CORPORATE FINANCE FOR LONG-TERM VALUE

Chapter 7: Capital budgeting

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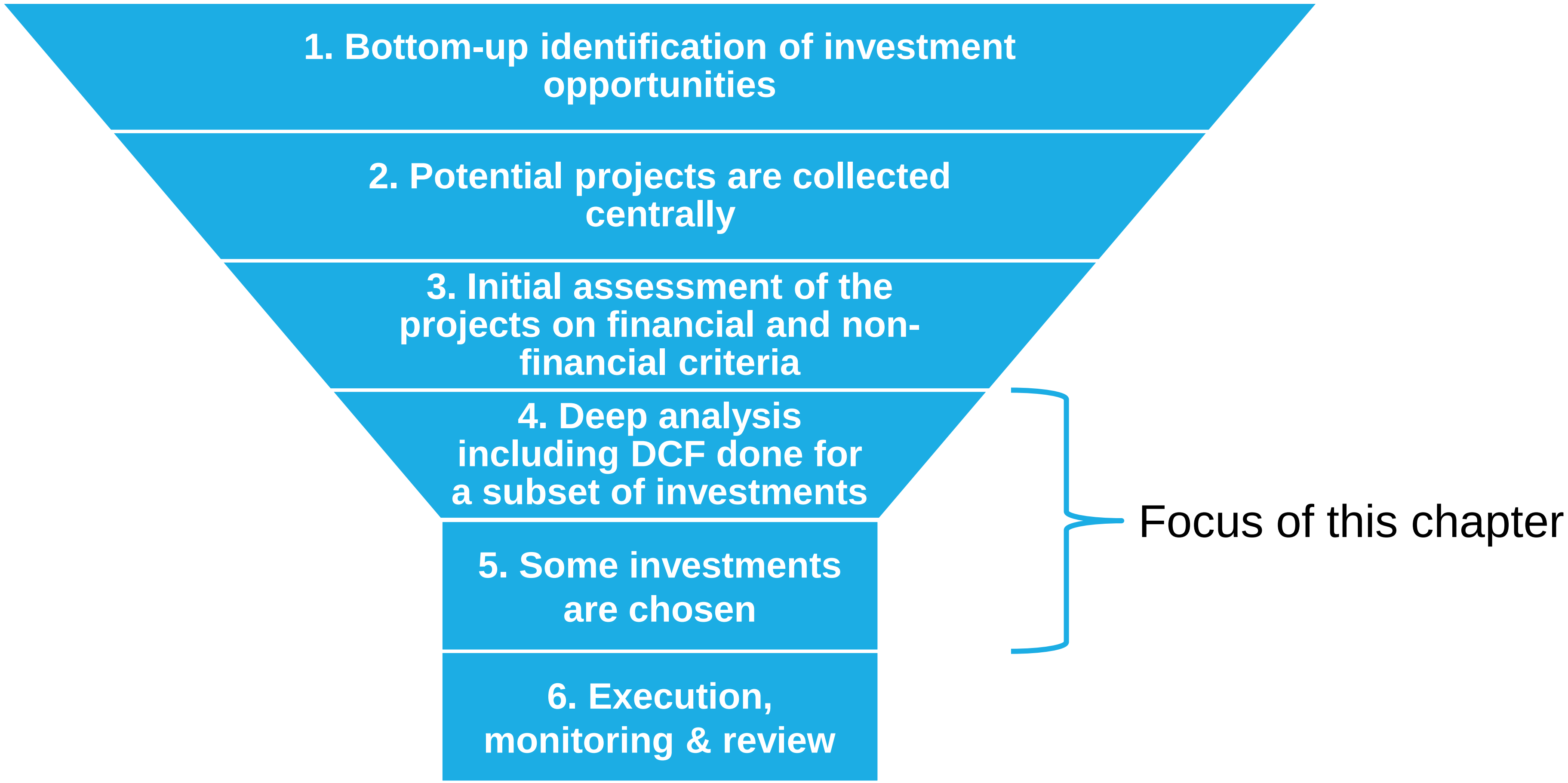
The BIG Picture

