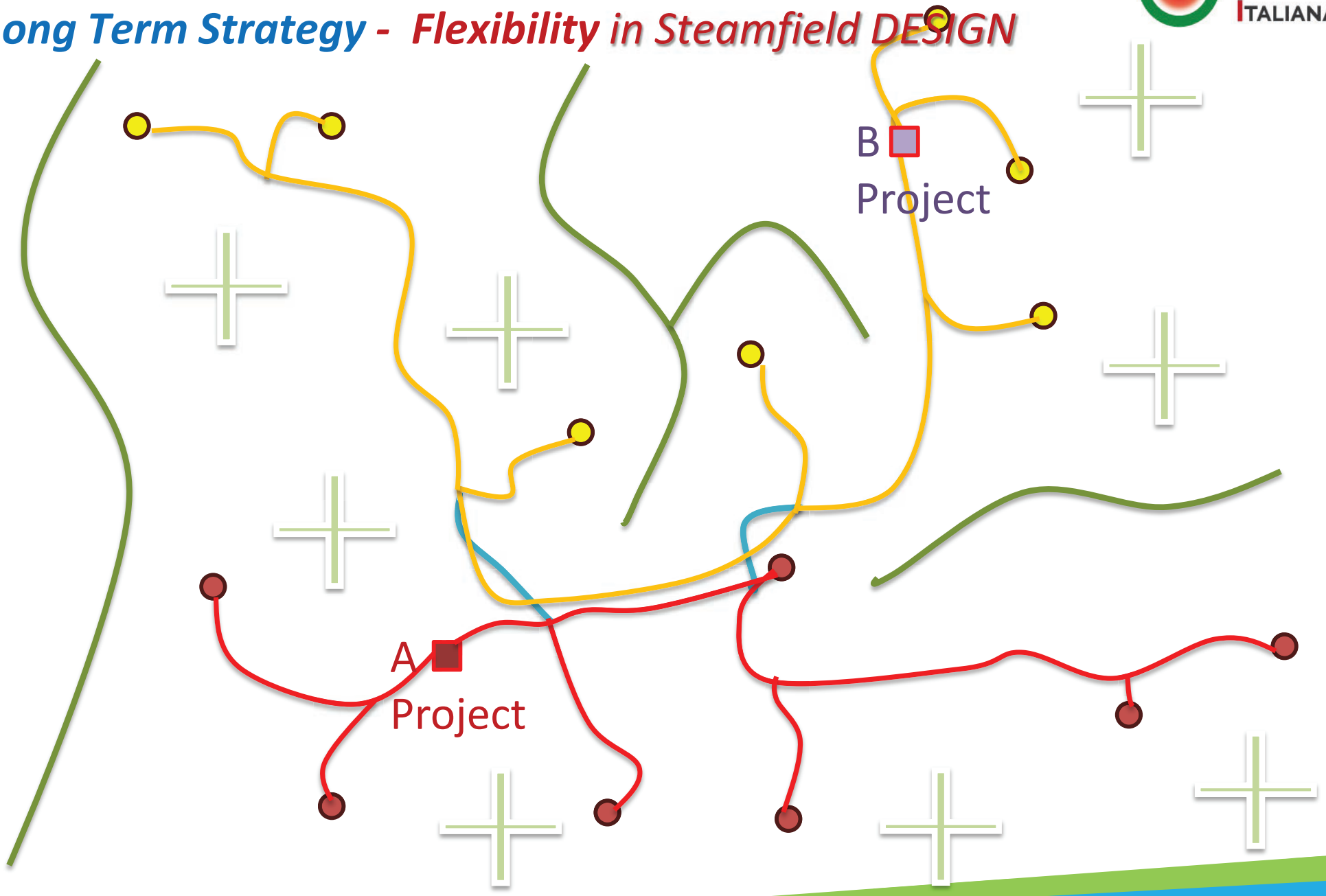
G = 110 t/h





Long Term Strategy - Modularity in PLANT DESIGN

Long Term Strategy - Flexibility in Steamfield DESIGN



