



**The upside and  
downside of  
ignorance in  
pavement and  
materials engineering**

**Dr Emile Horak Pr Eng**

# Framework

- Define Ignorance- Ignorance about ignorance
- Examples of general ignorance in society
- Ignorance in pavement materials
- Ignorance and research
- Lessons learned

## **What is Ignorance? : Synonyms include**

Benightedness, **bewilderment**, blindness, callowness, crudeness, darkness, **denseness**, **disregard**, dumbness, empty-headedness, fog, half-knowledge, illiteracy, incapacity, **incomprehension**, innocence, inscience, insensitivity, lack of education, mental incapacity, **naivete**´, nescience, oblivion, obtuseness, philistinism, rawness, sciolism, shallowness, **simplicity**, **stupidity**, unawareness, **unconsciousness**, uncouthness,

**States of ignorance (Smithson, 1990)**

**Four overlapping distinctions**

**Absence of knowledge** –facts are not known

**False knowledge** –facts are known with certainty but are actually false

**Absence of understanding** –there are deficits in knowledge

**False understanding** – failures in the sense making around uncertainties and falsehoods

**Much of the ignorance studied lately is produced by science!**

**Three tiered broad classification of Ignorance**

**1. Native or base state ignorance**

**2. Ignorance as Selective Choice**

**3. Ignorance as a Strategic Ploy  
or Active Construct**

# Three tiered broad classification of Ignorance

## 1. Native or natural ignorance -

*We all enter the world in a **naturally ignorant state**, but over time our natural ignorance shrinks as knowledge is accumulated or developed. Even though natural ignorance remains dominant, **rational ignorance gradually grows** as awareness of one's own ignorance increase '. ( Joanne Roberts. From Knowledge Management to Ignorance Management, 2009)*

Natural ignorance - unknown unknowns.

# Three tiered broad classification of Ignorance

## 2. Ignorance as Selective Choice-

Narrowing our focus in one direction.

Natural tendency for humans.

We become inattentive to other possible paths: Predator eyes vs Cow or Deer eyes

*“Ignorance is a product of inattention, and since we cannot study all things, some by necessity are left out.”*

# Three tiered broad classification of Ignorance

## 2. Ignorance as Selective Choice-

Kuhn 1962 - Concept of Paradigms!

*Conscious or rational ignorance*

Known unknowns

and *Opaque ignorance*

Denotes 'we don't know what we don't know!'



# Three tiered broad classification of Ignorance

## 2. Ignorance as Selective Choice-

### Confirmation bias – observed in forensic investigations

Cognitive bias -favouring information that confirms your previously existing beliefs or biases.

Impacts how we gather information, but they also influence how we interpret and recall information.

**Illustration:** “People who support or oppose a particular issue will not only seek information to support it, they will also interpret news stories in a way that upholds their existing ideas. They will also remember details in a way that reinforces these attitudes” .

## Three tiered broad classification of Ignorance

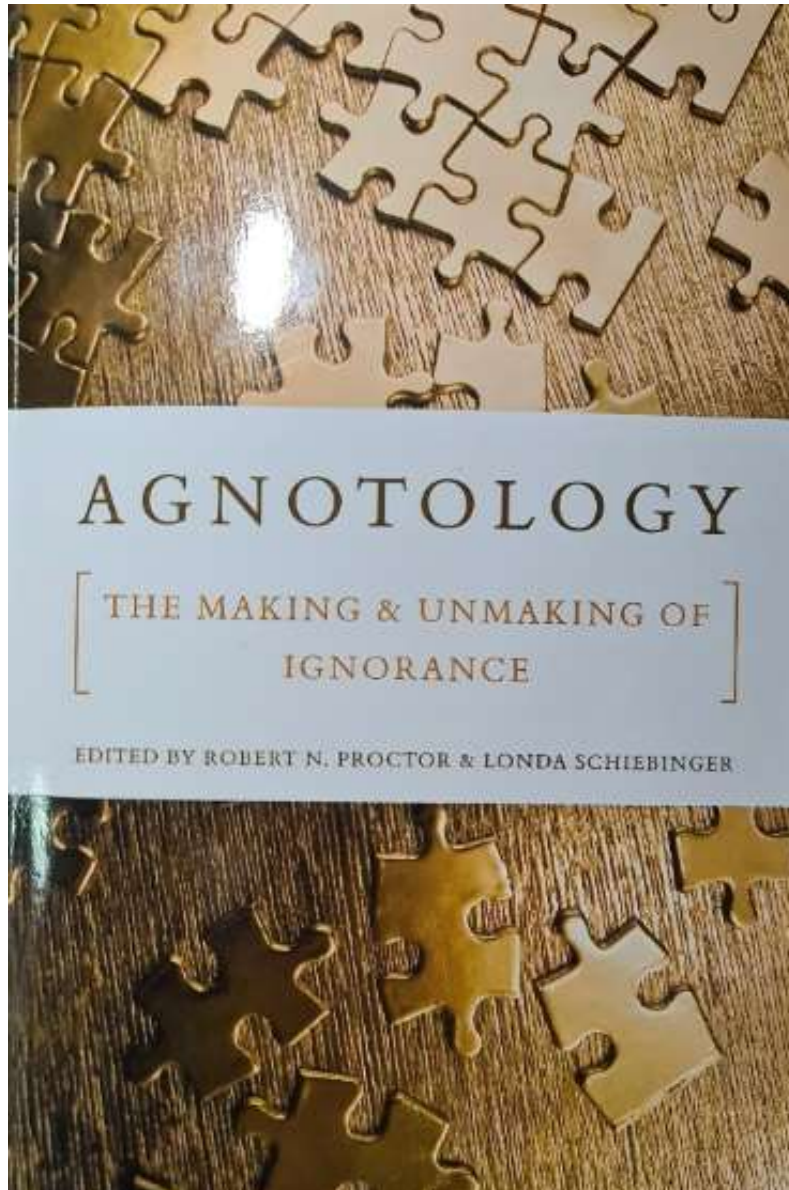
### 3. Ignorance as a Strategic Ploy or Active Construct

**Not a natural, native state, but rather something actively produced.**

Ignorance can be produced and used as a strategic ploy, precisely *because* ignorance is typically viewed as a native and curable state.

