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The 'Insurance Policy Model': An Alternative Approach to Evaluating Disruptive Technologies in the Energy Transition

Marc Abbott

Future Energy Innovations

25214 Hamden Valley Drive, Richmond, Texas, 77450, USA

Tel: 1-713-505-6795 E-Mail: Marc.Abbott@Gmail.com

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Abstract

The Energy Transition from hydrocarbon fuels (Oil, Coal, and Natural Gas) to carbon neutral or carbon zero fuels are bringing a necessary change in the way companies and markets evaluate and fund research and development (R&D) in the Energy Transition.

Historically research and development in oil, coal, and natural gas has been focused on "Sustainable Technology" that is developing technology that focuses on lowering cost, increasing efficiency, reducing environmental impacts, and using less energy in the production life cycle of an established product or commodity.

Sustainable technology projects and portfolios have proven evaluation and decision-making methodologies and are generally risk averse; For example, using risked net present value (rNPV) to evaluate incorporating a more efficient generator into a mature energy system.

With the Energy Transition many of the technologies are either in the very early stages of development or not yet tested beyond theory and can be classified as "Disruptive Technologies". Disruptive technologies have by their very nature, as they are unproven, a very different value proposition than sustainable technologies thus traditional evaluation and decision-making methods, such as rNPV are not applicable.

This short communication puts forward an alternative solution to evaluating and supporting decision making for disruptive technologies; The Insurance Premium model is developed where representative insurance premiums are proposed, ranging from very small for unproven technology many years from a significant presence in the market (0.03% of investment) to rather small (1%) for more matured technology that may be significant in the

market in five years' time.

Keywords: Disruptive, Sustainable, Insurance, Premium, Periodic, Assessments

1. Introduction

1.1 Sustainable vs Disruptive Technologies – The Need for a Different Evaluation Approach

Every company has technology, whether they use it to develop better performing products or manage their Human Resources processes or to harness innovation, it is fundamental for any company to be successful that they understand the strategic differences between investing, managing, and marketing in sustainable technologies versus disruptive technologies. Sustainable technologies are incremental in nature and "What all sustaining technologies have in common is that they improve the performance of established products, along the dimensions of performance that mainstream customers in major markets have historically valued." (Christensen, 1997a) The Apple iPhone is an example of sustainable technology, each iteration of the iPhone adds incremental performance to an established product.

Disruptive technologies are radical, have new features not seen before and the market for them does not yet exist. Most importantly "Disruptive technologies bring to a market a very different value proposition than had been available previously." (Christensen, 1997b) The introduction of Hydraulic Fracturing in the oil and gas industry is an example of disruptive technology that ultimately unlocked previously inaccessible gas reservoirs.

What has been historically observed in oil and gas companies pursing technological advancement through their research and development organizations, is the justification for investment based on financial returns that meet internal criteria. For example, an oil and gas company might set a minimum Return on Investment (ROI) rate of 15% for a marketing technology project or a rNPV of greater than $200mln for an enhanced oil recovery project, these methodologies are entirely appropriate as they are proven to be effective for quantifying investment decisions in what are sustainable technology projects.

The difficulty comes when these companies are required to justify investment for disruptive technology projects. As already mentioned, disruptive technology projects offer a different value proposition; market data does not exist to allow analysis of anticipated growth or size, additionally the resources, processes and values of these oil and gas companies have evolved to weigh heavily against investing in disruptive technology. "Companies whose investment processes demand qualification of market sizes and financial returns before they can enter a market get paralysed or make serious mistakes when faced with disruptive technologies". (Christensen, 1997c)

Figure 1.0 based on the Rumsfeld Matrix (Versett, 2023) illustrates the required shift needed in a company's values and processes to enable a level of awareness and understanding that facilitates a disruptive technology decision making environment.

