Inventing Green

A Toolkit for Sustainable Design
Contents

1. Introduction

2. Notes for Instructors

3. Inventing Green Guide

4. Sustainability Assessment for Innovators

5. Resource List

6. Methodology & Authors

© 2017 VentureWell
Introduction
The Inventing Green Initiative was generously supported by the Lemelson Foundation. The Lemelson Foundation uses the power of invention to improve lives by inspiring and enabling the next generation of inventors and invention-based enterprises to catalyze a stronger U.S. economy and create social and economic change for the poor in developing countries.

In 2014 and 2016, the Lemelson Foundation partnered with the Aspen Network of Development Entrepreneurs (ANDE) in holding a series of global stakeholder roundtables to address issues and unique needs in supporting "green inventors". The resulting report, Impact Inventing: Going Green, stated:

“Inventing green” is the concept that invention-based businesses focusing on developing commercially viable, environmentally sustainable products can have a positive social and environmental impact, while also becoming financially sustainable.”

VentureWell’s Inventing Green materials were born out of this work with the goal to create and share educational materials that can be used to directly impact the early-stage designs of inventors, innovators, and entrepreneurs. Whether or not their innovation is a typical "green" product, our hope is to provide a set of tools that enable all innovators to consider the sustainability implications of their innovations- and in ways that might enable the creation of more robust ventures in the long-run. There are fantastic resources to support growth-stage companies and medium-to-large size companies (see the Resource List), but few of these offer practical and hands-on tools to help instructors integrate principles of sustainability into the earliest stages of innovation and business development. This guide fills that gap and provides practical tools that you can use right away.
Notes for Instructors
The purpose of the guide is to help you provide opportunities for your students to explore what it means to integrate sustainability principles into their work, designs, products, innovations, or inventions. The tools in this guide use life-cycle analysis and systems-thinking frameworks because they were created with engineers and product designers in mind. Though we have created these tools for innovators of physical products, you can frame activities and interpret concepts so that the toolkit can be more broadly-used alongside non-physical innovations as well.

This toolkit contains the following items:

**Inventing Green Guide**
- This provides your students with a brief introduction to sustainability concepts and describes frameworks for sustainable design.
- Assign this as pre-work for a class or workshop to introduce students to the basic concepts of systems-thinking and life-cycle analysis.
- Use examples of “Impact Inventing” and “Inventing Green” to help student innovators consider the ways in which people similar to them have made a positive impact by embedding parts of these sustainability principles within their technologies and business models. Use them in an introductory lecture, assign video viewing to prepare for the assessment, or combine the videos and Inventing Green Guide to build a strong foundation for in-class discussion.

**Sustainability Assessment for Innovators**
- A self-assessment tool comprised of 18 questions allows teams to quickly assess and critically examine the environmental impacts of their innovation’s life-cycle within a systems context.
- We recommend that you use this tool as a means to foster conversation, thinking, and spur further innovation rather than as a benchmarking “scorecard” tool. Throughout our testing of this tool, we discovered that when students focused on their overall score from the assessment,
they missed the point of the lessons, which are to open their minds to sustainability-focused design, and to not worry about how “good” or “bad” they are doing compared to each other.

- We’ve found it is best administered as part of an in-class activity or homework assignment for two or more students working together to develop a product or business.

Resource List
Some of these resources, such as the Autodesk Sustainability Workshop, have become indispensable parts of our curriculum. Use this list to provide you with new inspiration.

Using the Toolkit
These tools are well-suited for use in a variety of settings, including classrooms, workshops, or study groups. They can be used in college-level coursework, incorporated into accelerator programs, or utilized by other capacity-building initiatives that support innovators globally.

We encourage you to explore the materials, familiarize yourself with the core concepts and content, and then use or adapt them to meet your own curricular goals for your particular students. Below are some ideas to get you started:

Sample Assignment #1:
1) Download and read the Inventing Green Guide (available at venturewell.org).
2) Watch the short video entitled “Whole Systems Design: Introduction to Life Cycle Thinking” that was produced in 2015 as part of the Autodesk Sustainability Workshop Series.
3) Exploring either the VentureWell Inventing Green examples or Autodesk examples, identify one example that felt most relevant to your project: What did you learn from this example that you could apply to your product design to make it more sustainable? In what ways could this improve the business case? Be prepared to share in class.

