

Why practical engineering solutions are an under-recognised yet pivotal key to societal progress

For decades, people have known the dominant approach to building cities, industries and economies is ultimately unsustainable. Today, people in developed and emerging markets are experiencing the consequences of our failure to adequately address the foreseeable issues. The risks and consequences of inaction are mounting, demanding urgent and collaborative action. But whether this can be achieved is in question. In this context, engineering has an important yet generally under-recognised role to play in greasing the wheels of societal transformation.

In 1987, the United Nation's World Commission on Environment and Development¹ revealed the nature and extent of the growing conflict between global economic growth and degradation of the ecosystems that sustain life on Earth. The Commission said that the central challenge was to harmonise prosperity with ecology, broadening from a narrow focus on economic development to a more holistic focus on sustainable development.

In 2000, all members of the United Nations reaffirmed the need for sustainable development, committing to the pursuit of eight Millennium Development Goals². By 2013, progress towards the goals was uneven. Some countries achieved many goals, while others were not on track to realise any.

In 2015, the development agenda was refreshed with all countries of the UN General Assembly adopting seventeen Sustainable Development Goals (SDGs)³.

Progress has been made – but not enough

Tracking of the performance of each nation against the goals demonstrates that progress has been made but the world still falls well short of achieving the Sustainable Development Goals⁴.

Australia, for example, performs well on several SDGs⁵ but poorly on others including greenhouse gas emissions reductions, consumption per capita, housing affordability and species extinction.

Globally, we are going backwards in terms of domestic consumption per unit of gross domestic product (GPD), the level of investment in agriculture (relative to the needs of a growing population), the sustainability of fish stocks and the protection of threatened species.

In tackling climate change, massive strides need to be made over a short timeframe to avoid increasing the Earth's average temperature by more than 1.5 degrees Celsius. What it requires is effectively halving global greenhouse gas (GHG) emissions each decade⁶.

Furthermore, the connectedness of our economic, social and environmental systems means that no indicators of progress can be seen in isolation, nor can trajectories be viewed linearly. Tipping points exist at which fundamental (and often irrecoverable) changes or even system collapse can occur.

As António Guterres, Secretary-General of the United Nation, says⁵

“The coming years will be a vital period to save the planet and to achieve sustainable, inclusive human development”.

Engineering innovations lack scale

Solutions to our development challenges are being developed and deployed. They include materials recycling, renewable energy technologies like solar panels and wind turbines, and more sustainable building products and designs. More sustainable farming practices are emerging, including vertical urban farming.

But it would be naïve to assume that “technology will save the day” – that we should operate on the hope that a technology breakthrough will occur to extract carbon from the atmosphere or rehabilitate vulnerable ecosystems at the pace and scale required to achieve our national and global goals. The SDGs will not be achieved without broad engagement, collaboration and sustained application of resources and effort. But can this be

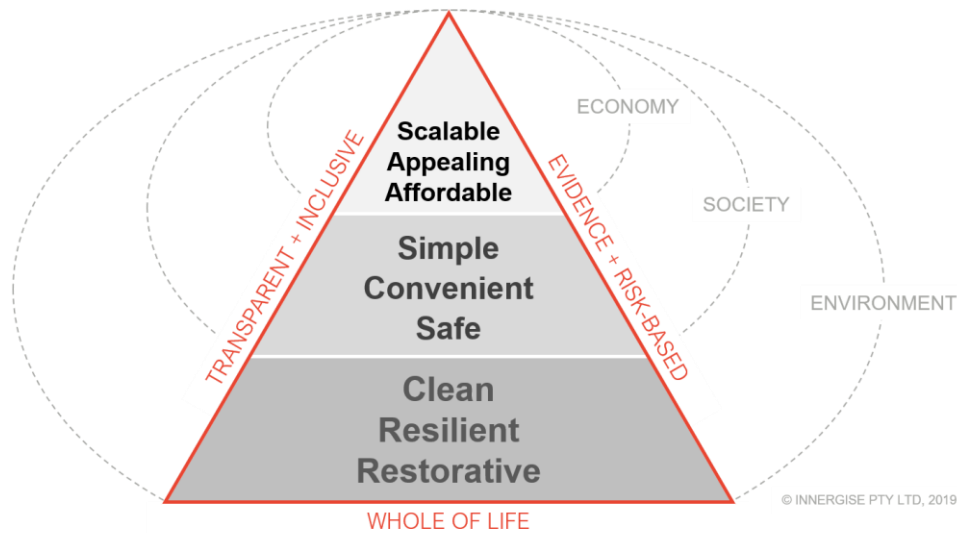


Figure 1. Enabling attributes of societally-transformative engineering solutions

achieved when the world appears to be becoming more divided, not more cooperative.