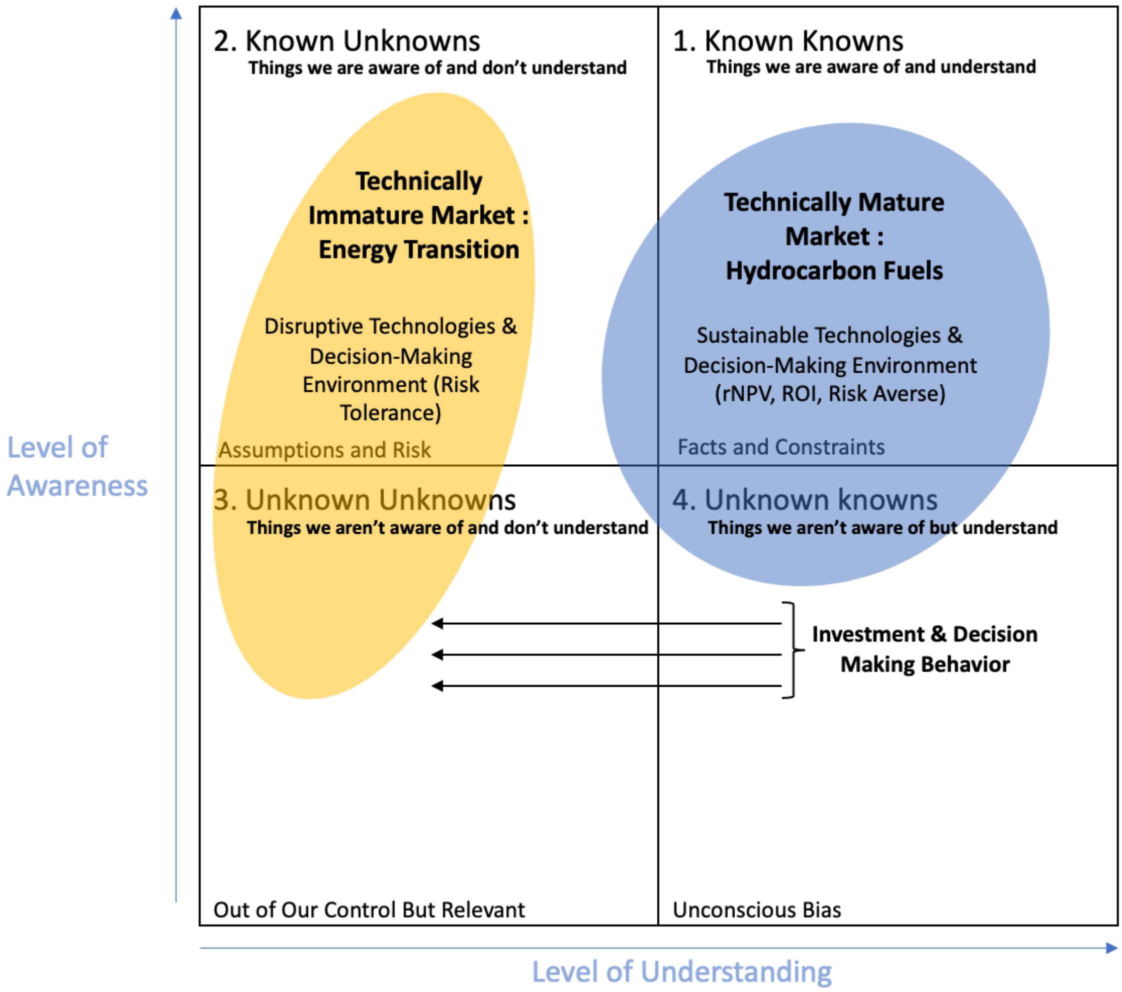

Figure 1. Managing Change: Disruptive vs. Sustainable Technologies

Thus, an alternative approach to justifying investment decision making is needed for oil and gas companies in the Energy Transition if they are to be successful transitioning from hydrocarbon fuels to the development of disruptive technologies in the Energy Transition.