Sample Assignment #2:
1) Download and read the Inventing Green Guide (available at venturewell.org).
2) Watch the short video entitled “Whole Systems Design: Introduction to Life Cycle Thinking” that was produced in 2015 as part of the Autodesk Sustainability Workshop Series.
3) Download and go through the Sustainability Assessment for Innovators (available at venturewell.org). Meet with your team to review and discuss your results. Prepare the insights from your discussion in a 3-minute class presentation.
Sample Prompts:
Prompts for written reflection or in-class discussion might include:

- Did your team find any results surprising? Exciting? Dispiriting?
- How did the assessment help your team think about making sustainability improvements?
- In what ways could these changes impact your competitive advantage, risk profile, or resource and cash efficiency (positively or negatively)?
- In what ways could these changes impact your value proposition?
- Were there any questions that inspired your team to make changes to your innovation? Can your team see any low-hanging fruit for easy wins?

Sample Activity: Connect to the Business Model Canvas
Lead into an activity in which you share business model innovation examples that tweak the life-cycle impacts. Share examples such as: Interface changed their Revenue and Cost Models by choosing to lease their carpeting instead of asset sale, so that it could recycle the used carpet; Tide and other companies enhanced their Value Proposition and Cost Models when they offered concentrated detergent in square bottles to save money and carbon footprint during shipping; Levi’s leveraged Customer Relationships to teach customers how to care for their denim while saving water; and so on, (see the Resource List for where to find more cases). Then send teams to revisit their canvases to identify where new resource efficiencies might reduce costs or change key partners, new features could increase value (price), or new benefits could change the value proposition.

Access and Attribution
All of these tools developed by VentureWell are free and available at venturewell.org. You will be asked to register with VentureWell in order to download the tools. VentureWell holds the copyright, please cite accordingly.
3 Inventing Green Guide
VentureWell developed this Inventing Green Guide to provide innovators with a brief introduction to sustainability, to make the business case for sustainability, and to provide context for the accompanying tool, the Sustainability Assessment for Innovators. We hope to support the next generation of inventors who are environmentally responsible and work toward reducing their negative impact on the environment, regardless of their industry or technology. [1]

Sustainability is a Choice
The term “sustainability” is tough to define and, unfortunately, it has been used as a catchall phrase to include anything that is remotely environmentally-friendly. However, inventors, innovators, and entrepreneurs need to know what it is and understand how it impacts their work and their ventures in today’s world.

Sustainability was first defined in 1987 in the context of sustainable development by the United Nations’ World Commission on Environment and Development (the Brundtland Commission) as, “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” [2]

Sustainability is about making intentional choices with a set of values that lead to positive environmental, social, and financial impacts, both in the short- and long-term.

Sustainable Design
Gone are the days of designing and inventing with no concern or forethought to the planet and its people; it’s not enough to simply create cool gadgets. There is growing global concern and scientific evidence of climate change, pollution, looming energy crises, and water scarcity. Every person on the planet contributes to or helps to alleviate these global issues on a daily basis. Innovators have an even more significant impact than do other individuals due to their powerful decision-making
role during the design and business development process. Using a guiding framework to support decision-making can have both short- and long-term benefits to you, your business, and the world.

As contemporary innovators, it is your team's responsibility to be environmentally conscious and to deliberately design your product or service and associated business in ways that consider and minimize negative environmental impacts. All future innovations should help to promote environmental sustainability. The future of the planet and its people depend upon it. Learning to make environmentally aware design decisions that will lead to positive environmental and social impacts is the future of innovation. It is a historic and consequential time to be an inventor, innovator, and entrepreneur.