- How to select investment projects in practice -> capital budgeting

Capital budgeting

- Calculate and compare the value of projects
- Integrate SV and EV into project evaluation
- Balance the financial, social and environmental dimensions of projects
- Critically evaluate projects in terms of company valuation profile

The capital budgeting process



Calculating cash flows

- The discounted cash flow (DCF) model calculates a project/company's Net Present Value (NPV):

Year	2022	2023	2024	2025	2026	2027	2028	2029
Cash flow	-100	25	25	25	25	25	25	25
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51
PV(Cash flow)	-100.0	22.7	20.7	18.8	17.1	15.5	14.1	12.8
NPV	**21.7**							

- Cash flows are calculated using:
  - EBIT: earnings before interest and taxes
  - CAPEX: capital expenditures – i.e. company investments
  - NWC: net working capital – the difference between current assets and current liabilities

Calculating cash flows

Year	2018	2019	2020	2021
Sales	0	320	633	1196
Costs (including depreciation)	-472	-501	-512	-855
EBIT = sales - total costs	**-472**	**-181**	**121**	**341**
Interest paid	-10	-12	-10	-8
x applicable corporate tax rate	25%	25%	25%	25%
Corporate tax	121	48	-28	-83
Net income = EBIT - interest - corporate tax	**-362**	**-145**	**83**	**250**
+ depreciation	48	48	48	48
- CAPEX	-516	-37	-37	-37
- increase in NWC	-12	-14	-24	-37
Project Cash Flows	**-842**	**-148**	**70**	**224**

Note that corporate tax is first positive (tax refund) and later negative (tax paid)

Estimating future cash flows

- Determining future cash flows requires estimates on individual line-items and their underlying value drivers

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Volume (thousands of tonnes)	n/a	n/a	50	120	130	140		140
Price (USD/tonne)	n/a	n/a	8,000	8,000	8,000	8,000		8,000
Sales (USD million)	**0**	**0**	**400**	**960**	**1,040**	**1,120**		**1,120**
Costs per tonne	n/a	n/a	-7,000	-5,000	-4,200	-4,200		-4,200
Costs (USD million)	-100	-100	-350	-600	-546	-588		-588
EBIT = sales - total costs	**-100**	**-100**	**50**	**360**	**494**	**532**		**532**
EBIT margin	n/a	n/a	13%	38%	48%	48%		48%
x applicable corporate tax rate	25%	25%	25%	25%	25%	25%		25%
Corporate tax	25	25	-13	-90	-124	-133		-133
Net income = EBIT - corporate tax	**-75**	**-75**	**38**	**270**	**371**	**399**		**399**
+ depreciation	100	100	100	100	100	100		100
- CAPEX	-600	-700	-400	-60	-60	-60		-60
- increase in NWC	-20	-20	-20	-20	-20	-20		-20
Project Cash Flows	**-595**	**-695**	**-283**	**290**	**391**	**419**		**419**

Terminal value

- If cash flows are expected to run for more years (i.e. 30), then you can calculate the annuity from the last estimated year (in this case year 10) using a constant cost of capital:
  - Assume constant cash flows of 419 for 20 years (from year 11 to 30) with a cost of capital of 11%
  - $PV = \frac{CF}{r} \cdot \left(1 - \frac{1}{(1+r)^N}\right) = \frac{419}{0.11} \cdot \left(1 - \frac{1}{(1+0.11)^{20}}\right) = 3{,}809.1 \cdot (1 - 0.124) = 3{,}336.8$

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Project cash flows	-595	-695	-283	290	391	419	419	419	419	419
Terminal value										3,337
Total cash flows	-595	-695	-283	290	391	419	419	419	419	3,756
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535	0.482	0.434	0.391	0.352
Present value	-536	-564	-207	191	232	224	202	182	164	1,323
NPV	**1,210**									

Forecasting assumptions

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales growth	n/a	n/a	167%	5%	5%	5%	5%	5%
EBIT margin	n/a	-50%	31%	31%	31%	31%	31%	31%
Corporate tax rate	25%	25%	25%	25%	25%	25%	25%	25%
Depreciation/sales	n/a	33%	13%	12%	11%	10%	9%	8%
CAPEX/sales	n/a	17%	6%	8%	8%	8%	8%	8%
Increase in NWC/sales	n/a	3%	1%	1%	1%	1%	1%	1%