1.2 What Problem Needs to be Solved?

The problem to be solved is both behavioural and quantitative in nature. Looking at the behavioural aspect, the oil and gas industry has historically focused on sustainable technologies, for all the right reasons, supported by a corporate decision-making framework designed around Values (the criteria a company uses to make decisions), Processes (the methods used to transform inputs into higher value outputs) and Resources (people, assets, patents, brand recognition, etc.) that demand qualification of financial returns and future value before funding for given technology project can proceed. Technology and business managers in these companies spend many hours agreeing at the outset the value of the project before making the investment decision.

With the advent of the Energy Transition and the push externally for oil and gas companies to invest in carbon neutral or carbon zero projects the majority of which are disruptive technologies an alternative solution to valuing and supporting decision making must be developed if these companies are to not only survive and prosper in the Energy Transition but to ensure that disruptive technology projects are appropriately assessed and funded equitably vis-a-vis sustainable technology projects.

> "Using planning and marketing techniques that were developed to manage sustaining technologies in the very different context of disruptive ones is an exercise in flapping wings." (Christensen, 1997d)

1.3 Evaluation of Energy Transition Research & Development Projects

Within oil and gas companies, justification of R&D spend on Energy Transition projects is not business as usual! As already mentioned, these projects focus on the development of disruptive technologies that are at the research or scouting study phases commonly known as Discover (D1) and Develop (D2) where the market and customers are unknown and by default good data does not exist for 'regular financial or spend justification'. In addition, the values of these companies, say project hurdle rates, are currently focused on financial performance rather than innovating technologies. For example, a well-established oil and gas company recently set ROI as undernoted, given the context of what we now know about disruptive technologies one could reasonably assume that this company is not serious about investing in Energy Transition projects.

- Marketing return on investment >14%
- Low Carbon Fuels >11%
- Hydrogen, CCS & NBS >9%

In the Energy Transition space, a successful research and development project on disruptive technology might take five years, and a reasonable market might not develop for another five years or might not develop at all. However, Energy Transition research and development projects have a crucial advantage that many large, traditional sustainable ones do not: at the start of year one we only need to commit a very small fraction of the money necessary to launch a product or build a facility: we start with a small spend and review progress and likelihood of success as we go, abandoning un-promising ideas well before large investments are required.

Given this, early-stage Energy Transition research and development projects can be thought of as Insurance Policies. This idea gives us a potentially useful way to evaluate the project using a fit for purpose methodology, which I develop herein.

2. Developing the Insurance Policy Model

2.1 The Decision-Making Environment

The purpose of research in the early phases of disruptive technology is not to identify a winner, this isn't merely "difficult", rather the winner is not known as there are still too many unknowns and/or hurdles (assumptions and risks some of which we do not understand) enroute to defining a market for the technology. The "hurdles" analogy is quite useful as there are multiple reasons why a technology might not emerge as the winner: the technology itself, its HSSE aspects, its cost, does it provide a great customer experience or product, and particularly for some technologies its adoption as an industry standard.

Figure 1.1 Identifying a winner in the early stages of disruptive technology is not merely "difficult", rather it is impossible as many of the hurdles (let alone their solutions) will not yet be fully understood, even by experts in the field.