Making the Business Case

If businesses are to succeed in tomorrow's economy, the ways in which they define and measure success must evolve to include sustainability initiatives. The International Finance Corporation stated in a report for the World Bank, "Whether managing downside risk, creating business value by incorporating sustainable solutions or identifying innovative ways to finance sustainability, the private sector is becoming the engine of competitive solutions to sustainability and can help finance and address sustainability challenges in the years ahead." [3]

Businesses that solve sustainability challenges or build sustainability into their processes will be best positioned for long-term growth. The 2017 State of Green Business report shows massive revenue opportunity in developing markets: China will invest $361 billion in renewable energy by 2020, which will enable renewables to make up 50% of its electricity generation. "Non-cleantech" companies can benefit from sustainable design as well. The report cites participants in the Carbon Disclosure Project, in which over 1,200 global companies have committed to setting an internal price of carbon emissions; as a result, they can anticipate the impacts of policy change and optimize efficiencies that save money and resources. Investors are taking notice: the report states that in 2016, "total assets invested that consider environmental issues have grown 77-fold since 2010 and now exceed $7.79 trillion in the United States." [4] Though it may seem too early to plan for taking your innovation to a global scale, now is actually the perfect time to set the parameters and defaults for your innovation prototypes and business model iterations in order to position yourself for success down the road.
“interventions similar to those used in cleaner production audits, such as increasing energy efficiency, using recycled materials, designing for recyclability, reducing toxic materials, extending product life, and providing services in new ways. Life-cycle analysis and supply chain management are more precise tools for evaluating material flows and environmental impacts in a product’s life cycle, and can help designers identify additional improvements”.
A Systems Approach

Just like ecosystems that are comprised of numerous and complex direct and indirect interactions, all innovations have a life-cycle that is part of a larger, complex system. Most innovations have many parts that are constructed separately and are assembled into a functional system. By taking a whole systems-thinking approach – that is, viewing your innovation as a system in itself as well as considering its entire life-cycle as a part of a larger system within which it will exist – your team will begin on a path toward sustainability-focused design.

Environmental impact can be evaluated at each of the three life-cycle stages:

1. Supply Chain
2. Product Use
3. End-of-Life

Supply Chain: Sourcing, Manufacturing, and Distribution

Examining the potential environmental impacts of the beginning phase of an innovation's lifetime is crucial. Making educated decisions about where raw materials are sourced and thinking about ways to reduce virgin material consumption is the first step to assessing the environmental impact of the design. Considering how and where the innovation will be manufactured and ultimately distributed to the marketplace is the next step. How could making sustainability improvements during these parts of the life-cycle increase the efficiency of the innovation yet reduce harmful impacts on the environment?

Product Use

Often overlooked during the innovation process, there are many potential negative environmental impacts that could occur during the use-phase of the product/service's life-cycle. For example, the greatest environmental impact of a product may be during the use-phase when excessive amount of water or energy is consumed to clean or charge the product. Considering the use-phase of the life-cycle is critical to promote environmental sustainability.

End-of-Life

Knowing where the product will go when the consumer is finished with it is an important piece of the sustainability puzzle. Will it go into a landfill or could it be disassembled and upcycled for use as a source material for another industry? Can it be easily recycled? By employing a whole systems approach, innovators and entrepreneurs begin with the end in mind and create a ‘cradle-to-cradle’ design rather than a ‘cradle-to-grave’ design. [5]
Examples of “Impact Inventing” / “Inventing Green”

It can be helpful to see examples of startups whose businesses demonstrate the principles of “inventing green” to see that it can be applied in many different contexts.

VentureWell offers a video series, available at venturewell.org, featuring companies that started as student innovator teams. Today, these companies are recognized as some of the most innovative and environmentally-friendly entrepreneurial companies in the world.

<table>
<thead>
<tr>
<th>Company</th>
<th>Reduce toxic waste</th>
<th>Information about environmental impact of the products</th>
<th>Replace petroleum-based with carbon-neutral materials</th>
<th>Improve energy efficiency and quality</th>
<th>Provide clean energy to developing world</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essentium Materials</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GoodGuide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecovative Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iConserve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sierra Environmental Testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar Ivy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Envirofit International</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenlight Planet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manna Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promethean Power Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sustainability Assessment for Innovators
Sustainability Assessment for Innovators

A Systems Thinking Tool
The Sustainability Assessment for Innovators is a tool that will help your team examine the development of your product or service using a whole-systems and life-cycle approach. Using it will foster environmentally responsible design.