Will we collaborate in a fracturing world?

Whether tackled locally or globally, sustainable development involves a suite of inter-related issues and challenges⁸. Grasping and addressing these challenges with pace and at scale is particularly complex.

Reaching agreement amongst business and political leaders about “what’s going on” is difficult enough, irrespective of the challenges of moving to action.

Why is this the case? Behavioural sciences provide an answer. In simple terms, the complexity of many of the big problems we face today exceeds the capability of about 95% of our leaders to think about them⁷. They are literally “in over their heads”⁹. So, the stories they tell about what’s going on and how to fix the problem and make progress is often unrealistically simple. Consequently, problems are perpetuated, conditions get worse and people lose trust in their politicians, governments and institutions¹⁰.

Dealing effectively with complex public problems requires greater curiosity, humility and collaboration to usefully diagnose and address the systemic root causes of our major societal challenges. Regrettably, the current state of political discourse suggests that we’re unlikely to achieve consensus and collaboration on meaningful actions at the pace and scale required any time soon.

Designing solutions that people love

The question we need to ask is “Do we need everyone to be equipped to grapple with our complex problems in order to make progress?” Fortunately, the answer is “No”.

We *can* make progress even in the face of considerable adversity. Take, for example, the rapid uptake of rooftop photovoltaic (PV) power technologies by households all over Australia despite the failure by successive national governments to deal meaningfully with climate change and energy policies¹¹. Practical, appealing solutions – *that people want to support, use and pay for* – can gain traction and scale-up quickly.

This is where engineering can play its critical but under-recognised role in facilitating societal progress. **Practical solutions can cut through the discussion and debate** over “What is the problem?” and “What should we do?” and “What would be fair?” and “Who should pay for it?” Practical engineering solutions eliminate the need for non-scientists to understand the complexity of the challenges we face, and they provide bankable solutions that financiers need to achieve sustainable, risk-managed investments.

Attributes of transformative engineering

What then are the attributes of engineered products and solutions that people love – that make them scalable at pace? And can those attributes be expressed in simple terms? Just as we should not expect every citizen to understand the intricate complexities of climate science or the functioning of the economy, nor should engineers need deep experience in behavioural science, ecosystem functions or commerce to possess practical guidance for engineering design, delivery and operations.

An answer to these questions is depicted in Figure 1 and described in Table 1. These attributes are inter-dependent and have the potential to deliver solutions that are not only sustainable but affordable and profitable.

Table 1. Enabling attributes of societally-transformative engineering products

Scalable	Capable of being adopted and deployed across markets.
Appealing	Delivering features that are highly desirable in meeting customer needs and wants.
Affordable	Able to be afforded by a large majority customers and communities.
Simple	No more complex than is essential to fulfil its function in its operating environment.
Convenient	Makes adoption and use easy.
Safe	Presents no material risk to human health and well-being.
Clean	Generates no pollution or waste.
Resilient	Able to withstand shocks and stresses.
Restorative	Contributes to improving the health and integrity of ecosystems.

How these attributes are delivered through the engineering process also matters. A further five attributes are set out in Table 2.

Table 2. Important attributes of the societally-transformative engineering process

Whole of life	Considering the design, delivery, operation and repurposing stages of the life cycle
Evidence based	Relying on scientific evidence for guidance and decision-making
Risk based	Considers risks of action and inaction in a precautionary way
Inclusive	Ensures no-one is excluded or left behind
Transparent	An open process that fosters ethics, integrity and quality in engineering

Some people might think that these enabling attributes are too ambitious or even naïve. Of course, this is another of our human impediments to progress. Effective leaders know that stretch goals are essential to innovate and achieve real progress. So, these enabling attributes of societally-transformative engineering are for the progressive engineering leaders of all ages.

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