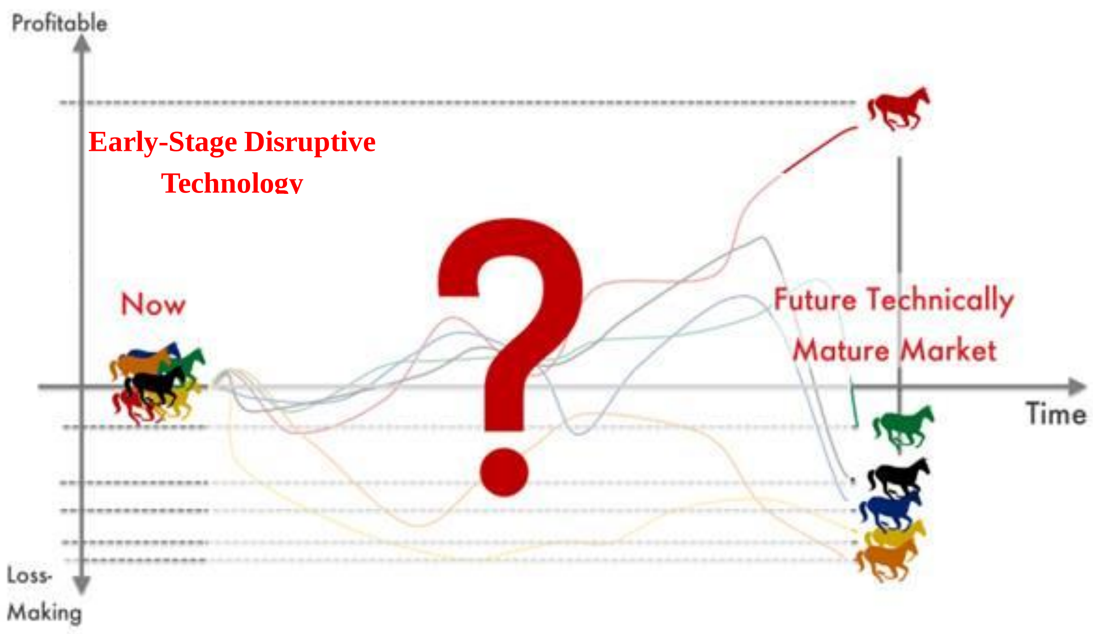

Figure 1.1 Identifying a Winner

A recent example of a research and development project in an oil and gas company reinforces that identifying a winner in developing disruptive technology is "an exercise in wing flapping".

The conversion of water to hydrogen via electrolysis can be achieved via various methods (Abbott, 2023) however a very significant hurdle is the technical readiness of competing membranes each of which determines performance degradation, scalability, and overall electrolyser design. Rather than worrying about which membrane design might win out over the others, the bigger question should be: "Will hydrogen fuelled vehicles replace electric vehicles for future mobility, or vice versa, or is there a long-term mass market for each? (Or neither!)"

In oil and gas companies where they have well established values, processes, and risk averse decision making the shift required to enter quadrant 2 behaviours will be time consuming and extremely difficult to achieve. (Refer Figure 1.0) Is this one of the reasons behind Shell, BP, Total and Suncor's recent pivot back to focusing on oil and gas investment and less on Energy Transition technologies? (Euronews, 2023 and CBC, 2023)

The current decision-making environment in oil and gas companies is clearly not favourable for the R&D of disruptive technologies but it must be noted that to justify funding and investment using the Insurance Policy model, behavioural change where failure in R&D is accepted as a norm i.e., greater risk tolerance must happen simultaneously.

2.2 The Insurance Policy Model

In traditional insurance such as auto the amount of premium paid varies depending on driver age, type of vehicle, claims history etc., (the risk profile). With the proposed Insurance Policy model, the methodology is identical: lines of businesses in an oil and gas company (or any other company), will require an insurance policy that is graduated to the level of awareness and understanding for areas to be researched and developed in disruptive technologies. The lesser the level of awareness and understanding of the technology the greater the uncertainty of winning.

Returning to traditional insurance policies the insurance premium earned is income for the insurance company and the insurer must provide coverage for claims made against the policy. Taking the same methodology for the Insurance Policy model, line of businesses will allocate a spend 'the insurance premium' which is then budget for the R&D project, should the project start to be successful then as in 'making a claim' the businesses will provide further spend to continue should all criteria be satisfied. The insurance rate should initially be very low, as many technologies lobbied for by research and development fail. Additionally in the initial stages the project would likely be non-experimental such as information gathering, relationship building and therefore relatively low cost. It is also unlikely to be needed every year, rather it would be needed only if there was significant progress made.