**Technical terms for active constructed ignorance that have emerged include: nichtwissen, negative knowledge, non-knowledge, and of course agnotology.**

**Agnotology** - Greek prefix 'a-' for 'without' and 'gnosis' for 'knowing' or 'knowledge'.



Internet search brings up various studies on Agnotology in various fields and research

Best collective : Robert N. Proctor (1995), *Agnotology: The Making and Unmaking of Ignorance* " co-edited with Londa Schiebinger

# Ignorance, Power and Harm

Agnotology and  
The Criminological Imagination



Edited by Alana Barton  
and Howard Davis



**Ignorance as an active construct- Agnotology: Is the study of culturally induced ignorance or doubt, including wilful acts to spread confusion and deceit. Facts can be hidden (secrecy) or removed (censorship), misrepresented and 'forgotten'. Agnotology is often more than just an absence of knowledge; it can also be the outcome of cultural and political struggles.**

**Proctor Example- Agnotology - As early as 1950/60s -Tobacco Industry goal - create ignorance to stave off people learning the truth -by creating doubt - throwing up a smoke screen - throwing sand in the gears**

7000 papers  
\$450 million  
1950 to 1990

- **Tobacco industry opted to “fight science with science” - Developed “tobacco strategies”**
- **Funding and doing decoy research**

- **To distract from critical questions**
- **Jamming scientific airwaves - “friendly research” - Peer review?**
- **Leading to misinterpretations and suppression of such evidence**







**The tobacco industry -clever - creating doubt  
by emphasizing uncertainty!**

**Tobacco Institute to promote these  
supposed non-tobacco causes of cancer.**

**Giant misdirection campaign! "red herring  
research!"**

**Engines of uncertainty - saying there's  
two sides to every question! [*President***

***Donald Trump On Charlottesville:***

***"There are two sides to a story..."*]**

**Tobacco strategies** - adopted subsequently by various institutes that represent substances harmful and potentially harmful to humans.

The Beer Institute, the Sugar Institute, the Methyl Tertiary-Butyl Ether Taskforce, the Salt Institute , hydrocarbon energy field, etc.

“Basically, every product that might cause harm has an institute or a trade association”



**These groups sometimes even work together as engines of uncertainty, engines of ignorance.**

**Global warming** – scientists have been very active in misrepresentation, suppression attacking consensus positions, defending opposing but weaker positions in general creating the impression that controversy still surround issues where clear consensus had been reached.

★ DAILY ★

# FRIEND

Daily Friend



Is there really a 97% consensus about global warming and its consequences?

By John Kane-Berman - Apr 12, 2021

**Ignorance recognised long ago as problem:**

**Charles Darwin “ Ignorance more frequently begets confidence than does knowledge:**

**It is those who know little, and not those who know much, who positively assert that this or that problem will never be solved by science”.**

A person is shown from the chest up, wearing a dark long-sleeved shirt. Their head is completely covered by a brown paper shopping bag, which is tied at the top. The person's hands are resting on a dark, textured wooden surface. The background is a plain, light blue wall. The text is overlaid on the image in various colors and sizes.

**We live in the golden age of ignorance.**

**Ignorance spreads at the speed of light now.  
Rise of conspiracy theories- Rise of denial  
campaigns, (Q-anon impact in USA politics)**

**Siloing of people into information  
bubbles or reinforcing like communities  
through Facebook etc.**

**It's easy to find self-reinforcing bubble  
world - a huge problem.**

**Flattening of data and sources.** Getting information off a smart phone or a laptop - It doesn't discriminate by quality.

**Information democratization has also been a kind of a dumbing down.**

**It's very easy to circulate.**

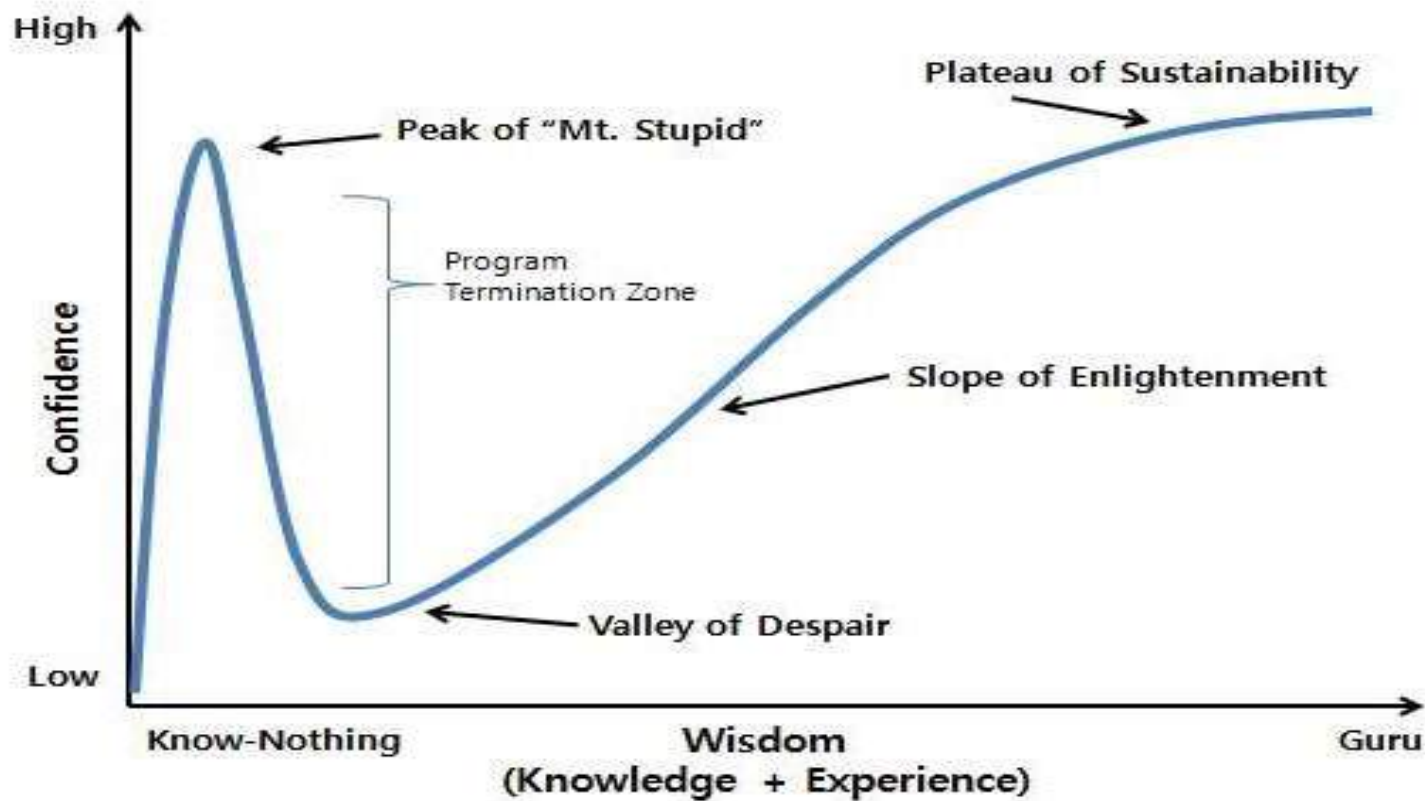
**If that's all you read, there's no quality control there. So that is a big problem.**

Eg Thabo Mbeki and the cause and cures for AIDS!

# Ignorance is bliss! Modern effect of the internet!

Everyone is an instant expert!

