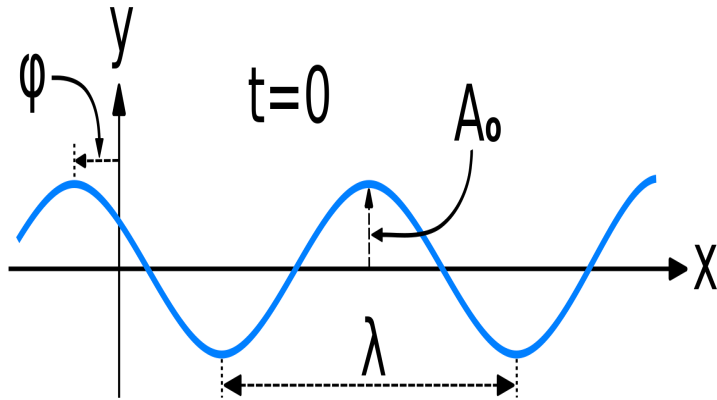# From the lab to the "real world"


Harvard Energy Journal Club

Friday October 7, 2022

Henri de Bokay, fellow, Harvard University Advanced Leadership Initiative

Why is this important?

- Understand people who decide what happens to your invention

- Hard lesson to learn: see your work from their perspective

- Learn to pick your battles

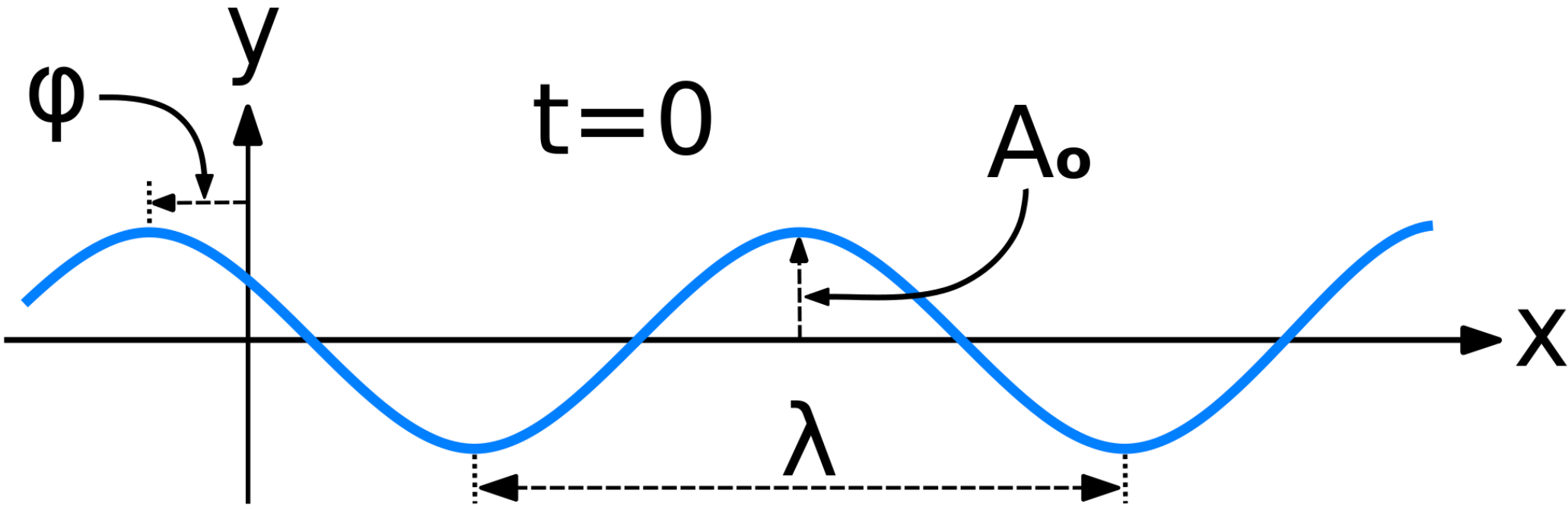- Do all you can to reassure them on the points that matter to them

