Investment and financing perspectives for a solar photovoltaic project

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Abstract. In this work we illustrate a simple logical framework serving the purpose of measuring value creation in a real-life solar photovoltaic project, funded with a lease contract, a loan contract and internal financing (i.e., withdrawal from liquid assets). We use the projected accounting data to compute the value created. We assess the project from both an investment perspective (operating assets and liquid assets) and a financing perspective (debt and equity). Furthermore, focusing on value creation for equityholders, we calculate the expected contribution on shareholders' wealth increase of operating and financing activity. In particular, we highlight the role of the distribution policy in financial modeling by describing the strict logical connections between estimated data and financial decisions.

Keywords: photovoltaic solar energy, project evaluation, net present value, distribution policy

1 Economic setting

Switching from traditional energy sources to renewable energy has a beneficial impact in terms of ecological sustainability (Ezbakhe and Pérez-Foguet 2021, Kang et al. 2020, Lei et al. 2019, Sinke 2019, Lupangu and Bansal 2017). However, firms willing to switch from retail energy to renewable energy are also concerned with the impact on economic profitability (Pham et al. 2019, Cucchiella et al. 2018, Dong et al. 2017). Therefore, an appropriate financial modeling and profitability metrics are required which correctly assess the effect on shareholders' wealth (Magni and Marchioni 2019, Baschieri, Magni and Marchioni 2020). In this study, we consider the appraisal of a solar photovoltaic (PhV) project proposed by an Italian installer company to a small firm, located in Northern Italy, which aims to switching from retail energy to solar energy and draw up a financial model which connects operating variables and financing variables.

Let Rev_t be the incremental revenues derived from the sale of excess energy, OpC_t be the incremental operational costs brought about by the plant, Dep_t be the depreciation charge of the solar PhV plant, I_t^l the interest income derived from reinvestment of liquid assets, I_t^d the interest expenses associated with debt, and τ the corporate tax rate. Formally, the project income is $I_t = (Rev_t - OpC_t - Dep_t + I_t^l)(1 - \tau) + \tau I_t^d$. As is standard in finance, the project's cash flows, F_t, can be computed by subtracting the change in capital from the income, so that $F_t = I_t - \Delta C_t$. Let r_t be the project's cost of capital (minimum required rate of return).

The net present value (NPV) quantifies the net effect of the project on the investors' current wealth (Brealey, Myers and Allen 2011):

$$NPV = F_0 + \frac{F_1}{1+r_1} + \frac{F_2}{(1+r_1)(1+r_2)} + \cdots + \frac{F_n}{(1+r_1)(1+r_2)\dots(1+r_n)}. \quad (1)$$

Capital amounts, incomes and cash flows of the project are intertwined in a non-trivial way via the pro forma financial statements, namely the balance sheets, the income statements and the cash-flow statements. These depend on estimated data regarding the operating activity but also on the firm's financing policy, that is, borrowing policy and distribution policy. Three sources of financing are possible:

- debt financing
- equity financing
- internal financing (i.e., withdrawal from liquid assets).

As for the distribution policy, the operating cash flows generated by the project may well be (wholly or partially) retained by the firm. and, if they are invested in financial assets, they produce interest incomes. Let $j = o, l, d, e$ be the operating assets, liquid assets, debt, and equity of the project, respectively. The first two components, o and l, represent the investment side of the project whereas the last two categories, d and e, describe its financing side. Each area is associated with its own net present value (NPV), as represented in Figure 1.

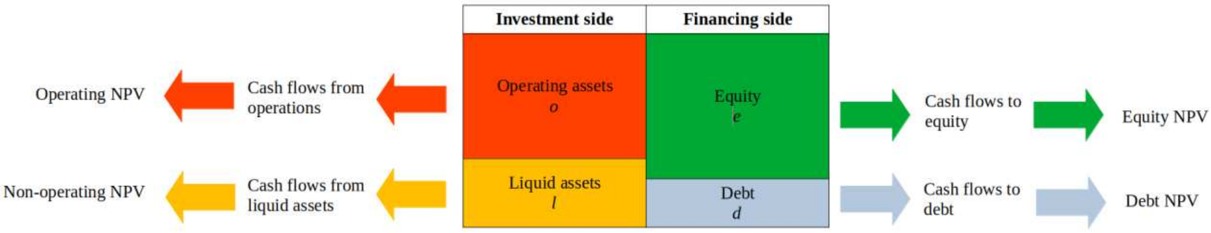

Figure 1: NPV of investments and financing sources

The NPV of each asset class j can be computed as

$$NPV^j = F_0^j + \frac{F_1^j}{1+r_1^j} + \frac{F_2^j}{(1+r_1^j)(1+r_2^j)} + \cdots + \frac{F_n^j}{(1+r_1^j)(1+r_2^j)\dots(1+r_n^j)}$$