The assessment may be used in two ways: 1) as a method to assess the sustainability impact of innovations and, 2) as an innovation-ideation tool. In both cases, the assessment will promote new, sustainability-focused thinking. Your team will learn to consciously consider design decisions and strive to promote environmental sustainability through the development of your innovation and business ventures.

The Assessment has several objectives:
• critically evaluate each of the three life-cycle phases of the innovation in order to pinpoint areas to reduce negative environmental impacts and identify opportunities for positive impact,
• facilitate team communication about individual and team perspectives related to the sustainability-focus of your work, and
• foster a larger group discourse around the topic of sustainability. Specifically, encourage innovators to explore the responsibility and available opportunities to minimize negative impacts on the environment and/or address environmental and social challenges through design.
Introduction

Why do this?
“Sustainability” is more than a feel-good story or an ethical imperative. It is core to a 21st century strategy, for ALL businesses. As you complete the assessment, consider how elements can be applied to your startup in order to amplify impact, increase efficiency, reduce risk, or gain a competitive edge!

How is it Organized?
The Sustainability Assessment for Innovators is a tool comprised of 18 questions divided into three phases of an invention’s life-cycle:
1. Supply Chain: Sourcing, Manufacturing, and Distribution
2. Product Use
3. End-of-Life
This framework will allow your team to quickly assess and critically examine the environmental impacts of your innovation’s life-cycle within a systems context.

Guiding Question
Use this prompt for each question in the assessment:
“Does your product/service reduce direct environmental impacts by being designed to...”
We recognize that your startup is still in the early stages—this is why the questions are oriented to DESIGN, product use-case, and business model, rather than assessing operations in your current status.

Scoring Guidelines
For each question, your team will rate your response on a scale from 1-5 where:
1 = We HAVE NOT considered this for our business
2 = We MIGHT consider this for our business
3 = We ARE considering this for our business
4 = We HAVE considered this for our business
5 = We are WORKING ON this for our business
NOTE: If the question is not applicable to your innovation, please skip the question.

The points are a way to help your team communicate where you stand; don’t worry too much about the score value itself!
What is your company/team name?

Provide a summary of your company/product.

At this stage of your venture, what do you intend to build/produce (e.g., a specific product, a series of prototypes, etc.)? This will help to define the boundary for the questions asked in the assessment.
Technology that increases the strength and durability of concrete while making it lighter, reducing its carbon footprint.

-Helix Steel
Supply Chain: Sourcing, Manufacturing, and Distribution
Sourcing/Manufacturing/Distribution

The six questions below pertain to the Sourcing, Manufacturing, and/or Distribution phase of your product or service’s life-cycle. Answer the questions as if your invention was ready to be made and sold.

Unsure about what it means to source sustainable materials? Watch this video to get a primer on green materials selection. When considering the environmental properties of materials, look for materials that are abundant, non-toxic, have low-embodied energy, and meet or exceed regulations.

Autodesk Sustainability Workshop: Physical Properties of Materials, Choosing Green Materials
https://www.youtube.com/watch?v=amgywLrR_iY (3 minutes)

During the Sourcing/Manufacturing/Distribution phase, would your product reduce direct environmental impacts by being designed to...
For each question, your team will rate your response on a scale from 1-5 where:

1 = We HAVE NOT considered this for our business
2 = We MIGHT consider this for our business
3 = We ARE considering this for our business
4 = We HAVE considered this for our business
5 = We are WORKING ON this for our business

NOTE: If the question is not applicable to your innovation, please skip the question.

...Reduce resource consumption, especially virgin materials inputs?
For example, could non-virgin materials be utilized in the manufacturing process (recycled, reused, or feedstock material(s) that were a waste product from another product or industry)?