Long Term Strategy in DESIGN & CONSTRUCTION

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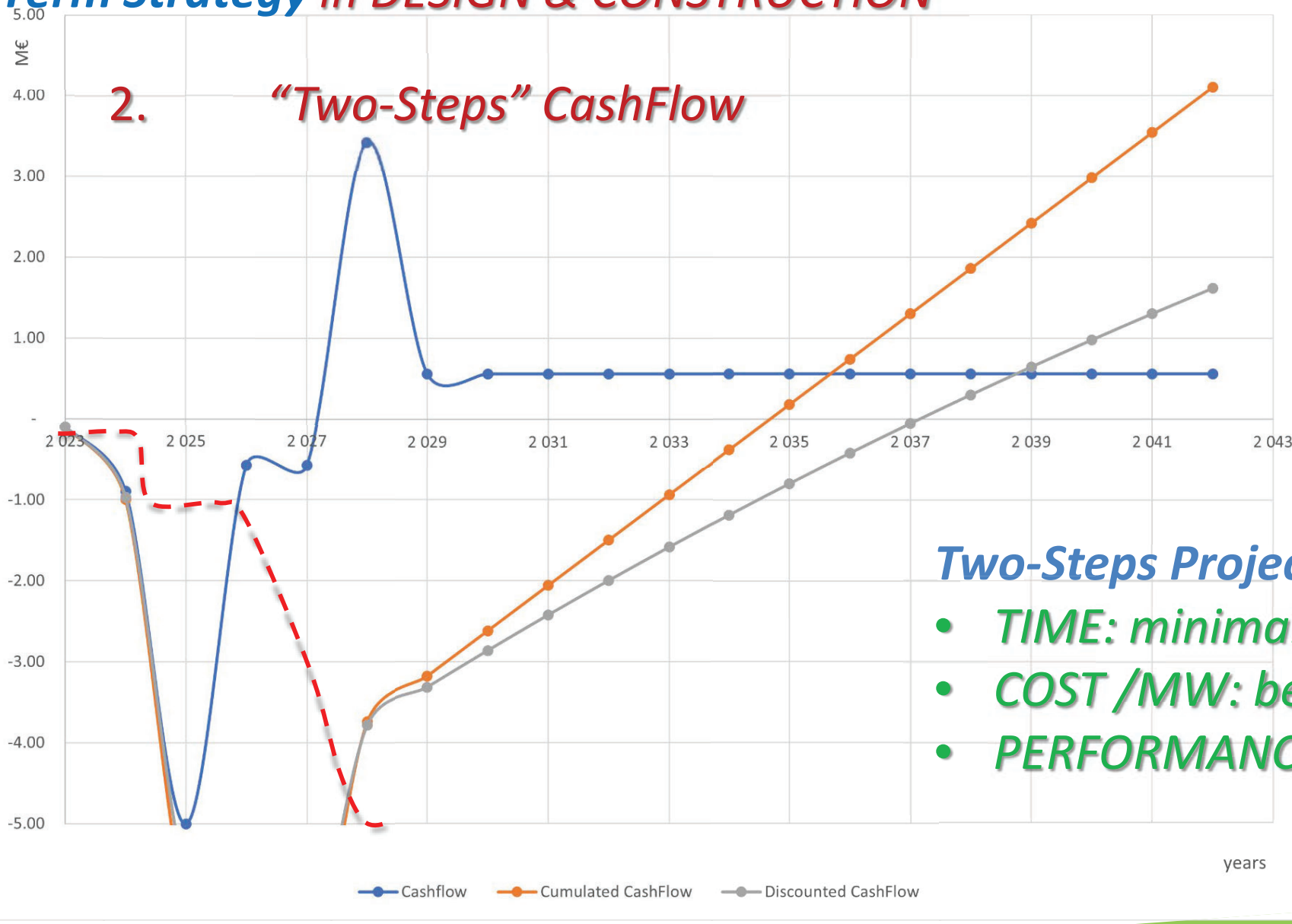
2.