where F_t^j and r_t^j are the cash flows and costs of capital corresponding to each asset class. As shown in Magni (2020), the NPV of the project may be viewed under an investment perspective and a financing perspective:

$$\overbrace{NPV^o + NPV^l}^{\text{investment perspective}} = \overbrace{NPV}^{\text{project NPV}} = \overbrace{NPV^e + NPV^d}^{\text{financing perspective}}, \quad (2)$$

where

NPV^o = NPV of operating assets
NPV^l = NPV of liquid assets
NPV^e = NPV of equityholders
NPV^d = NPV of debtholders.

Since the managers' primary mandate is wealth increase of equityholders, the measure we focus on is the equity NPV, NPV^e. From (2),

$$NPV^e = NPV^o + NPV^l - NPV^d, \quad (3)$$

meaning that equityholders may benefit not just from a value-creating operating activity ($NPV^o > 0$), but also from an efficient management of liquid assets such that they are invested at a rate of return greater than the cost of capital of liquid assets ($NPV^l > 0$), and from the ability of borrowing at lower rate than the cost of debt, that is, the equilibrium rate prevailing in the capital markets ($NPV^d < 0$).[1]

In this work, we model the technical and financial description of a real-life case of solar PhV system. We measure the contribution of operating and financial areas on the overall value creation of the investment project and on the wealth increase for equityholders.

2 Solar PhV plant

We describe a real-life industrial case where an Italian company located in Northern Italy faces the opportunity of replacing a conventional retail electricity system (based on supplies from a grid operator) with a standalone solar PhV system purchased from an Italian producer and installer. The plant will be installed on a land property owned by the company and currently rented. With retail energy, the firm periodically pays a utility bill and receives a rental income from the rent of the land. The solar PhV plant implies a leasing contract whereby lease payments and operating and maintenance costs are made periodically. After several years, at the expiration date, the lessee will pay a lump sum to acquire the plant, and the system will continue to generate electric power for some years. The lump sum is paid through the issuance of new debt capital and withdrawal from liquid assets. At the end of its useful life, the plant will be removed, and the firm will incur disposal costs. If the retail system is replaced by the PhV plant, the incomes and cash flows will increase as a result of the ceased lease payment and the cost savings (the utility bill), but will increase as a result of operating and maintenance costs, the terminal outlay for acquiring the plant, and the lost rental income.

The model is described as follows: the quantity of energy consumed for the firm's operations is estimated to be constant through time and equal to q; the current purchase price of energy is p_p, growing at a constant rate g_p per year. The utility bill is payed periodically, in the same year in which energy is consumed. The leasing contract contains the following economic conditions: the lease payment, equal to L, is made periodically; at time m (expiration date) the firm may acquire the plant paying a lump sum equal to $CapEx$, and the system will keep producing electric power for some years, until time n. $CapEx$ represents the capital expenditure for buying the plant and is depreciated evenly from $t = m + 1$ until $t = n$, so that the depreciation charge is $Dep = CapEx/(n - m)$. As anticipated, the PhV plant is installed at $t = 0$ in a field owned by the firm, which could otherwise be rented on the property market

1 The debt NPV is the part of the value generated by the project captured by debtholders: if it is negative, then equityholders grasp that value. Usually, such an NPV is zero or positive, so part of the value generated by the project is shared with the debtholders.

at a rent equal to R growing at the constant annual rate g_c. The latter represents an opportunity cost for the firm (a foregone income).
Starting from the first period, the PhV plant requires operating, maintenance and insurance costs. Technical experts determine a suggested level of these costs for the first year in order to maximize the energy production, which we denote as $SuggO\&M$. We denote as $O\&M$ the actual expenses, which may be equal to or smaller than the suggested ones (i.e., $O\&M \leq SuggO\&M$), both assumed to grow at the constant annual rate g_c.