To build on the progress aspect of a project the preferred approach will be to have periodic assessments of the Technology Readiness Level (red bars in Figure 2.0 below) each of which is designed to reduce uncertainty in possible outcomes represented by the red bars getting shorter in Figure 2.0. With each assessment the technology becomes better understood represented by the red bars getting wider and thus increases the level of awareness and understanding of the disruptive technology project. This approach allows time to develop strong relationships between say technology projects and the businesses to understand each other's requirements and to cooperate to launch a coherent, robust, reliable solution at the right time within a given technology strategy. It eliminates those technologies that are unlikely to 'win' and subsequently do not require further insurance premiums.

Figure 2.0 Periodic assessments of the Technology Readiness Level: as the technology progresses a better assessment of the unknowns and a possibility of success starts to emerge. The assessments are not intended to be annual, but repeated as necessary with significant technological progress.

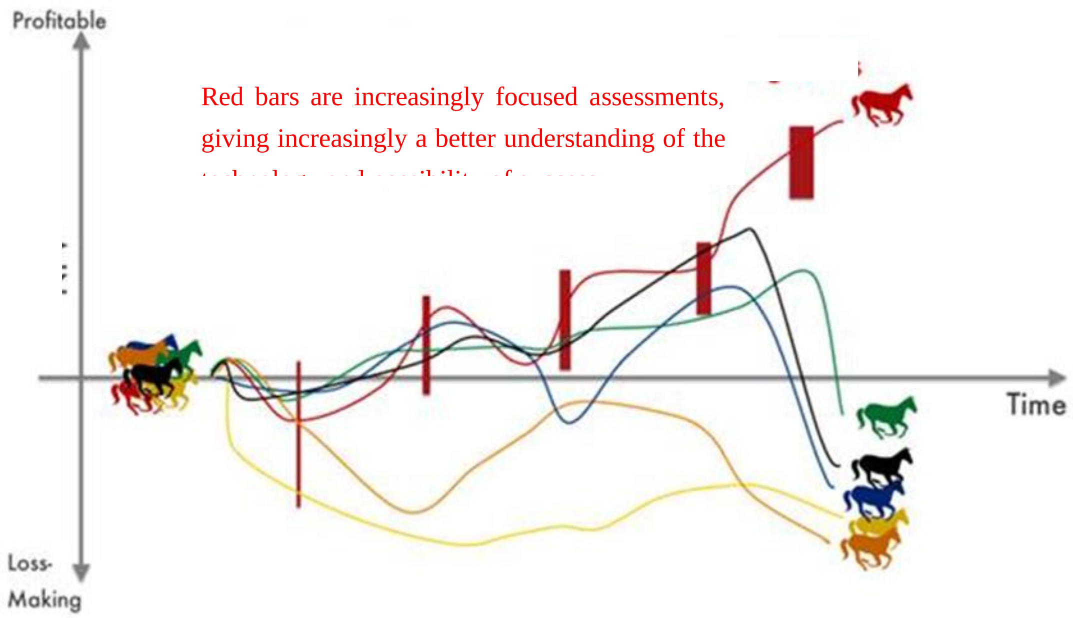

Figure 2. Periodic Assessments of the Technology Readiness Level

To summarize, research and development in disruptive technology generates knowledge rather than tangibles for the early development years and it is important to sponsoring business that sunk costs are minimized. The Insurance Policy model coupled with periodic assessments of the technology readiness level, lowers the risk profile, helps eliminate at an early stage 'unwinnable' technologies and ultimately makes picking a profitable winner much more likely.

3. Applying the Insurance Policy Approach

Table 1. summarizes the preceding discussions and proposes representative insurance rates for different technology readiness levels of the technology being investigated the value of the expected spend that we are insuring against must be agreed on a case-by-case basis by the sponsoring business. It is likely that the expected spend will cover multiple years during which time the disruptive technology will mature, hence the need for periodic assessments.