Dunning-Kruger Effect





Mark Twain

Dec 2, 1887 “ All you need in life is ignorance and confidence, the success is sure”

**US president Donald Trump’s understanding and handling of the Covid 19 Pandemic in the USA is probably the best example of over confidence with a biased ignorance**

**(Bleach (Jik) and powerful lights? )**

**When ignorance is turned into propaganda**

## **Other examples of Agnotology in plain sight:**

**International various Government's  
handling of Covid 19**

**NZ , Australia vs India**

**Sweden-False narrative of Herd Immunity  
(USA Dr Atlas and Trump –Herd Mentality?)**

**SA- The great PPE heist! ( Political Pirating Enterprises)**



# Realities of dealing with the ongoing impact of Covid 19- The air transport industry and wider impact



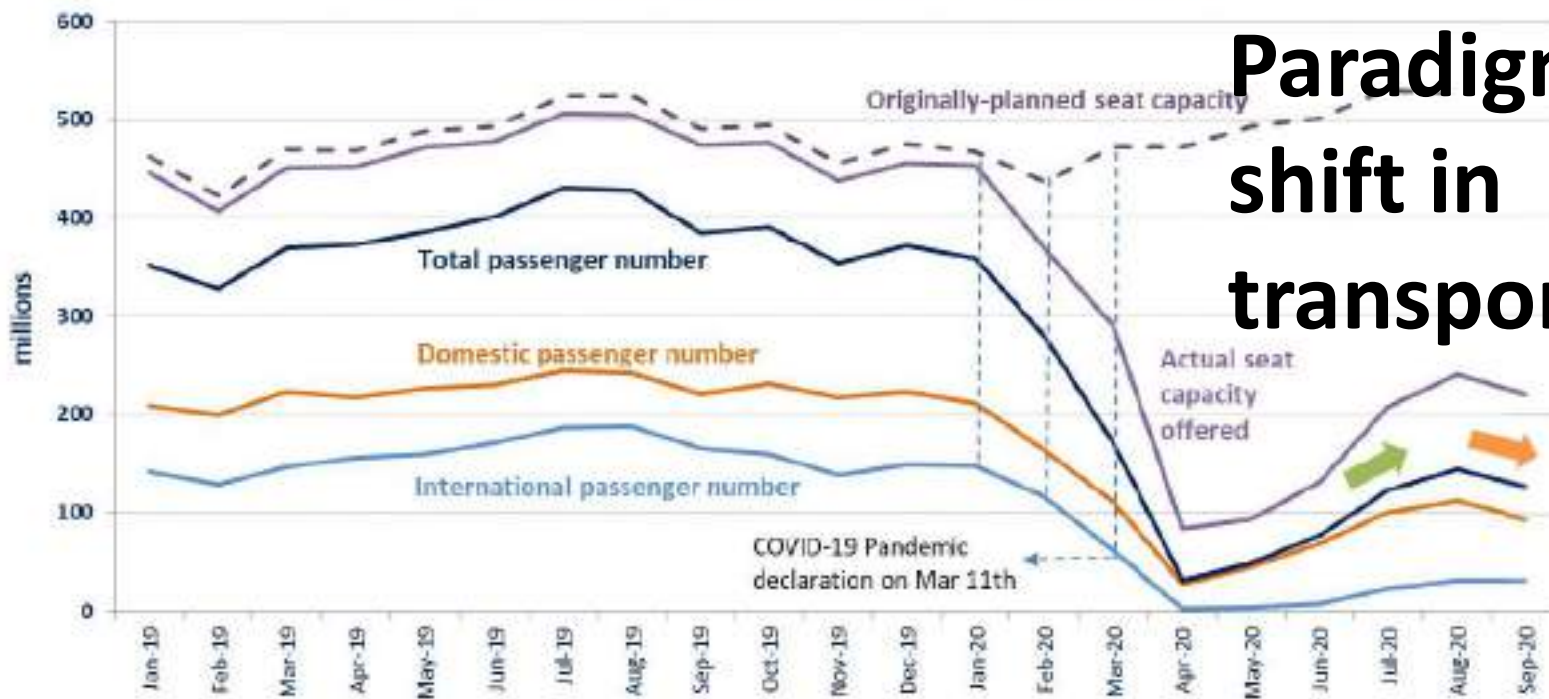


ICAO

UNITING AVIATION

**Drastic capacity cut along with dramatic drop in demand**

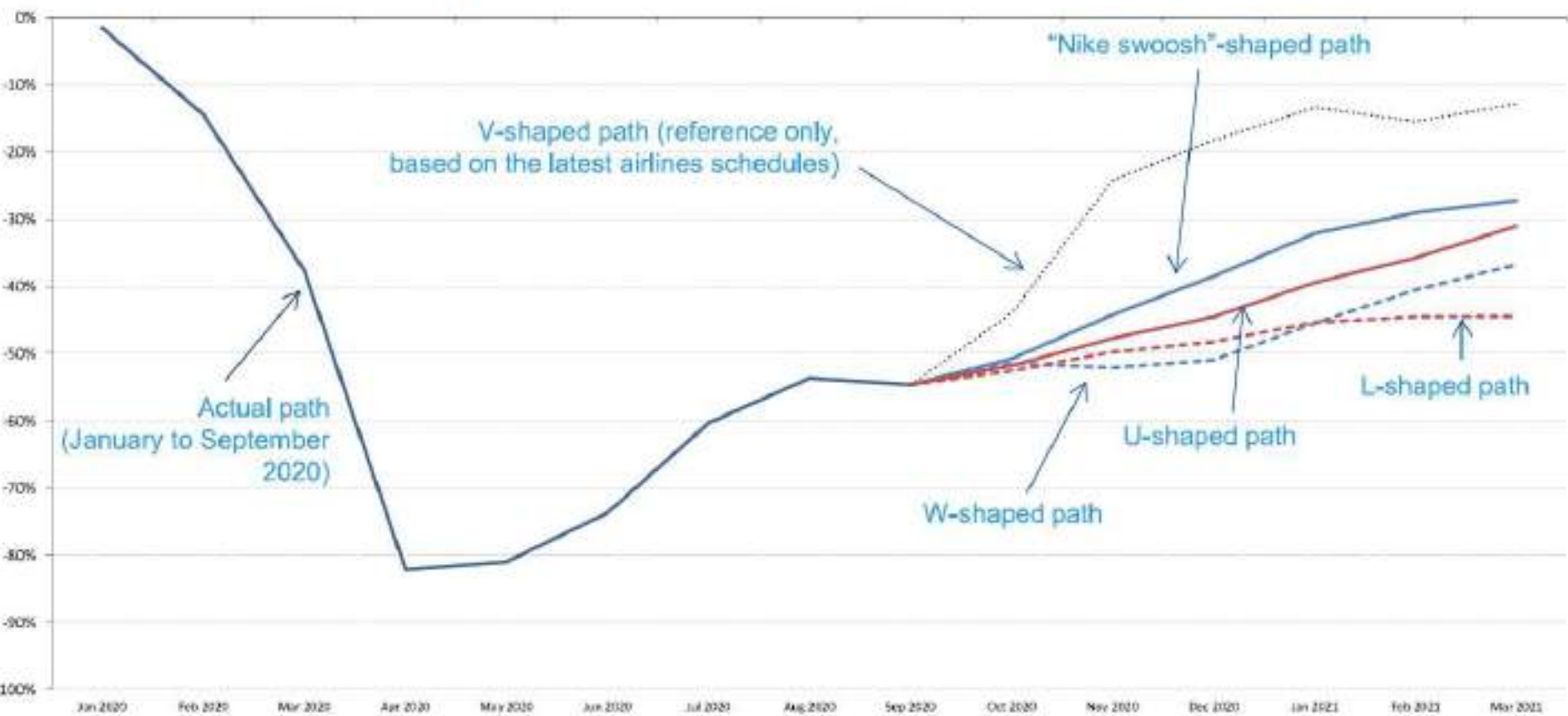
### Comparison of passenger numbers and capacity (Domestic travel is leading the recovery)