If $O\&M = SuggO\&M$, the PhV system will produce Q_{max} units of energy in the first year, which decrease every year at the rate g_Q. In contrast, if $O\&M = 0$ (i.e., the company is not willing to spend for operating and maintenance costs), the energy production suffers from a percentage loss due to lack of maintenance, denoted as $ProdLoss$. Furthermore, technical experts expect that the effective energy production in each period t, denoted as Q_t, is proportional to the level of actual $O\&M$ costs as compared to the suggested level. Specifically,

$$Q_t = Q_{max}\left(1-g_Q\right)^{t-1} \cdot \left(1 - \max\left(ProdLoss \cdot \frac{SuggO\&M - O\&M}{SuggO\&M}, 0\right)\right).$$

If the energy produced by the plant, Q_t, is higher than the energy consumed by the firm, the firm sells the differential quantity to the Energy Service Operator at the energy selling price p_s, growing at a constant rate g_p per year, with payment in the following year. We assume that, at time $t = n$, the energy sold is paid immediately. Therefore, if the produced quantity is lower than the consumed energy in year t, that is, $Q_t < q$, energy costs savings arise equal to $Q_t \cdot p_p\left(1+g_p\right)^{t-1}$; if the produced quantity is higher than the consumed one, that is, $Q_t > q$, energy costs savings arise equal to $q \cdot p_p\left(1+g_p\right)^{t-1}$ as well as energy sales revenues equal to $(Q_t - q) \cdot p_s\left(1+g_p\right)^{t-1}$, determining the presence of operating working capital. Hence, the income effect of the energy sales revenues and costs savings in the two different scenarios can be summarized with the expression

$$\min(q, Q_t) \cdot p_p\left(1+g_p\right)^{t-1} + \max(0, Q_t - q) \cdot p_s\left(1+g_p\right)^{t-1}$$

and the operating working capital can be represented with the formula $WC_t = max(0, Q_t - q) \cdot p_s\left(1+g_p\right)^{t-1}$ and $WC_n = 0$. At time n, the plant is removed with disposal costs equal to H growing at the constant annual rate g_c.

To sum up, the firm-without-the-project pays the utility bills and receives the rent for the land (for the whole period); in contrast, the firm-with-the-project sustains the lease payments (until $t = m$), the operating and maintenance costs (until $t = n$), the lump sum (in $t = m$), and the disposal costs (in $t = n$), and receives payments for the energy sold to the Energy Service Operator. Considering that a project represents, by definition, the difference between the firm-with-the-project and the firm-without-the-project, the project's incomes are:

$$I_t = \Big[\min(q, Q_t) \cdot p_p\left(1+g_p\right)^{t-1} + \max(0, Q_t - q) \cdot p_s\left(1+g_p\right)^{t-1} - L - R \cdot (1+g_c)^{t-1} - O\&M \cdot (1+g_c)^{t-1} + I_t^l\Big](1-\tau) + \tau I_t^d$$

for $1 \leq t \leq m$

$$I_t = \Big[\min(q, Q_t) \cdot p_p\big(1 + g_p\big)^{t-1} + \max(0, Q_t - q) \cdot p_s\big(1 + g_p\big)^{t-1} - R \cdot (1 + g_c)^{t-1} - O\&M \cdot (1 + g_c)^{t-1} - Dep + I_t^l\Big](1 - \tau) + \tau I_t^d \qquad \text{for } m + 1 \leq t \leq n - 1$$

$$I_t = \Big[\min(q, Q_t) \cdot p_p\big(1 + g_p\big)^{t-1} + \max(0, Q_t - q) \cdot p_s\big(1 + g_p\big)^{t-1} - R \cdot (1 + g_c)^{t-1} - O\&M \cdot (1 + g_c)^{t-1} - Dep - H \cdot (1 + g_c)^{t-1} + I_t^l\Big](1 - \tau) + \tau I_t^d \qquad \text{for } t = n.$$

The project's assets are represented by working capital, liquid assets (C_t^l) and, from time m, fixed assets:

$$C_t = \overbrace{\max(0, Q_t - q) \cdot p_s\big(1 + g_p\big)^{t-1}}^{\text{working capital}} + \overbrace{C_t^l}^{\text{liquid assets}} \qquad \text{for } 1 \leq t \leq m - 1$$

$$C_t = \overbrace{\max(0, Q_t - q) \cdot p_s\big(1 + g_p\big)^{t-1}}^{\text{working capital}} + \overbrace{CapEx - Dep \cdot (t - m)}^{\text{fixed assets}} + \overbrace{C_t^l}^{\text{liquid assets}} \qquad \text{for } m \leq t \leq n\text{-}1$$

$$C_t = 0 \qquad \text{for } t = n$$

where the balance of liquid assets at the end of period t, C_t^l, is obtained from the liquid balance at the beginning of period, C_{t-1}^l, increased by the interest income I_t^l and by the cash contribution into the liquid assets account at time t, equal to $-F_t^l$, that is, $C_t^l = C_{t-1}^l + I_t^l - F_t^l$ (for the derivation of liquid assets see also the numerical application below). Finally, as already mentioned, the forecasted cash flows are obtained as $F_t = I_t - \Delta C_t,\ \forall t = 0,1, \dots, n$.