The Journey

Idea --> Lab --> Spin-off --> VC

Project Finance

Corporate: B2B

Corporate: B2C
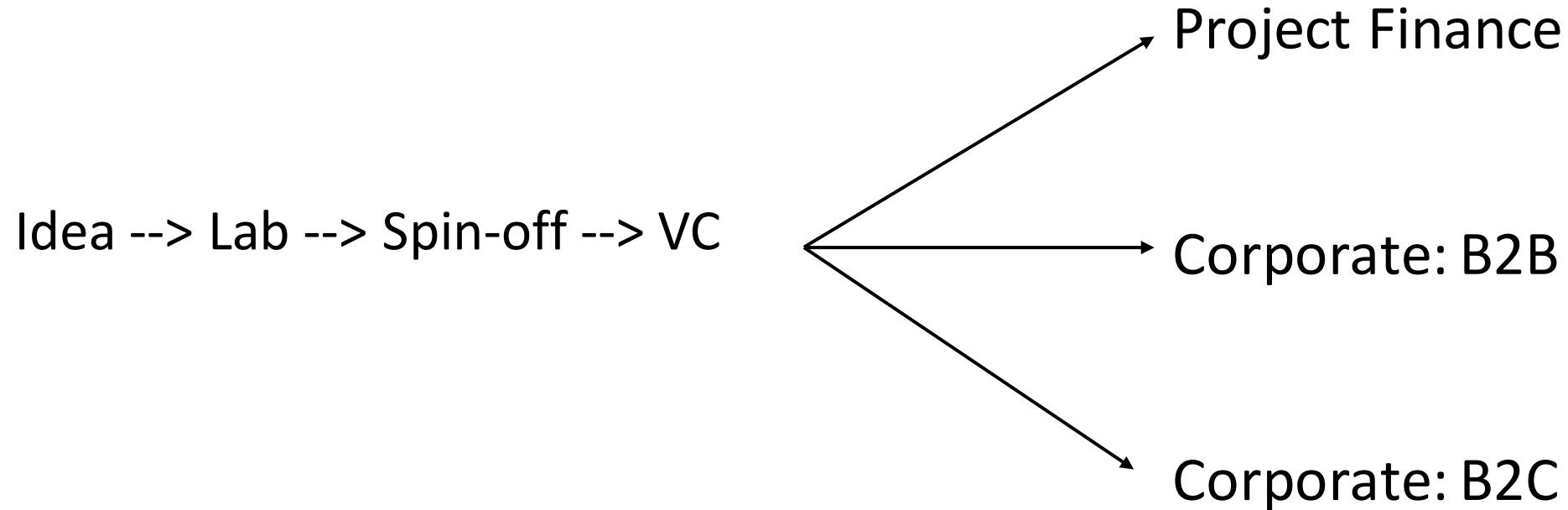
*Government: Idea —> Lab—> Production—> Deployment

Same steps, less interfaces, different incentives (cost+, avoid failure): better integrated, but often slower & more expensive (NASA vs SpaceX)

The lab

Who Decides?

- You and your team? The head of the lab? Who constrains them?

- Follow the money! (Always follow the money)

- Who funds the lab? A grantor! (University/Corporate/Gov't/ NGO)

- What is going through their minds as they contemplate a decision?

- TRL Progress? Weighing rewards of success vs cost of failure

Incentive Profile of Grantor

- Rewards & Costs?

- Let's write this one together (we'll edit and file later)

- Hint: avoid embarrassment

Grantor Decision Maker Profile

- Criteria: TRL progress vs efforts consented

- Optimisation Mode: maximise prestige, minimise embarrassment

- Level of understanding: high on science, low on application

- Financial thinking: cash in- cash out

What is the most likely outcome?

- Optimal funding vs dysfunctional outcomes:

  - No funding
  - Too little funding
  - Too much funding

- Probabilities?

Venture Capital

Photo by Silas Baisch, on Unsplash

Meet the VC

- Technical background

- Commercial experience and outlook

- Confident (especially in their own and their firm's success)

- Not unduly bothered by failure (especially yours: note asymmetry)

The VC's Tools

- Equity (VC backed companies don't usually have a lot of debt)

