“The Perspectives of a Skeptical Co-founder”
Stanford Energy Seminar
Howard W. Turner
January 28th 2012
Key considerations in 2010 for “NewCo”….

Personal experiences suggest
- Pure “materials” plays are difficult
- Pure “engineering” plays are irrelevant to me
- But amazing things can be created when great chemists and engineers work closely together to “evolve” the materials, processes and products

Parameters for next professional steps
- Big target and impact (*meets or exceeds Exxon/Symyx experiences*)
- New chemistry and materials need to be invented (*I have a role*)
- Bringing a “real” product to market (*self-reliant*)
- Create and capture value in less than 7 years (*son graduates from high school in 2017….*)
The problem with “new materials” in existing markets

My paradigm
- Large markets are risk-adverse and price sensitive
- Low cost requires high volume of production
- High volume production requires huge capital infrastructure (financing risk)

My initial instinct
- There is no larger, more price sensitive, more risk adverse, more capital intensive, slower moving, or worse fit than the “energy” market
- Consider meeting “un-met” needs in a market that pays for performance such as healthcare
An example of a recent pure “energy” play

- XTO was founded in 1985 and had grown into the largest natural-gas producer in the U.S.

- On Dec. 14, 2009, Exxon announced a $31 billion all-stock acquisition of XTO

- "Exxon made a bet on natural gas, and so far they are underwater, because the price of gas in the U.S. has collapsed," says Fadel Gheit, the longtime Oppenheimer energy analyst. "That doesn't mean that they are wrong, because their investment horizon is not the same as Wall Street's."

- "The strategic decision I made was, Okay, we're going to enter this wholeheartedly, and we want a big position now," says ExxonMobil CEO Tillerson. "We can build it, and it will take several years for us to get to a material position. Or we can buy it."
Electro-chromic dynamic windows offer substantial energy savings potential

Solar heat gain a primary cause of building energy consumption

Current low-E coated windows offer some protection

DOE estimates 30% lower total energy consumption than low-E

Buildings consume 40% of primary energy in the US, substantial portion is cooling & heating

Low E windows can reduce solar heat gain to about 27%

Dynamic glass has attracted interest from pvt and govt sources
But in addition to energy savings: consumers love dynamic windows for comfort and function...

- Provide energy savings
- Higher comfort
- Cut down on glare/control tint...
- Offer UV protection
- Provide privacy
- Eliminate need for shade/blinds
- Interior design freedom

~30% value

~70% value to consumers is comfort related
First generation dynamic window performance gaps

**Color limited by materials**

**Non-uniform switching**

Slow switching from “edge-to-middle” caused by voltage drops across the TCO’s

**Common Device structure**

Windows require 20 minutes of longer to full switch from clear to dark

State-of-art Dynamic Window
Dynamic windows can become a very high volume consumer electronics category

Dynamic windows can provide a compelling ‘user’ experience

Consumers willing to pay significant premium but

- New materials, processes, and device concepts need to be invented to serve this market

Very large market potential accessible through innovation and the commercialization of high-value products
Kinestral Technologies History

- Founded in 2010 to develop new materials, processes, and dynamic window devices and products
- Initial experimental work carried out at the Molecular Foundry in early 2011 (Delia Milliron labs)
- Executive team includes Dr. SB Cha (CEO, PhD ChemE; MBA; display industry) and co-founder Dr. Sam Bergh (COO; ChemE/EE)
- Strong materials discovery engine and staff, strong process and device engineering expertise
- Bringing “display industry” practices and principles to the “window industry”
- Series A ($16M; September 2012) led by 5AM and Versant Venture
A Graduate Student's Guide to Why, How, and When to Start A Company

Craig H. Peters & Brian E. Hardin
Co-Founders, PLANT PV

PLANT PV
New Materials For Photovoltaic Cells
Start-up demystified

**Start-up**: Group of people with a common vision trying solve a pain in the marketplace....hopefully at a profit!

- Founders
- Core Team
- Expansion Team

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<th>Business tasks</th>
<th>Lab work</th>
<th>Diversity of tasks</th>
<th>Good work/life balance</th>
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Need to find a work/life balance that takes into account your aspirations!
A day in the life of....