The Two Steps Strategy consists of a Large-Size Plant preceded by Well-Head small generators in order to shorten the Time-To-Market phase

But: *be careful in* ***TIME*** *Managing*

Long Term Strategy in DESIGN & CONSTRUCTION

2. *"Two-Steps" CashFlow*

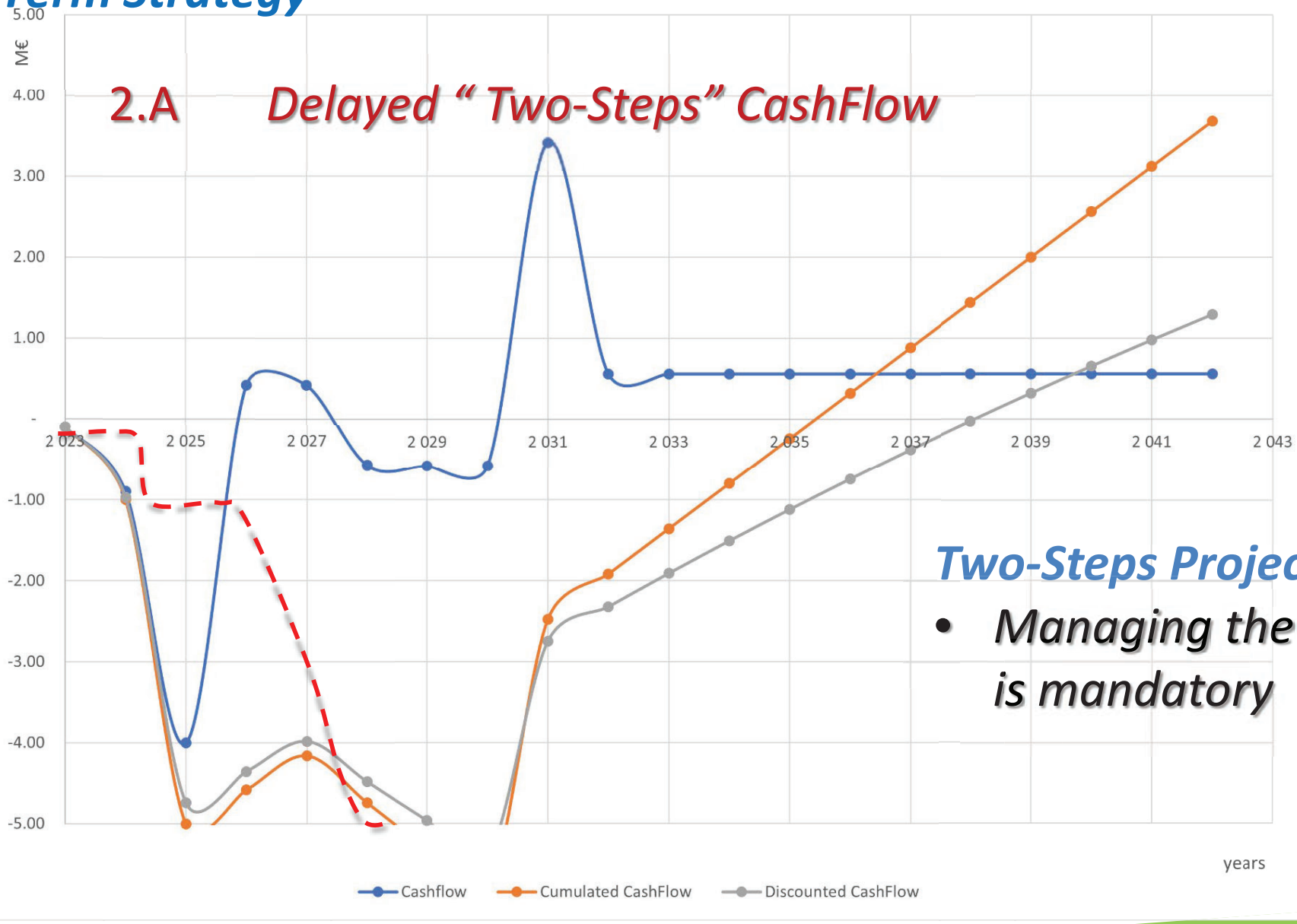


Two-Steps Project

- *TIME: minimal*
- *COST /MW: best*
- *PERFORMANCE: best*

Long Term Strategy

2.A Delayed " Two-Steps" CashFlow



Two-Steps Project

- Managing the TIME is mandatory

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3.

The Step-By-Step Strategy is based on a different technology

(High entHalpy Organic Rankine Cycle)

…next presentation

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Thanks for your attention