**Paradigm shift in transportation?**

**Due to extreme uncertainty, 4 different paths are considered**

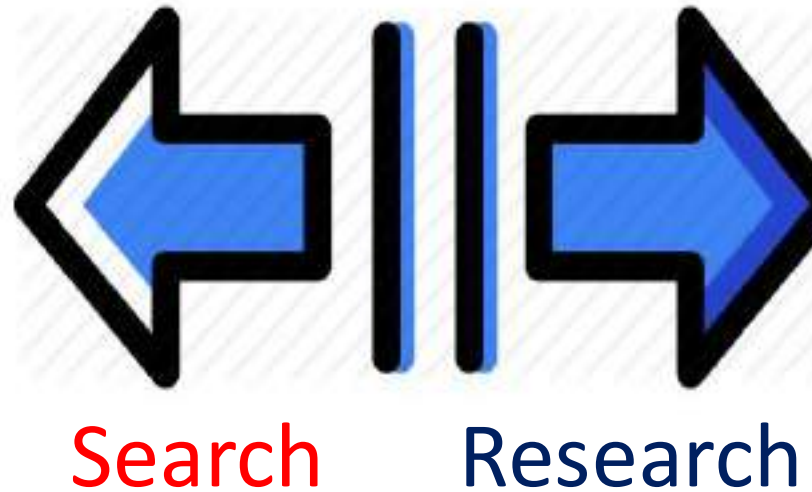
### Scenarios for passenger seat capacity compared to Baseline (business as usual)



**Agnotology is in the other direction of “knowledge”**

**The difficulty of studying something we don't know**

...Agnotology, the study of ignorance. Agnotology is seldom discussed, because studying the absence of something- incredibly difficult.



Epistemology, or the study of knowledge. This field helps define what we know and why we know it. (Confirmation and hindsight biases)





What we  
know  
Research

What we do  
not know  
Ignorance  
Search



Parallel - An iceberg

**Confucius (551 BC-479  
BC)**

**“Real knowledge is to  
know the extent of  
one’s ignorance”**

**RE-SEARCH** (Implies searching again for existing info) Is your **research** effort geared at managing and retaining “knowledge”? - Codifying your knowledge.

**Think:** Guidelines, Method Statements, Specifications, etc

CSIR Research effort over past 30 years?

There is a down side to codification knowledge!

*‘Such knowledge codification practices, by their very nature, lead to ignorance since they involve the reduction of often complex rich knowledge to those components that are central for the task at hand’.* ( Joanne Roberts From Knowledge management to Ignorance Management, 2009)

Any process of abstraction has this impact.

**Agnotology** also focuses on how and why diverse forms of knowledge do not "come to be", or are ignored or delayed.

**Secrecy and deliberate suppression of knowledge**  
**Nuclear physics- \$ Billions pa by the USA to suppress information**

**Example:** Plate tectonics knowledge-censored - delayed for at least a decade - some evidence remained classified military information related to undersea warfare.



# **Ignorance in our own midst ?**

## **California Bearing Ratio (CBR)**

**Still one of the mainstays of defining granular material class and quality**

In TRH 14 main criteria

Written in COTO specs

Weighting high in Appendix A of TG 2

SAPeM

# History

**1930s California- Porter- material -performed best.**

**CBR test -benchmark soils and granular materials -  
simple plunger - simulating a loaded wheel  
(Scaling?)**

**Mainly intended to evaluate subgrade material.**

## **CBR Test method issues**

Notoriously unreproducible with a coefficient of reproducibility of 20% .

CBR=80 may vary from 48 to 112. This implies a variance between a G5 to a G3 material classification!

***No universal standard regarding the CBR testing method.*** For example handling of +19/20mm to 37.5mm size aggregate?

Does not provide a good representation of the in-situ condition over the majority of areas of Southern Africa and does not correlate with the classical soaked CBR evaluation. (Emery)

The CBR test by means of the plunger penetration tend to ***evaluate only the top portion of the sample*** with known upheaval effects and not the material deeper in the CBR mould.

**CBR test got prominence via two historic events;**

**Second world War – US Army Corpse of Engineers- aircraft size increased- higher wheel loads –off the shelf rush solution in a crisis.**