- Terms: valuation, downside protection (liquidity preference), controls

- Board representation

- Rounds, cap tables

VC Decision Making

- Criterium? MOIC (Multiple On Invested Capital): nx first, IRR for time

- Optimisation Mode: optimise cap gains for time & risk; diversify

- Understanding: smart, but constrained curiosity and time

- Financial thinking: profit, time value of money, probabilities*

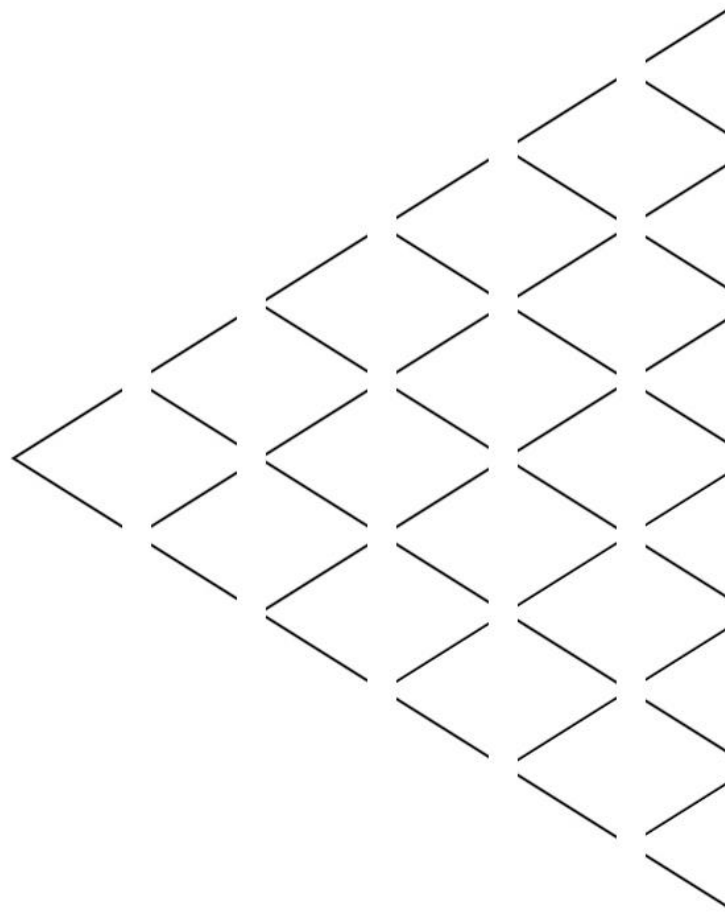# *Finance In One: a Meditation on Time & Risk

$$PV = FV/(1+r)^n$$

PV= Present Value

FV= Future Value

r=interest rate

n=period

VC: the good, the bad, and the ugly

- Good:
  - Take early stage risk, good at finding potential in the lab
  - Nurture companies
- Bad:
  - Excessive focus on speed
  - Limited understanding of/ for technology hurdles or deployment constraints
- Ugly:
  - Asymmetry of outcomes
  - Primacy of investment return over success of technology

Introducing Nexwafe – Case Study

- Spun-out of Fraunhofer Institute, Germany in 2015
- Solar cell manufactured by gaseous deposition on matrix (epitaxy)
- Cheaper (less waste, less energy), square shape, higher yield
- Series D coming up
- EUR 25 mm investment by Reliance of India
- Experimental manufacturing, ramping up to 3GW
- Preparing for deployment from 2024

The end user in mind?

THE NEXWAFE WAY

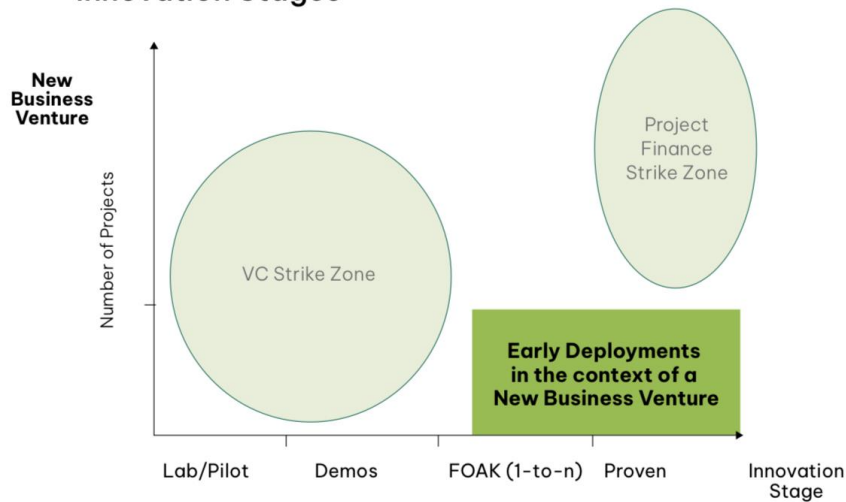Our direct gas-to-wafer process bypasses 6 capex-intensive intermediate steps