Considering the financing policy, until the expiration date of the leasing contract$m$, the project is fully financed with internal financing, that is, with retained cash. The rate of return on liquid assets is constant and equal to i^l, hence the interest income is $I_t^l = i^l \cdot C_{t-1}^l$. At time m, the operating disbursement is covered by absorbing resources from the liquid assets (internal financing), according to a proportion W, and by a loan contract for the complementary proportion $1 - W$. After time m, further disbursements are fully satisfied via internal financing.

The dividend distribution to equityholders, F_t^e, starts at a time d_m, according to the payout ratio α, to be applied to the smallest between the net income and the potential dividend (i.e., the difference between the operating cash flow and the cash flow to debt, $F_t^o - F_t^d$), provided that they are both positive, that is $F_t^e = \alpha \cdot \max\big[0, \min\big(I_t^e, F_t^o - F_t^d\big)\big]$. The cash contribution into the liquid assets account at time t, $-F_t^l$, is the retained cash, that is, the amount not distributed to the equityholders, therefore $-F_t^l = (F_t^o - F_t^d) - \alpha \cdot \max\big[0, \min\big(I_t^e, F_t^o - F_t^d\big)\big]$. At time n, the project is terminated, such that every asset and liability go back to zero.

The income statements, balance sheets, and cash-flow statements of the solar PhV plant are derived from the technical and financial model described above. The overall value creation is calculated via eq. (1) by discounting the cash flows F_t and, analogously, the NPVs of the asset classes $j = o, l, d, e$ are determined by considering the corresponding cash flows F_t^j. The decomposition of the project NPV and the explanation of the equityholders' value creation are computed via (2) and (3).

In the next section, we present the technical and financial data of the photovoltaic project and illustrate the practical applications of the financial measures for making a decision.

3 Value creation and NPV decomposition of the solar PhV plant

The industrial case of the solar PhV project is described with the following operating and financial input data.

Operating inputs:

- Useful life of PV plant: n =28 years
- Total cost of the plant = € 96,600.00
- Annual unit production in the first year at the technically suggested O&M (including insurance costs): Q_{max} =103,960 kWh
- Efficiency loss (per year): $g_Q = 0.65\%$
- Actual O&M and insurance: $O\&M = 2.75\%$ of total cost of the plant
- Technically suggested O&M and insurance: $SuggO\&M = 4\,\%$ of total cost of the plant
- Productivity loss due to lack of maintenance (with O&M=0): $ProdLoss = 15\,\%$
- Disposal costs: $H =$ €2,500.00
- Lost rent from land property: $R =$ €1,250.00
- Growth rate for costs: $g_c = 0.50\%$
- Lease term length: $m = 20$ years
- Purchase price of PV plant: $CapEx =$ €25,000.00
- Leasing annual payment: $L =$ €6,268.45
- Annual energy consumption: $q = 87{,}500$ kWh
- Tax rate: $\tau = 20.00\%$
- Energy purchase price: $p_p = 0.180$(€/kWh)
- Energy selling price: $p_s = 0.155$ (€/kWh)
- Growth rate of energy price: $g_p = 2.00\%$

Financial inputs:

- First of year of CFE distribution: $d_m = 1^{st}$ year
- Payout Ratio: $\alpha = 50.0\%$ of the minimum between the net income and the potential dividends
- Internal financing: $W = 60\%$ of the purchase price of PhV plant
- Debt borrowing: $1 - W = 40\%$ of the purchase price of PhV plant
- Interest rate on liquid assets $i^l = 0\%$
- Interest rate on debt: $i^d = 2.00\%$
- Required return on operating assets (constant): $r^o = 6.00\%$
- Required return on liquid assets (constant): $r^l = 2.00\%$
- Required return on debt (constant): $r^d = 3.00\%$

The corresponding pro forma balance sheets, income statements and cash-flow statements are presented in Tables 1-3. Discounting the overall cash flows F_t, it results that the project NPV is $NPV = 84{,}338 >$

0, signaling that the PhV solar plant creates value. The decomposition of the value created under the investing and financing perspectives is described in the table below, via eq. (2).

Investment perspective			Financing perspective		
NPV^o	$=$	$+108{,}125$	NPV^e	$=$	$+88{,}635$
NPV^l	$=$	$-19{,}721$	NPV^d	$=$	-231
NPV	$=$	$88{,}404$	NPV	$=$	$88{,}404$

According to the investment perspective (left side of the table), the operations create value by $NPV^o = 108{,}125 > 0$, which is partly offset by the significant value destruction due to the liquidity management with $NPV^l = -19{,}721 < 0$ (due to an inefficient allocation of capital with $i^l = 0\% < r^l = 2.00\%$).