...Use safe, non-toxic, and life-friendly materials or ingredients?
For example, does your technology use green chemistry, and/or does it reduce the release of toxins and pollutants (to air, water, soil) relative to the status quo?
...Reduce energy consumption and greenhouse gas emissions?
For example, using inputs with lower-embodied energy or using lean manufacturing and distribution methods that could reduce the amount of required water, energy, power, heat, materials, etc.

---

...Promote resource independence?
For example, are inputs locally abundant (materials, energy, water, forestry)? This could reduce transportation or input costs, make repairs easy, etc.

---

...Use decentralized manufacturing facilities and/or is manufactured/constructed in the location where it will be used?
In contrast, is it reliant on specialized or exclusive facilities, or talent? This could protect proprietary materials or processes in the short-run, but may increase shipping costs and reduce the ability to scale in the long-run.

---

...Consider design constraints and question assumptions about the future?
For example, your team might face additional risk if: your design assumes that cheap energy or petroleum will always be available, and/or relies on a technology or protocol that may become obsolete in the short-medium term.
Water filtration for areas around the world affected by arsenic poisoning. The reusable filter is changing the way water is sourced.

-Drinkwell
Product Use
Product Use

Each of the six questions below pertain to the Use phase of your product or service’s life-cycle. The two videos below are primers to the Use phase of the life-cycle. Persuasive design introduces ways that you may reduce environmental impacts by designing your product’s interface to actually change your user’s behavior through interaction. Want ideas on energy efficient design? Watch the videos below to learn more.

Autodesk Sustainability Workshop: Introduction to Persuasive Design
https://www.youtube.com/watch?v=pO755TmugCw (3 minutes)
Autodesk Sustainability Workshop: Introduction to Energy Use in Design
https://www.youtube.com/watch?v=4q8ugvNZyrM (4 minutes)

During the Use Phase, could your product reduce environmental impacts by being designed to...

For each question, your team will rate your response on a scale from 1-5 where:

1 = We HAVE NOT considered this for our business
2 = We MIGHT consider this for our business
3 = We ARE considering this for our business
4 = We HAVE considered this for our business
5 = We are WORKING ON this for our business

NOTE: If the question is not applicable to your innovation, please skip the question.

...Promote actions that protect, restore, and regenerate the environment during its lifetime of use?
For example, does it return nutrients to the soil, create habitat, clean water, generate renewable energy, etc.? or feedstock material(s) that were a waste product from another product or industry?

...Reduce resource consumption and use during its lifetime?
(i.e., water, energy, materials, power, etc.)
For example, this could include direct impacts by products that are self-cleaning, require significantly less energy to operate, are lightweight, etc. or indirect impacts by using persuasive design and pollutants (to air, water, soil) relative to the status quo?
...Utilize renewable resources and reduce reliance on non-renewable resources during its lifetime of use?
Examples of renewable resources include hydropower, wind energy, solar, and biomass; non-renewable resources include petroleum, natural gas, and water (depending on level of contamination during use). Sometimes you might not have direct control of your users’ choice here; however, are there ways that the design could enable more sustainable choices?

...Capture, convert, or otherwise utilize wasted resources during its lifetime?
For example, it can use other systems’ byproducts such as power, energy, heat, steam, water, biomass, etc. Examples: a device that converts algae from nitrogen-contaminated water into a nutritional supplement; a power generator that uses agricultural waste for fuel.

...Be adaptable? Is it able to incorporate real-time information to improve its efficiency or monitor its utilization?
Does the product/service “learn” from or about the user when being used? Example #1: a surgical device sterilization machine for low-income rural hospitals also relays utilization information back to the ministry of health so that they can monitor whether it is being used or if it is broken and in need of repairs. Is it able to adapt and enhance performance over time? Can it be upgraded without being replaced? Example #2: a cloud-based software that can continuously update with the latest construction technologies and hone in on architects’ preferences in order to make customized green-building recommendations.

...Be multifunctional?
Does it leverage integrated design so that the user receives multiple benefits from using the product yet has only purchased one product/service? Example #1: a smartphone that is a phone, camera, video camera, email account, calculator, and calendar. Example #2: a solar-powered LED lantern that is also a cell phone charger.
Hygienic sanitation facilities for slums around the world. Human waste is collected and converted into fertilizer, reducing water and introducing a renewable resource.