Calculated on given data

Extrapolated assumptions

Detailed → High-level

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales	**0**	**30**	**80**	**84**	**88**	**93**	**97**	**102**
Costs	-10	-45	-55	-58	-61	-64	-67	-70
EBIT	**-10**	**-15**	**25**	**26**	**27**	**29**	**30**	**32**
x applicable tax rate	25%	25%	25%	25%	25%	25%	25%	25%
Corporate tax	3	4	-6	-7	-7	-7	-8	-8
Net income	**-8**	**-11**	**19**	**20**	**21**	**22**	**23**	**24**
+ depreciation	10	10	10	10	9	9	8	8
- CAPEX	-70	-5	-5	-7	-7	-7	-8	-8
- increase in NWC	-1	-1	-1	-1	-1	-1	-1	-1
Project Cash Flows	**-69**	**-7**	**23**	**21**	**22**	**22**	**22**	**22**
Discount factor	1.000	0.917	0.842	0.772	0.708	0.650	0.596	0.547
Present value	-69	-7	19	17	15	14	13	12
NPV	**15**							

Incremental cash flows

- Investment assessment is about changes to the current situation
  - If a project creates new cash flows - but at the same time reduces the cash flows on ongoing projects - the net effect should be calculated (i.e. the incremental cash flows)
- Incremental cash flows reflect the difference in the company’s overall cash flows with and without the project
- Cannibalisation: if a new product has superior characteristics compared to the existing product, then clients will switch and buy the new product instead of the existing one
- Opportunity cost of the project: missed value of what could have been done instead

Incremental cash flows

	Product A before introduction product B	Product A after introduction product B	Change in product A	Product B	Incremental cash flows of product B
Sales	1,000	850	-150	1,200	**1,050**
Costs	-700	-620	80	-800	**-720**
EBIT	300	230	-70	400	**330**
EBIT margin	30%	27%	-3%	33%	**31%**
x applicable tax rate	25%	25%	0%	25%	**25%**
Corporate tax	-75	-58	18	-100	**-83**
Net income	225	173	-53	300	**248**
+ depreciation	50	50	0	100	**100**
- CAPEX	-50	-40	10	100	**110**
- increase in NWC	-20	-20	0	-30	**-30**
Total Cash Flows	205	163	-43	470	**428**

Should project B be done? Yes, incremental cash flows > 0

Including opportunity costs

- Case: the water stress of a project is so severe that it puts drinking water quality and availability for the local population at risk
- Result: the company runs the risk of losing the project, and all cash flows associated with it, at the end of year 3 (with a 50% chance)

NPV of 50% chance of losing the asset in year 4

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total cash flows	0	0	0	-145	-195	-210	-210	-210	-210	-1,878
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535	0.482	0.434	0.391	0.352
Present value	0	0	0	-96	-116	-112	-101	-91	-82	-661
NPV	**-1,258**									

Including opportunity costs

- To address this risk and reduce the probability of losing the asset to 0%, the company could build a desalination plant, which makes seawater suitable for human consumption.

Desalination plant's marginal cash flows excluding opportunity costs

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Marginal operating costs	0	-10	-10	-10	-10	-10		10
Marginal depreciation	0	-25	-25	-25	-25	-25		-25
Marginal costs	0	-35	-35	-35	-35	-35		-35
Marginal EBIT	0	-35	-35	-35	-35	-35		-35
Marginal corporate tax	0	9	9	9	9	9		9
Marginal Net Income	0	-26	-26	-26	-26	-26		-26
Marginal depreciation	0	25	25	25	25	25		25
Marginal CAPEX	-500	-10	-10	-10	-10	-10		-10
Marginal project cash flow	**-500**	**-11**	**-11**	**-11**	**-11**	**-11**		**-11**
Terminal value								**-90**
Total marginal project cash flow	**-500**	**-11**	**-11**	**-11**	**-11**	**-11**		**-101**
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535		0.352
Present value	-450	-9	-8	-7	-7	-6		-36
NPV	**-538**							