Founders (24x7 lifestyle)
- Heavy in the early stage (until you raise $ and hire)
- The vision
- Tech roadmap
- Fund raising
- BusDev & legal
- Hiring & mgmt
- Lab work

Core Team (12 hour days)
- Manage tech tasks
- Lab work
- Business support

Expansion Team (9-10 hour days)
- Execute tasks
It all starts with an idea

Your field of research

Thesis topic

Field with transferable skills

Heliotrope Technologies

SOLUM

PLANT PV New Materials for Photovoltaic Cells
When & how to begin brainstorming

Grad school/Postdoc

4th

5th

Your Field of Research

- Met once per month
- 6 teams of 4 students
- Educated ourselves on the details of the power grid and solar industry

Field w/ Transferable Skills

- Met twice/month
- 6~8 people
- One person brought a problem and suggested a technology solution

Newton’s 3rd Law of Graduation: PhD Comics
“For every action towards graduation there is an equal and opposite distraction”
Other ways to prepare yourself for start-ups while in graduate school

• Become an expert in your field (10,000 hour rule) and build lab skills

• Manage a research project from inception to completion

• Help your advisor write a grant proposal

Common mistakes PhD students make:

• Believe that they should be getting/need an MBA and neglect research

• Extracurricular activities take precedent over research
How long to hit your first milestone?
What resources are required to start?
What skill sets are crucial for success?
What are the major show stoppers?
What need are you trying to satisfy?

Socratic staircase to map your business
Building A-Team

- Find people that are exceptionally skilled to tackle the hardest tasks.
- Stay lean → only bring in people that are crucial to hit your first milestones.
- Very little management
- In a high risk space; the a-team is more important than the idea.

The perfect start-up team
Venture capital math 101

Venture Capital Fun Facts:

1) Want to own 30-50% of start-ups that can obtain valuations of >$500M in 3-8 years

2) Great VCs break even on their most successful company in the portfolio

3) It is in their interest to accelerate development in all aspects to achieve liquidity sooner

Market Size
Margins
Scale Up
Time to return

Google
1998-2004, $23Bn mkt cap @ IPO

Facebook
2004-2012, $104Bn mkt cap @ IPO

Instagram
2010-2012, $1Bn sale to FB
Cleantech companies are different:

1) Compete against commodities with lower margins than IT

2) Takes a lot of time and money to scale up physical products that are expected to last >25 years

3) VCs are not partying like it’s 2007.

See [http://mnordan.com/](http://mnordan.com/) for more information
Government Funding: Fire bullets not cannonballs*

California Energy Commission: Energy Innovations Small Grant Program (EISG)** = $95K

DOE/NSF/USDA: Small Business Innovative Research grants (SBIR)** = $150K-$1M

SunShot programs** = $350K-$10M

ARPA-E & DARPA programs = $200K-$20M

* = Quote from Great by Choice by Jim Clark
** = PLANT PV has received these grants
National labs can be ideal for early stage start ups

- **Figure it out quickly**: National labs have experts and state-of-the-art equipment to help determine if your project is feasible.

- **Failure is OK**: Can cycle through promising ideas at a minimal cost.

- **Need to do cutting edge science**: NOT a place to scale up or do basic engineering projects

Molecular Foundry is a Department of Energy User Facility at Lawrence Berkeley National Labs
If you begin your email with the “I am a graduate student at Stanford,” it is very easy to talk to:

Venture Capitalists

Program Managers at Government Agencies

CEO/CTOs of major companies

Lawyers & Accountants

Other start-ups

This man is not Charlie Gay

If you now Charlie- can you please have him contact me at bhardin@plantpv.com
Company Goal: Perform basic materials science research and prototype PV materials to hit $1/W SunShot goal.

Elan Management
Conclusions / Questions

• It starts with asking the right questions

• Find your A-Team

• Stay lean and flexible

• Raise what you need, not what you can

• Be careful with venture capitalists

• Be proactive

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