-Sanergy
End-of-Life
End-of-Life

Each of the six questions below pertain to the End-of-Life phase of your product or service’s life-cycle. This phase is when the product is no longer used: what happens to it?

Design for lifetime sustainability means designing to get the most efficient use out of the materials and energy that go into a product by extending its useful life. Understanding the material flow of a product can help you make sustainable decisions that will affect the product life-cycle. Watch the videos below to learn more.

Autodesk Sustainability Workshop: Introduction to Design for Lifetime
https://www.youtube.com/watch?v=tlPlp_Kn7f4 (4 minutes)

During your product’s End-of-Life phase, will your product reduce direct environmental impacts by being designed to...
For each question, your team will rate your response on a scale from 1-5 where:

1 = We HAVE NOT considered this for our business
2 = We MIGHT consider this for our business
3 = We ARE considering this for our business
4 = We HAVE considered this for our business
5 = We are WORKING ON this for our business

NOTE: If the question is not applicable to your innovation, please skip the question.

...Be resilient to change by being durable and able to be repaired, improved, and/or upgraded or updated?
That way, its useful life is extended, and end-of-life is delayed as long as possible. Example:
Interface carpeting is made and sold in modular sets so that only the worn or stained pieces need to be replaced.

...Be repurposed and/or reused?
...Be disassembled with clearly labeled materials for sourcing?  
For example, incorporate recycling icons, directions for disassembly, etc., will enable the product to be broken down for recycling or refurbishing. Check out Herman Miller’s work on furniture!

We HAVE NOT considered this for our business  
1 2 3 4 5  
We are WORKING ON this for our business

...Become an input/raw material for another company/product?  
BONUS: if the product is used to make a new product that is worth more, this is called “upcycling”

We HAVE NOT considered this for our business  
1 2 3 4 5  
We are WORKING ON this for our business

...Be compostable or recycled?

We HAVE NOT considered this for our business  
1 2 3 4 5  
We are WORKING ON this for our business

...Reduce (or eliminate) amount of solid and liquid waste in disposal?

We HAVE NOT considered this for our business  
1 2 3 4 5  
We are WORKING ON this for our business

Thank you for taking the assessment.
Resource List
Resource List

This is by no means an exhaustive list of the resources available for teaching about design for sustainability, green business, or measuring positive impact. However, if you are new to the space or looking for additional support, this is a good place to start. The list features some resources that we will directly refer to in the sample curricula, while others are great sources of industry-specific reports, case studies, and other green-business topics that your students might enjoy.

Video Resources

• Inventing Green Video Series (VentureWell)
  www.venturewell.org/
  A series of short vignettes about science and technology innovators who designed sustainability into their products and business models.
  These examples feature early-stage entrepreneurs who were our former grantees, which may be more relatable than big corporations for case studies. The stories provided can be used to demonstrate life-cycle phases, trade-offs, and design-thinking.

• Autodesk Sustainability Workshop (Autodesk)
  https://sustainabilityworkshop.autodesk.com/
  https://www.youtube.com/user/Autodesk
  https://sustainabilityworkshop.autodesk.com/educator-downloads
  This site includes examples, mini-courses, and videos that focus on green building, product design for sustainability, and cradle-to-cradle thinking.
  Their materials have been indispensable to the Sustainability Toolkit, providing tangible examples to engineering-minded students.
  Examples: Electrosurgery device, Biomimetic water collector, and Core toaster
  Concepts: Systems & Lifecycle Thinking; Lightweighting; Design for Disassembly; Product Life Time
  See their Courses section > For Educators, for more tips on integrating these resources into your lessons
Follow the Frog (Rainforest Alliance)
https://www.youtube.com/watch?v=3iIkOi3srLo
A short, mostly-comedic video that tells the story of an average Joe who then tries to save the rainforest. It’s an ad for Rainforest-certified consumer products, but is also a great starting point for discussions.