Considering the financing perspective (right side of the table), equityholders increase their wealth by $NPV^e = 88{,}635 > 0$, higher than the project NPV, $NPV = 88{,}404$, due to a value-creating borrowing policy, such that $NPV^d = -231 < 0$ (because the loan interest rate i^d is lower than the cost of debt capital r^d). This means that equityholders gain value at the expense of the debt-holders, but this transfer of value is tiny, due to the very small difference between the interest rate on debt (2%) and the maximum acceptable financing rate (3%), as well as the limited scale of the debt.

Finally, we decompose the wealth increase of equityholders into the contributions of operations, liquidity and debt, according to (3), obtaining the following partition.

$+NPV^o$	$=$	$108{,}125$
$+NPV^l$	$=$	$-19{,}721$
$-NPV^d$	$=$	$-(-231)$
$=NPV^e$	$=$	$88{,}635$

The equity NPV is lower than the operating NPV because investments in liquid assets significantly destroy value whereas value transfer from debtholders to equityholders is almost irrelevant (as also depicted in Figure 2).

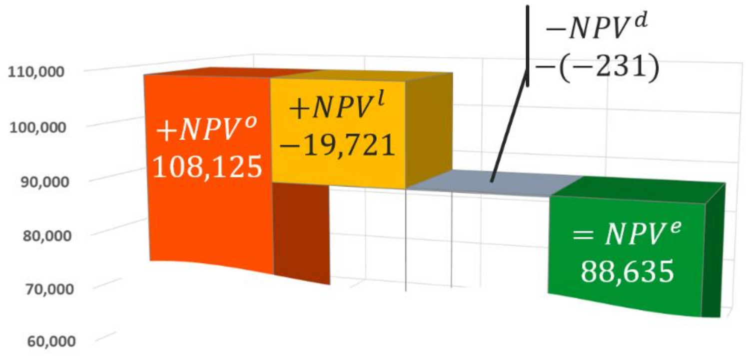

Figure 2: Decomposition of equity NPV

4 Financial efficiency of the solar PhV plant

As opposed to the NPV which does not suffer from any shortcoming, we note that the Internal Rate of Return (IRR), which is the most employed relative performance ratio in capital budgeting, does not exist for the overall project nor for the equity investment, as a consequence of the non-conventional cash flows streams $(F_0, F_1, \ldots, F_n)$ and $(F_0^e, F_1^e, \ldots, F_n^e)$, the first one having more than one change in sign and the second one having no change in sign.

Since the IRR fails, a viable solution for measuring the rate of return (and, therefore, the financial efficiency) of the project and of the equity investment is offered by the so-called average internal rate of return (AIRR) approach, introduced in Magni (2010, 2013), based on the estimated incomes and capital amounts, coherently defined as the ratio of the overall (discounted) income over the overall (discounted) capital. The AIRR of the project quantifies the project's rate of return over the total invested capital:

$$AIRR = \frac{\sum_{t=1}^{n} \frac{I_t}{(1+r_1)(1+r_2)\ldots(1+r_t)}}{C_0 + \sum_{t=1}^{n} \frac{C_t}{(1+r_1)(1+r_2)\ldots(1+r_t)}} = \frac{113{,}956}{589{,}145} = 19.34\% \qquad (4)$$

and, analogously, the equity AIRR measures the relative performance for equityholders, expressed as the ratio of net income to total equity invested:

$$AIRR^e = \frac{\sum_{t=1}^{n} \frac{I_t^e}{(1+r_1)(1+r_2)\ldots(1+r_t)}}{C_0^e + \sum_{t=1}^{n} \frac{C_t^e}{(1+r_1^e)(1+r_2^e)\ldots(1+r_t^e)}} = \frac{113{,}717}{575{,}270} = 19.77\% \qquad (5)$$

where r_t and r_t^e are explicitly derived from the costs of capital of operating assets, non-operating assets, and debt (see Magni 2020, Ch. 8 for details on the calculation of the project costs of capital).