**AASHO road test 1950/60 incorporated in other material characterization and performance**

**CBR got QWERTY status- Recognition it is wrong, but already entrenched**

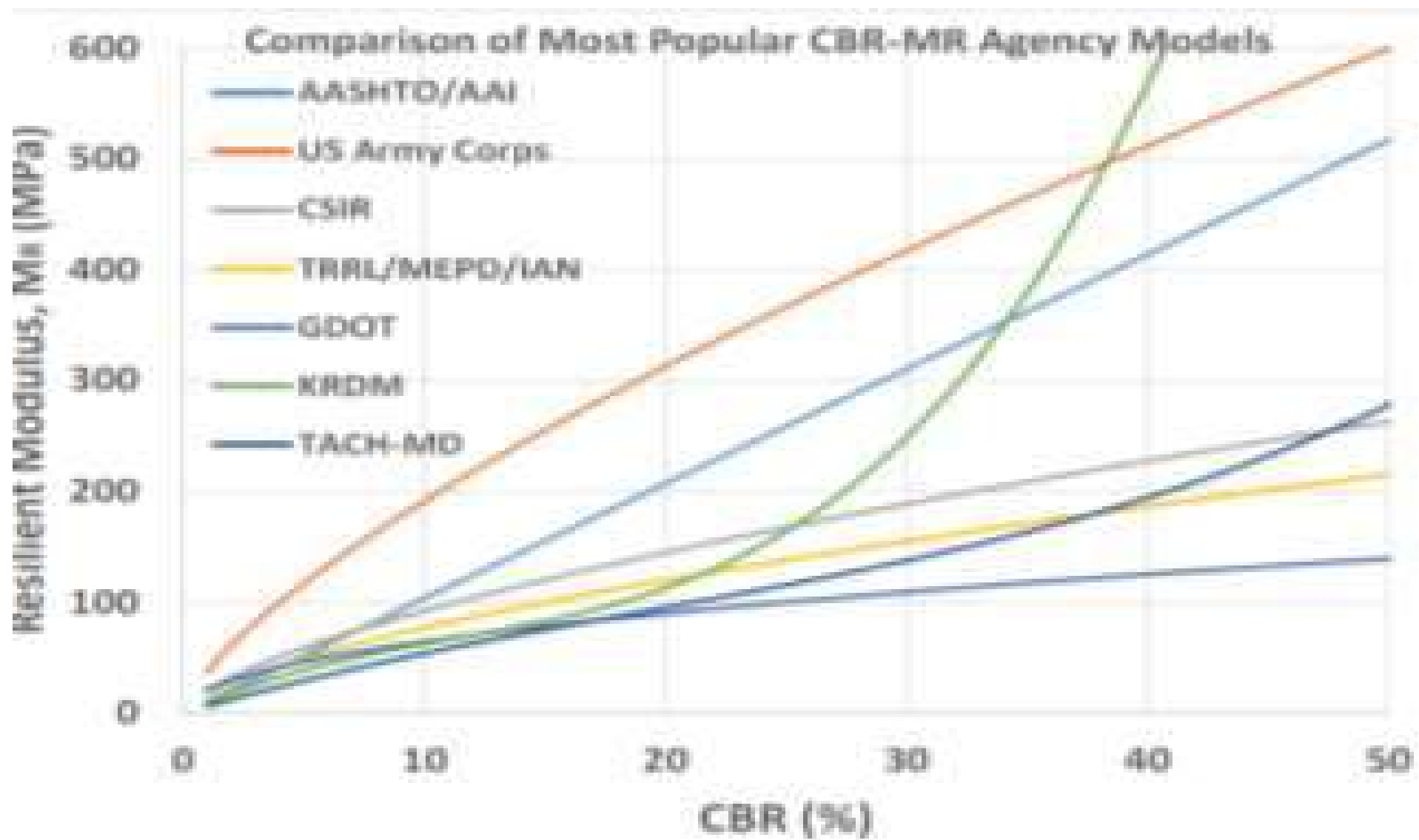
***“...California Bearing Ratio (CBR) is not a fundamental material property and thus is unsuitable for direct use in mechanistic and mechanistic-empirical design procedures.”***

***Various empirical relations to relate CBR to fundamental engineering values such as  $M_r$ , effective elastic modulus, etc. Leads to variable results***

CBR is well established world wide it is ***not a truly scientific test method and do not actually describe a specific engineering or material characteristic.***

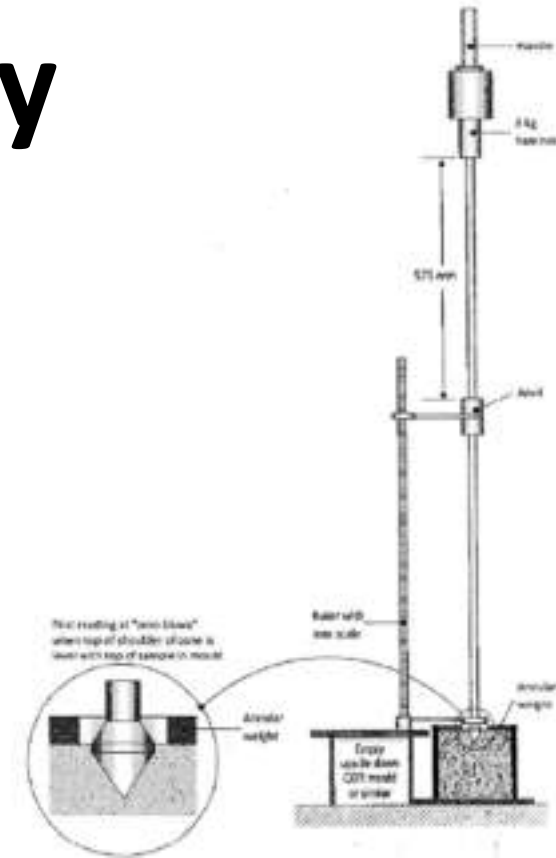
The key properties of a material that exert a significant influence on the performance of a flexible pavement include:

- Shear strength.
- Stiffness (Resilient Modulus).





**ReCAP- Building on previous work in old NITRR, CSIR - by Netterberg, Paige-Green, Sampson, de Beer, Kleyn Promote and use the DCP penetration rate (DN) and not relate to CBR**



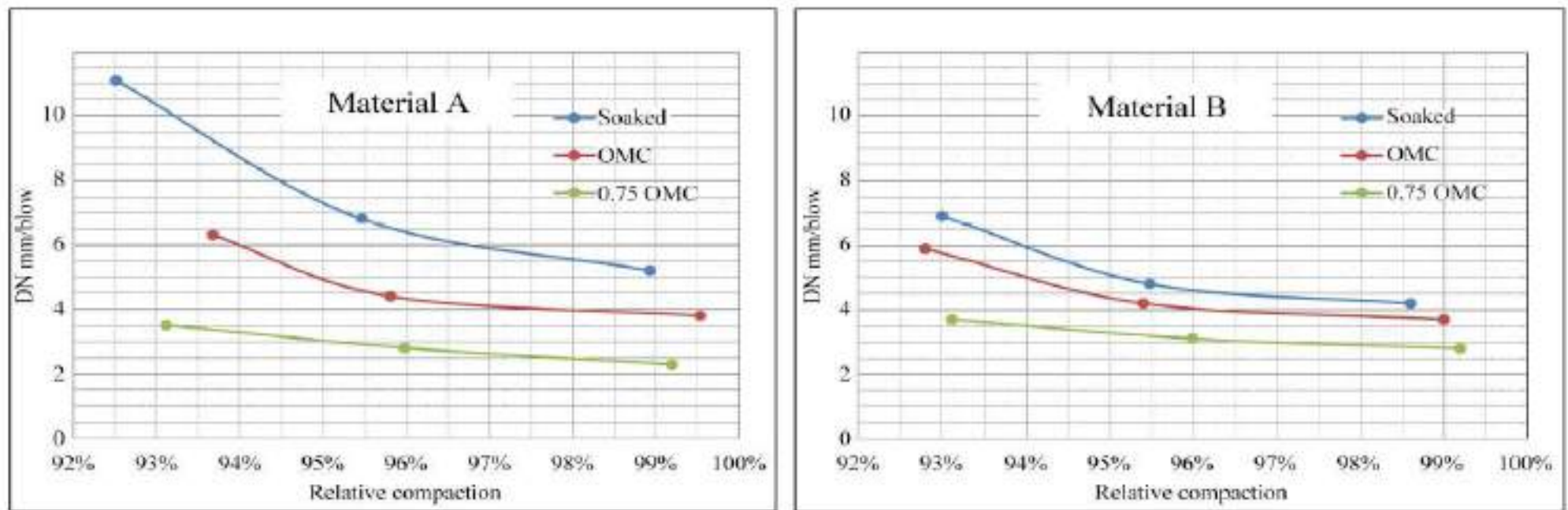
***DCP penetration rate as better laboratory and field evaluation tool*** for specifically natural granular material. In the lab the CBR mould is used for ***penetration through the whole sample*** ( not just the surface)

The **repeatability and reproducibility** of the DCP test, which is governed by **an ASTM standard** are reported to be high and to be **about 33% better** than that of a CBR test.