Use this video to start one of two conversations:
“As students who are already passionate about a social/environmental cause, how can you better use your skills in design and engineering in order to be heroes in a different way?” Segue into a session in which students articulate their “theory of change.”

Address the protagonist’s cognitive disconnect: “Sometimes it’s easy for us to forget that the things we do in our daily lives are connected to the impact we want to have in the world. How many of you recycle? Carpool? etc. Have you considered ways in which this project COULD have an impact?” Assign the Inventing Green Guide and Sustainability Assessment for Innovators as homework—what’s intuitive, problematic, confusing, or inspiring?

Green Industry Resources

• State of Green Business Report (Greenbiz.com)
A website and online community that produces “The State of Green Business” report, newsletters with case studies, and the annual VERGE conference.
A good resource for sector-specific case studies, especially consumer goods, energy, and green building. Reports describe current trends in regulation, commerce, and voluntary reporting frameworks for reducing carbon emissions.

• Sustainable Brands (Sustainable Brands)
http://www.sustainablebrands.com/
The organization focuses on Fortune 100 companies that are likely familiar to teams.
A good resource for sector-specific case studies about consumer-facing brands. We like to use the examples to show cases when sustainable practices not only enhance brand reputations (and therefore revenue potential), but also reduce supply chain risks or save money.
Entrepreneurial Ecosystem Resources

• Impact Inventing: Strengthening the Ecosystem for Invention-Based Entrepreneurship in Emerging Markets and Impact Inventing: Going Green (ANDE)
http://www.andeglobal.org/
Supported by the Lemelson Foundation, the reports speak at a global level about the opportunities and challenges facing green-oriented inventors and entrepreneurs. The examples of entrepreneur cases in each report are quite valuable to highlight particular concepts that you might teach using the VentureWell Sustainability Toolkit or Autodesk Sustainability Workshop.

• IRIS (The Global Impact Investing Network (GIIN))
https://thegiin.org/
IRIS is a robust database that enables investors to track the social impact of their portfolios in a more standardized format. A tremendous resource if your curriculum is 1) exploring ways that your students can identify metrics for tracking their long-term impact, or 2) are learning about the field of impact investing as it relates to commercializing their innovations.

• GIIRS Ratings (B-Lab)
http://b-analytics.net/giirs-ratings
A cousin to IRIS, the Global Impact Investment Reporting System (GIIRS) is a “gold standard for impact measurement in impact investing.” For teams hoping to raise capital from impact investors, this is an important tool to be aware of. However, because the ratings system assumes the company has facilities, sales, etc., it is less accessible to idea- or prototype-stage teams as a teaching tool.
Methodology & Authors
Methodology & Authors

Remember, please feel free to download and share the toolkit with your students.
VentureWell holds the copyright for the Inventing Green: A Toolkit for Sustainable Design.

Methodology & Evaluation
Using an iterative design approach, the authors developed the toolkit and tested it with nearly 70 workshop participants in VentureWell’s six E-team workshops over the course of 2016. Student inventors touched a variety industries, including medical device, defense, green building, clothing, and global health.

The Sustainability toolkit was deployed within the workshops by providing some portions as pre-work, in-class debrief, and homework assignments. The students’ experiences were then evaluated to inform refinement of the tools themselves and the ways in which they were presented; evaluation included a post-workshop assessment and 14 user-experience interviews.
Evaluation Results:

- Though 70% of participants stated that personal sustainability practices were of the utmost importance (saving electricity, recycling, etc.), only 40% had even considered the environmental sustainability impacts of their designs.
- Before engaging with the toolkit, 80% of students reported “good” familiarity with sustainability concepts; prior to the toolkit, 80% and 60% reported “poor” knowledge of systems-thinking and life-cycle analysis, respectively.
- The assessment took an average of 16 minutes to complete as a team.
- 50% of teams reported that “Sourcing/Manufacturing/Distribution” was the easiest to understand, and 90% had never considered “End-of-Life/Disposal” prior to using the toolkit.
- As a result of using the toolkit and engaging in class discussions, 60% of teams reported that they discovered potential opportunities to tweak their product designs to create a larger positive impact.