Furthermore, Magni (2010, 2013) proves that the AIRR approach is NPV-consistent[2] and is possible to decompose the value creation of the project into a financial efficiency component (defined as the difference between the AIRR of the project and the average cost of capital r) and an investment scale component, therefore enriching the informational content of the valuation. More precisely,

$$NPV = \overbrace{(AIRR - r)}^{\text{financial efficiency}} \cdot \overbrace{\left(C_0 + \sum_{t=1}^{n} \frac{C_t}{(1+r_1)(1+r_2)\dots(1+r_t)}\right)}^{\text{scale}} \tag{6}$$
$$= (19.34\% - 4.34\%) \cdot 589{,}145 = 15.01\% \cdot 589{,}145 = € \, 84{,}404$$

where r is the project's average cost of capital. Symmetrically, the equity NPV is decomposed via the AIRR approach as the product of financial efficiency for equityholders and the scale of the equity investment:

$$NPV^e = \overbrace{(AIRR^e - r^e)}^{\substack{\text{equity} \\ \text{financial efficiency}}} \cdot \overbrace{\left(C_0^e + \sum_{t=1}^{n} \frac{C^e{}_t}{(1+r^e{}_1)(1+r^e{}_2)\dots(1+r^e{}_t)}\right)}^{\substack{\text{equity} \\ \text{scale}}} \tag{7}$$
$$= (19.77\% - 4.66\%) \cdot 575{,}270 = 15.41\% \cdot 575{,}270 = € \, 88{,}635$$

where r^e is the average cost of equity capital.

Considering the equityholders' perspective, each euro invested in the project produces an equity return equal to 19.77%, remarkably higher than the alternative return equal to 4.66% that could be obtained on the financial market for investments of comparable risk. The financial efficiency of equity is positive, equal to 15.41%, representing the relative advantage for equityholders in investing in the PhV plant instead of alternative available investments. Overall, the equityholders invest € 575,270 at an above-normal return of 15.41%, so realizing a wealth increase equal to $€575{,}270 \cdot 15.41\% = €88{,}635$.

5 The role of distribution policy

It is worth noting that, in such a model, the estimated data are logically chained to decisions regarding distribution policy and retained cash. For example, to build the balance of liquid assets at the end of period $t = 14$, C_{14}^l, one needs start from the balance at the beginning of that period, $C_{13}^l = €45{,}997$. Assuming that the cash retained in the firm will not generate any interest income, the balance will increase by the retained cash (i.e., the amount not distributed to the equityholders) at time $t = 14$, which is equal to

$$\overbrace{-F_{14}^l}^{\text{retained cash}} = \overbrace{(F_{14}^o - F_{14}^d)}^{\text{potential dividends}} - \overbrace{\alpha \cdot \max\left[0, \min\left(I_{14}^e, F_{14}^o - F_{14}^d\right)\right]}^{\text{cash flow to equity}} = €4{,}362.$$

Therefore, we obtain the balance of liquid assets at the end of period as

$$C_{14}^l = C_{13}^l - F_{14}^l = €45{,}997 + €4{,}362 = €50{,}358.$$

In this application, the distribution policy remarkably affects the economic results, with $NPV^l = -19{,}721$, because of high differences between the interest rate on liquid assets and minimum acceptable

[2]See also Marchioni and Magni (2018) for a definition of strong NPV-consistency of rates of return.

rate of return on liquid assets and high balances of liquid assets in several different periods of the investment. Only after computing the balance of liquid assets, the equity book value may be calculated as $C_{14}^e = C_{14}^o + C_{14}^l - C_{14}^d$.

Logically, the disregard of the distribution policy would have invalidated the logical consistency of the model. It is necessary to first calculate the potential dividends, then subtract the part of it which is not distributed and add it to the cash balance, as we have shown above. This brings about a network of complex relationships among the accounting magnitudes, which makes it necessary to draw up the cash-flow statement. The latter enables the analyst to calculate the cash flow associated with the liquid assets, F_t^l, which depends on the cash flow distributed to equityholders, F_t^e, which in turn depends on the operating cash flow. However, the latter can be computed only on the basis of elements of the income statement (the operating income) and elements of the balance sheets (operating assets). In turn, the balance sheet cannot be completed without the cash-flow statement, because, as we remind, the equity capital is equal to $C_t^e = C_t^o + C_t^l - C_t^d$ and C^l cannot be computed without computing F_t^l (i.e., without using the cash-flow statement). This nontrivial relationships among these three financial statements also testifies to the connections between estimated data (operating variables) and decision variables (distribution policy and reinvestment of retained cash). As a result, pro forma balance sheet and income statement are not sufficient; the cash flow statement is required for a sound and logically consistent model (and, therefore, a correct valuation of the project).[3]

6 Conclusions

In the current work we have provided a logically consistent model for the investment appraisal of a real-life photovoltaic energy project. Contrary to traditional modeling, we take account of the subtle relations interconnecting operating variables and financing variables, which depend on decisions (borrowing decision and distribution policy). We have considered the firm's decisions on distribution in the cash-flow statement, which is necessary to draw up the balance sheet (and, therefore, the income statement of the next period). We have decomposed the value created under two different perspectives, namely, the investment view which considers operating and liquid assets, and the financing view, which analyzes the equity and debt components, highlighting that the equity NPV may be significanty different from the operating NPV due to the remarkable role of financial decisions about liquid assets and debt.