The desalination plant seems like a poor investment

Including opportunity costs

- The analysis should include the benefits of eliminating the probability of losing the asset

The desalination plant's incremental cash flows

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Marginal CF of the desalination plant, standalone	-500	-11	-11	-11	-11	-11		-11
Opportunity cost: eliminating the expected loss in CF	0	0	0	145	195	210		210
Incremental cash flow	**-500**	**-11**	**-11**	**134**	**184**	**198**		**198**
Terminal value								**1,579**
Total incremental cash flow	**-500**	**-11**	**-11**	**134**	**184**	**198**		**1,777**
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535		0.352
Present value	-450	-9	-8	88	109	106		626
NPV	**720**							

Now the desalination plant seems like a good investment

Including opportunity costs

Type of value	Calculation	Value
(1) Original NPV before the risk of losing the asset		1,210
(2) Loss due to risk of losing the asset		-1,258
(3) New NPV before the desalination plant	(3)=(1)+(2)	-48
(4) NPV of the desalination plant		720
(5) New NPV including the desalination plant	(5)=(3)+(4)	672

Sanity checks in analysing projects

- A sanity check (or test) is a basic test to quickly evaluate whether a claim, or the result of a calculation, can possibly be true
  - Sensitivity analysis
  - Break-even analysis
  - Scenario analysis

Sensitivity analysis on value drivers

Sales growth	EBIT margins 27%	29%	31%	33%	35%
1%	0	4	8	12	16
3%	3	7	11	16	20
5%	6	11	15	20	24
7%	9	14	19	24	29
9%	13	18	23	28	33

Scenario analysis on value drivers

Value driver	Base case	Bear case (Prices fall ↓)	Bull case (Prices rise ↑)
Product volume growth	3%	0%	5%
Sales price	€ 40	€ 30	€ 50
Cost per unit	€ 25	€ 30	€ 20
Capex needed	€ 100 million	€ 200 million	€ 80 million

Behavioural challenges in capital budgeting

- Sunk cost fallacy
  - Sunk costs are costs that have been made and are unrecoverable
  - Sunk costs have zero incremental impact, are irrelevant for the project and should not be included in incremental cash flows
  - When sunk costs are wrongly included, it can lead to rejecting good projects because of the extra cost burden
- Extrapolation bias
  - When forecasting future cash flows, there is a tendency to extrapolate business as usual into the future
  - Highly unrealistic when dealing with non-linear processes such as climate change and transitions

Behavioural challenges in capital budgeting

- Escalation of commitment
  - People feel so committed to the project that they ignore signals that it might not be as good as they thought
  - Continuing with projects that should be stopped, or starting with projects that should not be started
- Impact on discount rates
  - People tend to underestimate the risk of business as usual, while overestimating risk of new models
  - If new models benefit from internalisation processes, then their risk should fall; the risk of old business models rises with internalisation
- Dealing with behavioural issues:
  - Awareness
  - Realistic grounding and testing of the validity of assumptions

Integrating sustainability in capital budgeting

- Three ways to prioritise investments:
  - **Constrained PV:** includes S and E in own units as budget constraint
  - **Expanded PV:** expresses S and E in monetary values and adds to FV
  - **Integrated PV:** balances FV, SV and EV in formula

- Illustrated using example of copper mine
  - E issues: GHG emissions, water use and biodiversity effects
  - E benefits: enables renewable energy production
  - S issues: pollution and access to water for local communities
  - S benefits: jobs and schooling for local stakeholders

Constrained PV

- E effects:

Production starts in Year 3

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Emissions 750 kg per tonne copper (thousands of tonnes CO2e)			38	90	98	105		105
Emissions avoided 4,000 kg per tonne copper (thousands of tonnes CO2e)			200	480	520	560		560
of which attributable to the copper mining project			20%	20%	20%	20%		20%
Avoided emissions attributable (thousands of tonnes CO2e)			40	96	104	112		112
Net emissions (thousands of tonnes CO2e)			-3	-6	-7	-7		-7
Water stress: number of people at risk, thousands			120	120	120	120		120
Probability of risk materialising			1%	1%	1%	1%		1%
Expected number of people affected, thousands			1.2	1.2	1.2	1.2		1.2
Biodiversity damage: fall in MSA (mean species abundance)			?	?	?	?		?