Correlation studies done with the **DCP to determine Resilient Modulus** values for fine-grained soils and coarse grained soils found very good correlations (  $R^2$  values 0.71 and 0.72).

DCP offers a **viable alternative** - Less complicated and time-consuming procedures -Significant correlation with laboratory resilient modulus. De Beer Effective Elastic and DN -  $R^2 = 0.76$ .







AFCAP actively promote the use of in situ tests such as the DCP penetration rate by doing various laboratory tests at variable moisture contents and compaction efforts to enable direct evaluation of materials



**Figure** DN/density/moisture relationship for two different materials

# DESIGN BASIS

# COMPACTION CONTROL

	COMPACTION METHOD	MEASUREMENT TRAINING	IN-SITU TEST METHODS	COVERAGE
<p>MODULUS / STIFFNESS</p>	<p>Traditional Method</p>  <p>Operator Feel &amp; Memory</p>	<p>Density / CBR</p> <p>After Compaction is Complete</p> <p>Provides little or no "on the fly" feedback</p>	<p>Nuclear Gauge</p> 	<p>Traditional Compaction Testing Method</p>  <p>1 / 1,000,000</p>
<p>MODULUS / STIFFNESS</p>	<p>New Method</p> <p>Intelligent Compaction</p> 	<p>Stiffness / Modulus</p> <p>Ongoing measure &amp; feedback to operator</p>	<p>Modulus based (incl. Plate Load Test &amp; LWD)</p> 	<p>Compaction Testing and Coverage Mapping with AccuGrade</p>  <p>100 % Coverage</p>

**Ok for some of you it is old news!**

**However, we need to ask what kind of  
IGNORANCE does this display?**

**Ignorance as a passive construct? Deliberate?**

**Virtuous ignorance?**

Staying away from certain issues, eg certain kinds of biological, nuclear or chemical weapons.

**Question along virtuous ignorance lines:**

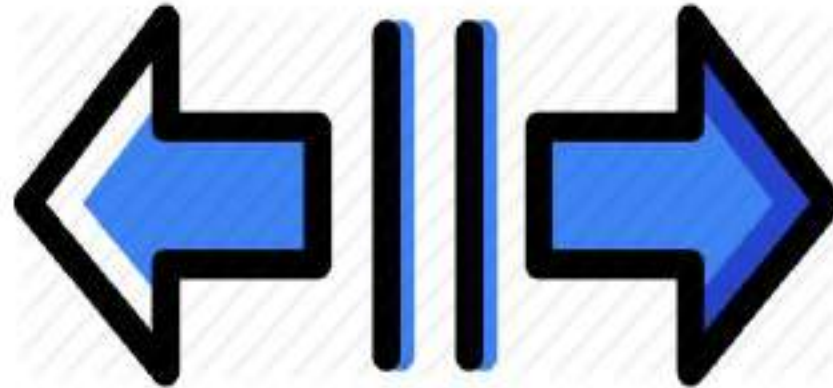
**Now 'laid to bed' issue of the use of SASOL Tar as road binder.**

**Is this a deliberate constructed virtuous ignorance or is it a case of the 'pot calling the kettle black' ?**



**Agnotology is in the other direction of “knowledge”**  
**The difficulty of studying something we don’t know**

...Agnotology,  
Absence of  
knowledge — is  
incredibly difficult.



Search

Research

Epistemology,  
What we know  
and why we  
know it.

**Socrates – “The truly wise are those who realise how little they know: knowledge of one’s ignorance is a precondition for enlightenment!”**

**Modern twist on this: “The more you know the more you realise how little you know.”**

**Important for real research and definitely search  
Start by acknowledging “I don’t know!”**

**Search:** Native Ignorance: I don't know!

**Search-** Innovation- Disruption

**See Prof Wynand Steyn on “ The upside of 4IR technology and innovation”**

**Example :**

Impact of electrical vehicles on transport?

Driverless vehicles?

Drones?

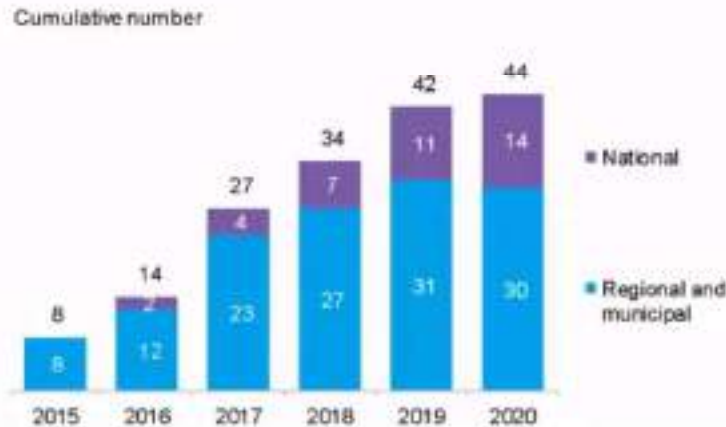
**Future mobility!**

# Future Mobility

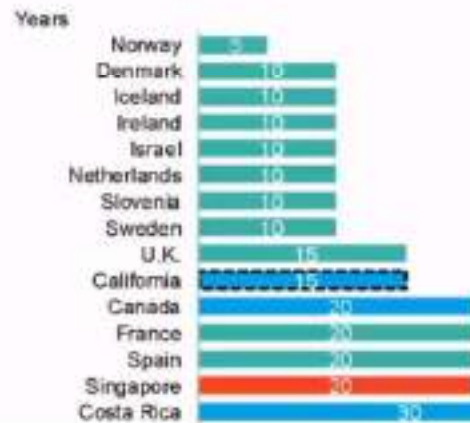
Policy Pressure is Rising - Phasing out of ICE

Policies world wide signalling a trend- technology disruption

Number of governments that have announced plans to phase out combustion vehicle sales