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[3] Some authors discount the potential dividends, $(F_t^o - F_t^d)$ at the cost of equity capital r_t^e thereby avoiding the calculation of the balance of liquid assets. However, this does not produce the correct equity NPV, unless the retained cash is invested at the cost of equity, an often implausible assumption, or the firm distributes 100% of the potential dividends to equityholders, which is not always the case (and is not the case of the Italian company we consider) (see also Magni 2020, p. 344).

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Table 1: Balance sheets (thousands of Euro)

BALANCE SHEET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
BS ASSETS																													
Operating Assets	-	1.8	1.7	1.7	1.6	1.5	1.4	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.1	25.0	21.9	18.8	15.6	12.5	9.4	6.3	3.1	-
Accounts receivable from grid operator	-	*1.8*	*1.7*	*1.7*	*1.6*	*1.5*	*1.4*	*1.4*	*1.3*	*1.2*	*1.1*	*1.0*	*0.9*	*0.8*	*0.7*	*0.6*	*0.5*	*0.4*	*0.3*	*0.1*	*0.0*	-	-	-	-	-	-	-	-
Net fixed assets	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*25.0*	*21.9*	*18.8*	*15.6*	*12.5*	*9.4*	*6.3*	*3.1*	-
Liquid assets	-	2.1	5.2	8.4	11.7	15.1	18.6	22.2	25.9	29.7	33.6	37.6	41.7	46.0	50.4	54.8	59.4	64.1	69.0	73.9	69.0	77.2	85.5	93.9	102.4	111.1	119.8	128.6	-
ASSETS	**-**	**3.8**	**6.9**	**10.0**	**13.2**	**16.6**	**20.0**	**23.5**	**27.1**	**30.9**	**34.7**	**38.6**	**42.7**	**46.8**	**51.1**	**55.4**	**59.9**	**64.5**	**69.2**	**74.1**	**94.0**	**99.1**	**104.3**	**109.5**	**114.9**	**120.4**	**126.0**	**131.8**	**-**
BS LIABILITIES																													
Loan current debt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.0	8.8	7.6	6.4	5.2	3.9	2.7	1.3	-0.0
Equity	-	3.8	6.9	10.0	13.2	16.6	20.0	23.5	27.1	30.9	34.7	38.6	42.7	46.8	51.1	55.4	59.9	64.5	69.2	74.1	84.0	90.2	96.6	103.1	109.7	116.5	123.4	130.4	-
LIABILITIES	**-**	**3.8**	**6.9**	**10.0**	**13.2**	**16.6**	**20.0**	**23.5**	**27.1**	**30.9**	**34.7**	**38.6**	**42.7**	**46.8**	**51.1**	**55.4**	**59.9**	**64.5**	**69.2**	**74.1**	**94.0**	**99.1**	**104.3**	**109.5**	**114.9**	**120.4**	**126.0**	**131.8**	**-0.0**

Table 2: Income statements (thousands of Euro)