Constrained PV

- S effects:

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Positive health effects for the local community (quality life years added) due to employment			25	25	25	25		25
Negative health effects for the local community (quality life years lost) due to accidents and pollution			-15	-15	-15	-15		-15
Net health effects (quality life years added)			10	10	10	10		10
Increase in years of schooling of the local population			200	200	200	200		200

Expanded PV

- E effects:

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Net emissions (thousands of tonnes CO2e)			-3	-6	-7	-7		-7
Shadow price of emissions, USD/t			240	248	257	266		305
Net value of emissions (USD millions)			0.6	1.5	1.7	1.9		2.1
Expected number of people affected (thousands)			1.2	1.2	1.2	1.2		1.2
Damage per person when affected (USD thousands)			29.8	29.8	29.8	29.8		29.8
Expected water stress damages (USD millions)			-35.8	-35.8	-35.8	-35.8		-35.8
Biodiversity damage			n/a	n/a	n/a	n/a		n/a

Expanded PV

- S effects:

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	..	Year 10
Net health effects (quality life years added)			10	10	10	10		10
Value per quality life year added (USD thousands)			119	119	119	119		119
Value of health effects (USD millions)			1.2	1.2	1.2	1.2		1.2
Increase in years of schooling of the local population			200	200	200	200		200
Value per year of schooling added (USD thousands)			25.3	25.3	25.3	25.3		25.3
Value of schooling effects (USD millions)			5.1	5.1	5.1	5.1		5.1

Expanded PV

- From annual EV flows to EV

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net external reduction in emissions (USD MM)			0.6	1.5	1.7	1.9	1.9	2.0	2.1	2.1
Value of biodiversity damage			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Annual environmental value flows (EVF)			**0.6**	**1.5**	**1.7**	**1.9**	**1.9**	**2.0**	**2.1**	**2.1**
Discount factor, 2%			0.942	0.924	0.906	0.888	0.871	0.853	0.837	0.820
PV (EVF)			0.6	1.4	1.5	1.7	1.7	1.7	1.7	1.8
Environmental value (EV) (USD MM)	**12.0**									

* Water stress damages can be eliminated through the enhancement of the desalination plant

Expanded PV

- From annual SV flows to SV

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Expected water benefits or damages (USD MM)			-35.8	-35.8	-35.8	-35.8	-35.8	-35.8	-35.8	-35.8
Value of health effects (USD MM)			1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Value of schooling effects (USD MM)			5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Annual social value flows (SVF)			**-29.5**	**-29.5**	**-29.5**	**-29.5**	**-29.5**	**-29.5**	**-29.5**	**-29.5**
Discount factor, 2%			0.942	0.924	0.906	0.888	0.871	0.853	0.837	0.820
PV (SVF)			-27.8	-27.3	-26.7	-26.2	-25.7	-25.2	-24.7	-24.2
Social value (SV) (USD MM)	**-207.8**									

Integrated PV = IPV

Project	FV	SV	EV	IPV=SV+EV+FV
Mining project with original desalination plant	672	-208	12	476
Desalination plant enhancement	-64	214	0	150
Mining project with enhanced desalination plant	608	6	12	626

Integrated PV under **intermediate regime**

Intermediate regime – $b = 0, c = 0.5$	FV	$b \cdot SV$	$c \cdot EV$	$IPV = FV + b \cdot SV + c \cdot EV$
Mining project with original desalination plant	672	0	6	678
Desalination plant enhancement	-64	0	0	-64
Mining project with enhanced desalination plant	608	0	6	614

Integrated PV under **responsible regime**

Responsible regime – $b = 1, c = 1$	FV	$b \cdot SV$	$c \cdot EV$	$IPV = FV + b \cdot SV + c \cdot EV$
Mining project with original desalination plant	672	-208	12	476
Desalination plant enhancement	-64	214	0	150
Mining project with enhanced desalination plant	608	6	12	626