One point worth noting: are we insuring the business spend or the expected revenue stream, or the subsequent profit margin? From a pragmatic point of view the business must find the money to spend, and it needs to think about allocating some of this spend to a technology program that provides some insurance that the spend will not be on a soon-to-be obsolete or unwinnable technology. From a conceptual perspective if we were confident that we could predict the revenue stream accurately then we would use rNPV or ROI as we would be back in the realm of sustainable technologies where the market and data are known. The Insurance Policy model is for cases where we can't do this (so we certainly can't predict the margin). Therefore, thinking of it as insurance for the business spend makes good sense.

3.1 The Insurance Premium Model - An Example

The mobility business of an established oil and gas company has provided a budget spend for the next 10 years of $200mln USD to grow the business in EV Charging and Low Carbon Fuels. Their ambition is to own and operate fast charging networks in the 120 countries it currently operates in and for Low Carbon Fuels to replace gasoline and diesel usage by 50% of volume by 2035.

To achieve these goals for which the technology is not yet available budget will be allocated to the company’s technology organization using the Insurance Premium Model. The business spend that is being insured is therefore, $200mln USD over the next 10 years. (Refer Table 1.0 for insurance rates)

It is believed that three promising technologies are in scope:

Technology Project #1 – Ultra-Fast Charging: enabling charging of Electric Vehicles in under 10 minutes using Megawatt chargers, current average charging time for an EV is 3 to 8 hours (KBB, 2023). Ultra-Fast charging is currently in the Demonstrate Phase.

∴ Project #1 Insurance Premium: $200mln x 1% = $2mln

Technology Project #2 – Hydrogen for Mobility: using hydrogen to replace gasoline and diesel as a Low Carbon Fuel in internal combustion engines, Hydrogen for Mobility is currently in the Develop Phase.

∴ Project #2 Insurance Premium: $200mln x 0.3%. = $600K

Technology Project #3 – Wireless Highway Charging: charging of EV’s whilst driving on the highway using wireless charging technology beneath the asphalt, Wireless Highway Charging is currently in the Discovery Phase.

∴ Project #3 Insurance Premium: $200mln x 0.1%. = $200K

Using this approach, we have three projects with a total insurance premium of $2.8mln we could argue that for these technology projects, one of which may well be established in the market within five years that this is insufficient insurance for a $200mln budget. Or more positively we could say that the insurance spend was well justified because it is unlikely that the business has wasted money through over-insurance. Either way the projects are warranted.

This approach may appear simplistic, and it is designed to be, however once you factor in the behavioural change required, the periodic assessments and how each company might qualify two key questions: Q1. What is an appropriate insurance rate for a given TRL? and Q2. What is the minimum budget it should apply to? the approach is neither simpler nor more complex than others.

Table 1.0 Stages in the Development of a Typical Disruptive Technology Project

Development stage for the technology that we are insuring against.	Time to Market Deployment (approx.)	Example Technology Readiness Levels	Representative insurance rate	Representative min. business investment worth insuring
Long Range Research	12-15 years	Testing basic principles	≤ ~0.03%	$300M
Discovery Phase	10-12 years	Lab prototypes	~0.1%	$100M
Develop Phase: technologies basic but functioning.	7-10 years	Lab trials	~0.3%	$30M
Demonstrate Phase: the technology is reasonably robust.	~5 years	Proof of Concept Trials	~1%	$10M
Delivery Phase: the technology is robust and achieving a market position seems likely.	~2 years	Scaling trials	Case specific	Case specific
The technology has no critical flaws, is scalable and a market exists.	0 years	Technology publicly deployable	Method not applicable	Method not applicable

3.2 Judging Technology Readiness Level

In this short communication I have used Technology Readiness Level in a way that fits within a typical oil and gas companies' technology organization (Refer table 1.0). I used fewer levels but included organizational factors for a broader set of 'System TRLs'.