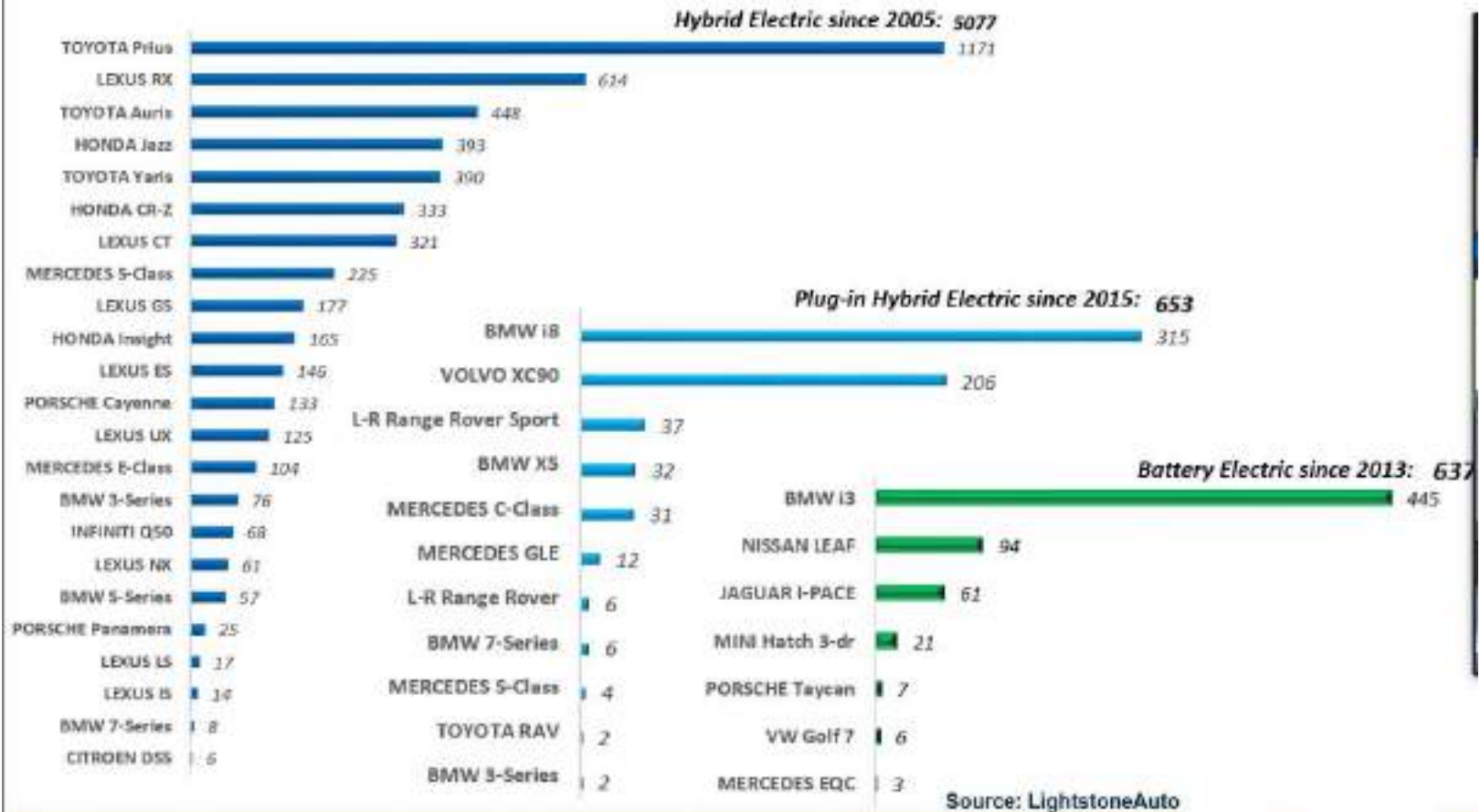
Years remaining until phase-out date



Source: RNEF

This looks like a Tsunami of technology disruptors are building up in the transport field!  
Where are we?

# South Africa's Landscape - xEV's (2020)



Hiten Parmar



# Charging Infrastructure: Vehicle-to-Everything (V2X)

QUICKCHARGING AND BEYOND  
CHAdeMO V2X products in market

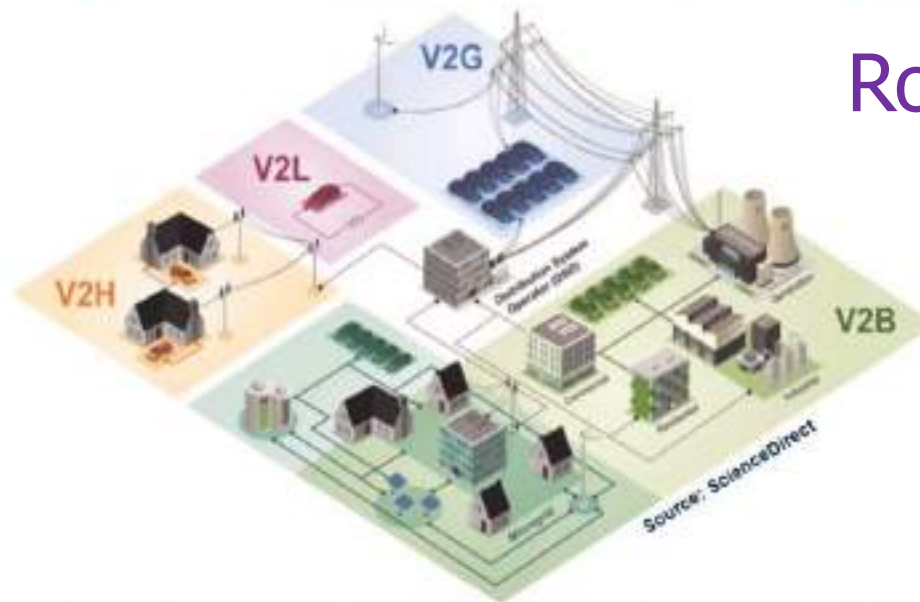
V2X  Source: CHAdeMO

V2L  
(Load)

V2H  
(Home)

V2B  
(Building)