THE NEXWAFE WAY

Our long-term roadmap will increase production efficiency by 50%
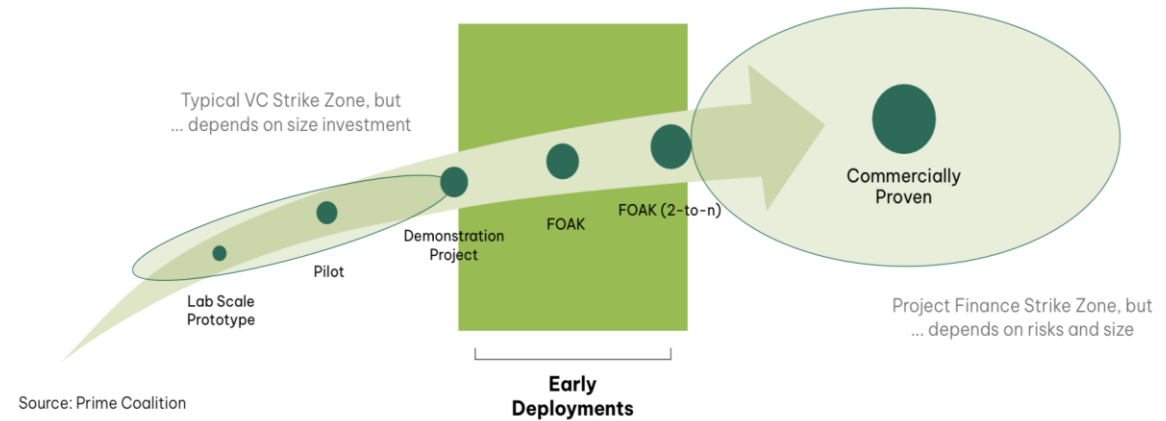
The "real world" - Deployment

From: Barriers to the Timely Deployment of Climate Infrastructure - Prime, April 2022, Khatcherian et al

Figure 2. New Business Venture Across Innovation Stages

Source: Prime Coalition

Figure 1. Sequence from Innovation to Adoption

Source: Prime Coalition

[14] An attempt at defining these stages is included in the full report.

Project Finance Decision Making

- Who? Teams of experts, driven by project manager under committee

- Criteria: IRR, internal rate of return, unlevered vs levered (debt)

- Optimisation mode: Secure funding, revenues, limit costs and risks

- Level of understanding: technology is a black box; expert in overcoming obstacles: legal, financial, human, technical...

Project Finance Tools

- Project Management (golden rule: it takes longer, costs more, gets better if good in the first place)

- Contracts: eg BOOT*, FiT, and many more

- Structured Finance: layering levels of capital (equity, preferred equity, junior debt, senior, senior secured) with different risks and return profiles

*Financial Accounting in One Slide

- Balance Sheet: what you own minus what you owe (understand your liabilities)

- Profit & Loss: getting richer or poorer? Revenue/Cost vs Investment (understand depreciation as a critical, non cash item)

- Cash Flow Statement: will you be able to settle your bills?

- All flow into one another: financial engineering is getting the numbers right

Corporate Clients: B2B & B2C

- Business to business (B2B) vs Business to consumer (B2C

- Criteria:
  - Contribution to profits (Earnings),
  - Potentially effect on P/E (price to earnings ratio)

- Optimisation mode: maximise profit potential of product sold to a rational buyer (B2B) vs an emotional buyer (B2C)

- Tools: full array of corporate disciplines (check syllabus of local b-school)

- Level of understanding: technology is a black box; what matters is the client

In All Cases Involving Final User

- Who is the decision maker? Rarely alone

- Harder to identify; no typical profile

- Learn to navigate stakeholders

- Learn to take seemingly petty concerns seriously

- Learn that your invention does not matter as such: learn to understand their goals

Conclusion

- We have covered a lot of ground in very little time: more to learn

- Not an academic discipline: talk to people!

- Key lesson: it's not about tech, it's about people

- Experiment: do it yourself! You will learn and you will grow (possibly richer, certainly wiser)

There is hope

A large-scale NexWafe facility can reduce CO_2 emissions at the equivalent of nearly 1 million Tesla vehicles on the road

Power for 5000 homes, south of France