Choice of regime matters:

- **Intermediate regime**

  Don’t do enhancement (IPV<0)

- **Responsible regime**

  Do enhancement (IPV>0)

Internalisation

- Internalisation is the (partial) elimination of external impacts due to changing market conditions, higher taxes, and/or tougher regulations
- Internalisation often involves spillovers from SV or EV to FV
  - For example, a higher carbon tax on emissions (EV) leads to reduced profits (FV)
- Dynamic perspective: do not assume the current conditions are going to last forever, but acknowledge that they can change in various ways
- The challenge: future outcomes are clouded in uncertainty

Internalisation example

- Example: bioplastics project for company with negative value creation for E
  - Bioplastics project produces positive E flows, but looks unattractive from (static) FV perspective
  - A (dynamic) internalisation perspective shows how EV can spill over into FV once shadow prices change (partly or fully) into real prices

Project without internalisation

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales	**0**	**0**	**900**	**3,200**	**3,264**	**3,329**	**3,396**	**3,464**
Sales growth				*256%*	*2%*	*2%*	*2%*	*2%*
Costs	-200	-200	-1,100	-2,976	-3,036	-3,096	-3,158	-3,221
EBIT	**-200**	**-200**	**-200**	**224**	**228**	**233**	**238**	**242**
EBIT margin			-22%	7%	7%	7%	7%	7%
Corporate tax	50	50	50	-56	-57	-58	-59	-61
Net income	**-150**	**-150**	**-150**	**168**	**171**	**175**	**178**	**182**

Leads to NPV (FV) of **-2,415**

Project with internalisation

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales	**0**	**0**	**900**	**3,840**	**4,032**	**4,234**	**4,445**	**4,668**
Sales growth				327%	5%	5%	5%	5%
Costs	-200	-200	-1,100	-2,995	-3,145	-3,302	-3,467	-3,641
EBIT	**-200**	**-200**	**-200**	**845**	**887**	**931**	**978**	**1,027**
EBIT margin			-22%	22%	22%	22%	22%	22%
Corporate tax	50	50	50	-211	-222	-233	-244	-257
Net income	**-150**	**-150**	**-150**	**634**	**665**	**699**	**733**	**770**

Leads to NPV (FV) of **1,063**

Internalisation

Value of the company with and without the project & with and without internalisation

FV	Company value excluding the project	Project value	Company value including the project
Without internalisation	15.4	-2.4	13.0
With internalisation	13.1	1.1	14.2
EV	**Company value excluding the project**	**Project value**	**Company value including the project**
Without internalisation	-13.3	4.1	-9.1
With internalisation	-10.7	4.3	-6.4
$IPV = FV + SV + EV$	**Company value excluding the project**	**Project value**	**Company value including the project**
Without internalisation	2.1	1.7	3.9
With internalisation	2.4	5.3	7.8

For FV, the investment decision depends on the probability of internalisation

FV	Probability of internalisation	Company value excluding the project	Company value including the project
Without internalisation	30%	15.4	13.0
With internalisation	70%	13.1	14.2
Expected value		**13.8**	**13.8**

At a 70% probability of internalisation,
FV with the project = FV without the project

Asymmetric and non-linear internalisation

- In practice, even the internalisation of small EVs can disrupt business models in such a way that they cause shifts in FV that are many times larger
- It is possible that internalisation of negative impacts boosts the FV of negative EV companies, because they have a strong competitive position
- Internalisation brings a dynamic aspect to the calculations: when impacts are internalised, even FV-focused companies are forced to move
- Laggards in the sector with more negative impacts will be hit harder if and when internalisation happens

Conclusions

- The capital budgeting process is the process used to make a list of investment projects to be done
- People tend to extrapolate business as usual into the future, which is unrealistic in dealing with non-linear processes such as climate change or biodiversity loss
- FV, SV and EV can have shared, reinforcing or conflicting underlying value drivers
- The IPV (integrated present value) rule leads to different investment decisions, resulting in the creation of integrated value