The system TRLs allow us to consider the impact of the following organizational factors:

- Decision making complexity
- Values and process
- Level of interdependency
- Internal/external capabilities to deliver
- Time to deployment
- Competitive intensity
- Supply chain arrangements
- External stakeholder complexity
- IP strategy and barriers

External widely used TRL rubrics typically focus on enabling technology for a new or improved product or service for SMEs, the example undernoted are the TRLs taken from the

(EU Horizon Program, 2020).

TRL 1 Basic principles observed.

TRL 2 Technology concept formulated.

TRL 3 Experimental proof of concept.

TRL 4 Technology validated in lab.

TRL 5 Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies).

TRL 6 Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies).

TRL 7 System proto-type demonstration in operational environment.

TRL 8 System complete and qualified.

TRL 9 Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies).

4. Discussion

Oil and gas companies in the Energy Transition are confronted with the fundamental problem that their existing business model (processes, values, capabilities and risk aversion) are designed to function in a technically mature hydrocarbon system, where facts and constraints are well understood and the use of financial tools such as rNPV and ROI are well established to support Sustainable Technology development. This model and its approach quite simply will not work for evaluating disruptive technologies in the Energy Transition, as the levels of awareness and understanding of the technologies demand a shift in organizational behaviours and risk tolerance to quadrant 2. (Refer Figure 1.)

These difficulties encountered in evaluating disruptive technologies led me to develop an alternative methodology which I called the Insurance Policy Model.

The advantages of this model:

1. Much lower spend commitment at project inception than with sustainable Technologies: only a small percentage needs to be committed upfront, this should allow openness to a more risk tolerant viewpoint and builds confidence for decision makers.
2. Periodic assessments of TRL allows the elimination of ‘unwinnable’ technologies: this enables a change from ‘we cannot fail’ too failure in disruptive technologies is more the norm. (Recall picking a winner is impossible in the early stages)
3. It is inherently simple and with parallels to insurance in everyday life relatable to everyone in the organization. Who truly understands rNPV and ROI outside financiers and economists?

The disadvantages:

1. It needs behavioural change in parallel to work: if an organization cannot breakdown its existing business model thinking, the Insurance Premium Model will fail.
2. Developing the appropriate insurance rate and applicable budget: in complex organizations it will be not easy to design and gain agreement on insurance rates and budgets, in the insurance business this done by actuaries.
3. It could be perceived as too simplistic: oil and gas companies like many other companies believe that the more complex something is the better it must be.

Finally, as an oil and gas company you could argue ‘Do we need to adapt to Disruptive Technologies and the Energy Transition? Why not just acquire these technologies along with their resources and capabilities as needed and play out hydrocarbon fuels for the considerable future?

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Glossary

Hydraulic Fracturing:	process of injecting high-pressure water and sand into underground formations to unlock hydrocarbon resources.
Gas Reservoirs:	naturally occurring storage areas for hydrocarbon gases.
Energy Transition:	The proposed alternative to our hydrocarbon energy system.
CCS:	Carbon Capture & Storage: using underground caverns or reservoirs to store captured CO2.
NBS:	Nature Based Solutions: working with natural ecosystems to capture and store carbon emissions.
Low Carbon Fuels:	Gaseous fuels (biogases, hydrogen, and synthetic methane) and liquid fuels (liquid biofuels, ammonia, and synthetic liquid hydrocarbon fuels).
rNPV:	Risked Net Present Value.
ROI:	Return on Investment.
TRL:	Technology Readiness Level.
R&D:	Research and Development.
SME:	Small to Medium Enterprise

Notes

I have worked in the energy industry for over thirty years in many countries across the world and currently lead the deployment of new energy technologies for a large integrated oil and gas company. Evaluating disruptive technology projects and portfolios in this R&D space has always been difficult and with Energy Transition technologies it is further compounded.

By writing this short communication we can hopefully start to move the conversation in the direction needed. Please feel free to contact me for further information or discussion.