INCOME STATEMENT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Revenues	**-**	**0.5**	**0.5**	**0.4**	**0.3**	**0.2**	**0.2**	**0.1**	**-0.0**	**-0.1**	**-0.2**	**-0.3**	**-0.4**	**-0.5**	**-0.6**	**-0.7**	**-0.9**	**-1.0**	**-1.1**	**-1.2**	**-1.4**	**-1.4**	**-1.4**	**-1.4**	**-1.4**	**-1.4**	**-1.4**	**-1.4**	**-1.4**
New revenue: sale of energy	-	*1.8*	*1.7*	*1.7*	*1.6*	*1.5*	*1.4*	*1.4*	*1.3*	*1.2*	*1.1*	*1.0*	*0.9*	*0.8*	*0.7*	*0.6*	*0.5*	*0.4*	*0.3*	*0.1*	*0.0*	-	-	-	-	-	-	-	-
Lost rent from land property	-	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.3*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*	*-1.4*
(-) Operating costs	**-**	**6.8**	**7.1**	**7.4**	**7.7**	**8.1**	**8.4**	**8.7**	**9.1**	**9.4**	**9.8**	**10.1**	**10.5**	**10.9**	**11.3**	**11.7**	**12.1**	**12.5**	**12.9**	**13.3**	**13.8**	**20.3**	**20.6**	**20.9**	**21.2**	**21.5**	**21.9**	**22.2**	**19.6**
(-) Lease annual payment	-	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	*-6.3*	-	-	-	-	-	-	-	-
(-) O&M cost	-	*-2.7*	*-2.7*	*-2.7*	*-2.7*	*-2.7*	*-2.7*	*-2.7*	*-2.8*	*-2.8*	*-2.8*	*-2.8*	*-2.8*	*-2.8*	*-2.8*	*-2.8*	*-2.9*	*-2.9*	*-2.9*	*-2.9*	*-2.9*	*-2.9*	*-2.9*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*
(-) Disposal costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*-2.9*
(-) Cost saving: self consumption of energy	-	*15.8*	*16.1*	*16.4*	*16.7*	*17.0*	*17.4*	*17.7*	*18.1*	*18.5*	*18.8*	*19.2*	*19.6*	*20.0*	*20.4*	*20.8*	*21.2*	*21.6*	*22.1*	*22.5*	*22.9*	*23.3*	*23.6*	*23.9*	*24.2*	*24.5*	*24.9*	*25.2*	*25.5*
EBITDA	**-**	**7.4**	**7.6**	**7.8**	**8.1**	**8.3**	**8.6**	**8.8**	**9.1**	**9.3**	**9.6**	**9.8**	**10.1**	**10.4**	**10.6**	**10.9**	**11.2**	**11.5**	**11.8**	**12.1**	**12.4**	**18.9**	**19.2**	**19.5**	**19.8**	**20.1**	**20.4**	**20.7**	**18.2**
(-) Depreciation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1
EBIT	**-**	**7.4**	**7.6**	**7.8**	**8.1**	**8.3**	**8.6**	**8.8**	**9.1**	**9.3**	**9.6**	**9.8**	**10.1**	**10.4**	**10.6**	**10.9**	**11.2**	**11.5**	**11.8**	**12.1**	**12.4**	**15.8**	**16.1**	**16.4**	**16.7**	**17.0**	**17.3**	**17.6**	**15.1**
Interest income	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(-) interest expenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.0
EBT	**-**	**7.4**	**7.6**	**7.8**	**8.1**	**8.3**	**8.6**	**8.8**	**9.1**	**9.3**	**9.6**	**9.8**	**10.1**	**10.4**	**10.6**	**10.9**	**11.2**	**11.5**	**11.8**	**12.1**	**12.4**	**15.6**	**15.9**	**16.3**	**16.6**	**16.9**	**17.2**	**17.6**	**15.0**
(-) Taxes	-	-1.5	-1.5	-1.6	-1.6	-1.7	-1.7	-1.8	-1.8	-1.9	-1.9	-2.0	-2.0	-2.1	-2.1	-2.2	-2.2	-2.3	-2.4	-2.4	-2.5	-3.1	-3.2	-3.3	-3.3	-3.4	-3.4	-3.5	-3.0
NET INCOME	**-**	**5.9**	**6.1**	**6.3**	**6.5**	**6.6**	**6.8**	**7.0**	**7.2**	**7.4**	**7.7**	**7.9**	**8.1**	**8.3**	**8.5**	**8.7**	**9.0**	**9.2**	**9.4**	**9.7**	**9.9**	**12.5**	**12.7**	**13.0**	**13.3**	**13.5**	**13.8**	**14.1**	**12.0**

Table 3: Cash flow statements (thousands of Euro)

CASH FLOW	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
(+) CFO	-	4.1	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.5	7.7	8.0	8.2	8.4	8.6	8.8	9.1	9.3	9.6	9.8	-15.0	15.8	16.0	16.3	16.5	16.7	17.0	17.2	15.2
(-) CFD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.0	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FCFE (Free Cash Flow for Equity)	**-**	**4.1**	**6.1**	**6.3**	**6.5**	**6.7**	**6.9**	**7.1**	**7.3**	**7.5**	**7.7**	**8.0**	**8.2**	**8.4**	**8.6**	**8.8**	**9.1**	**9.3**	**9.6**	**9.8**	**-5.0**	**14.5**	**14.7**	**14.9**	**15.1**	**15.4**	**15.6**	**15.9**	**13.8**
(-) CFE	-	-2.1	-3.0	-3.1	-3.2	-3.3	-3.4	-3.5	-3.6	-3.7	-3.8	-3.9	-4.0	-4.1	-4.3	-4.4	-4.5	-4.6	-4.7	-4.8	-	-6.2	-6.4	-6.5	-6.6	-6.8	-6.9	-7.0	-142.5
(-) CFL	**-**	**2.1**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**	**3.9**	**4.0**	**4.1**	**4.2**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**	**5.0**	**-5.0**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**	**8.8**	**-128.6**

Note: Notwithstanding the existence and uniqueness of NPV and NPV^e, neither the IRR of the project cash-flow stream nor the IRR of the equity cash-flow stream exists.