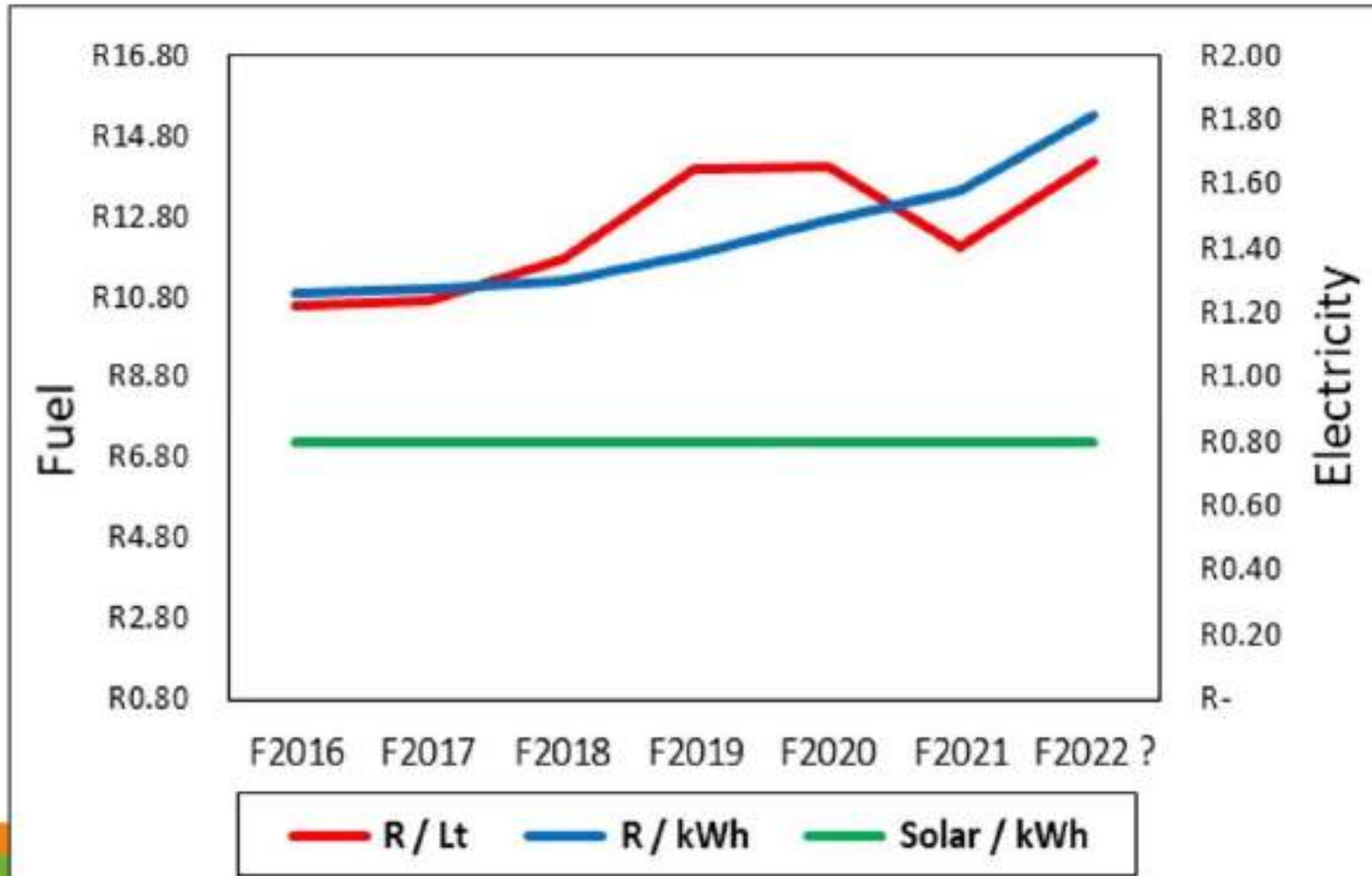
V2G  
(Grid)



Role for SANRAL?

Gideon Neethling of  
Golden Arrow Busses

# Energy Costs

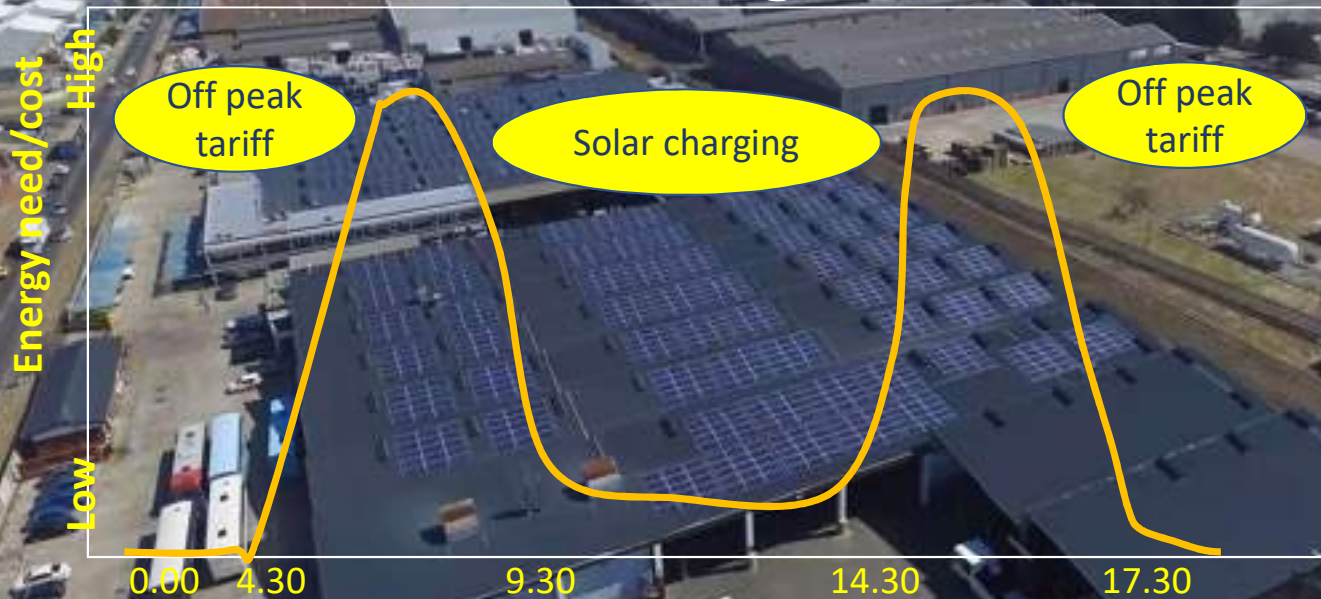




Gideon Neethling of Golden Arrow Busses

Joe Mahoney SATC Plenary session

Road reserve Solar generation





**Moving from sure fire staid research outcomes to innovative technology disruptor research**

**Positive Black Swans, Tim Hartford (2011)**

**How to fund research so that it generates insanely great ideas, not pretty good ones**

1980, Mario Capecchi- Genetic Engineering Idea - the National Institute for Health (NIH)- Idea too risky, but funded another proposal by him. Took money and did his own idea- 2007 Nobel Price for Medicine on mouse genes

- **The National Institute for Health (NIH)-**  
Designed to avoid failure
- Expert-led, results-based, rational evaluation of projects is a sensible way to produce a steady stream of high-quality,
- Can't-go-wrong scientific research.
- Very much like the current SANRAL Research Programme?

## **The Howard Hughes Medical Institute (HHMI )**

- Embraces risk
- Backs people rather than specific projects
- Allows scientists the flexibility to adapt as new information becomes available and pursue whatever avenues of research open up, without having to justify themselves to a panel of experts.
- It does not demand a detailed research project

**We need Positive Black Swan type research!**

***How research is funded, and organised,.....  
.....how research is evaluated and  
communicated are all issues that directly  
may influence the production of ignorance.***

Bjorn Hammarfelt

**Major concern worldwide regarding “the donor effect” on research outcome suppression – pharmaceutical industry -Tobacco industry tricks**

- **Major journals now want full disclosure of agreements between researcher and donors**
- **Are there signs of such secrecy and donor suppression - restrictions in our roads and materials environment?**

# Lessons from agnotology regarding new and innovative research

- **Teach critical thinking skills!** Example environmental studies regarding global warming
- Search- Innovation vs research- codify
- Use ignorance as your departure point. Like a paradigm shift- Admit you don't know!
- Publication versus secrecy and suppression