Key Takeaways:

- The Inventing Green Guide summarized basic sustainability principles with which many students were already familiar, and built on that knowledge to expand their thinking about systems-thinking and life-cycle analysis.
- Videos and in-class discussions provided valuable examples that grounded the sustainability theory within the Inventing Green Guide into the reality of building an invention-based startup.
- Teams appreciated seeing examples of other innovators and discussing the basics with their peers before taking the Sustainability Assessment, which was sometimes a little intimidating to idea-stage innovators who had not yet thought about sourcing, manufacturing, and distribution, much less in-use or at end-of-life!
- The assessment was originally intended to be a benchmarking tool against which teams could compare themselves to each other or to previous scores in order to track progress; however, by using the tool with diverse audiences of inventors, we realized that the results are also far too diverse to compare. When we emphasized scores, the teams worried about not being “green enough” or getting a bad score, and missed the point of the assessment. When we shifted the focus away from scores and comparisons to the teams entertaining the opportunities to build value into their products or reduce risks to their business models, the teams derived much more value from the Sustainability toolkit.
About the Authors

Dorn Carranza, PhD, MBA, is Director of Strategic Operations at VentureWell. Previously, Dorn advised and mentored PhD-level scientists, engineers, and entrepreneurs on business model creation, product/market fit, minimum viable product, customer discovery/validation, investment readiness, and sales and marketing roadmap and execution. Dorn holds an MBA from the Dominican University of California and a PhD in Bio-Organic Chemistry from Baylor University.

Janine Elliott, MBA, is Program Officer of Entrepreneurship Training and Curriculum Development at VentureWell. Within VentureWell’s programming, Janine works with idea-stage inventors to help them vet their opportunity, with startups that are building a business model, and early-stage companies that know their markets and are preparing to raise the first equity investments. Previously, she has taught science and leadership skills for students of all ages from diverse backgrounds, and most recently was a co-founder of a cleantech materials startup. Janine brings strategic insight, financial acumen, and a plethora of stories on best (and worst) practices for startups. Janine holds a BA in Environmental Policy from Colby College and a MBA of Sustainable Enterprise (GreenMBA™) from the Dominican University of California.

Cindy Gilbert, MS, MEd, is the Director of the Sustainable Design Program at Minneapolis College of Art and Design, and is founder of Alula Consulting, which specializes in innovative online and sustainability education projects for educational institutions, nonprofits, and corporations. Cindy brings to her current position prior experience as founding director of university education at the Biomimicry Institute, where she developed and managed all higher education programs, including the biomimicry professional certification program, the annual education summits, affiliate and fellows program, and student design challenges. VentureWell is proud to have awarded Cindy Course and Program grants to build and sustain her graduate-level program at Minneapolis College of Art and Design. Cindy has an M.Ed., Griffith University, Australia, and an M.S. from Oregon State University.
About VentureWell
VentureWell is a non-profit organization that supports the creation of new ventures from an emerging generation of science and technology inventors and supports the innovation and entrepreneurship ecosystems that are critical to their success. We've funded or trained over 4,500 science and technology inventors and innovators, and nurtured nearly a thousand of their startups reaching millions of people in over 50 countries.

We are proud that leading institutions, from foundations to government agencies to major businesses, support our mission to transform higher education and technology entrepreneurship. The Lemelson Foundation, National Science Foundation (NSF), Bill & Melinda Gates Foundation, USAID, and the Ewing Marion Kauffman Foundation are among those who recognize ours as a powerful model for supporting emerging STEM innovators and the entrepreneurship ecosystems that are critical to their success.

Visit www.venturewell.org to learn more.

About The Lemelson Foundation
The Inventing Green Project was generously supported by the Lemelson Foundation.

The Lemelson Foundation uses the power of invention to improve lives by inspiring and enabling the next generation of inventors and invention-based enterprises to catalyze a stronger U.S. economy and create social and economic change for the poor in developing countries. Established by prolific independent U.S. Inventor Jerome Lemelson and his wife Dorothy in the early 1990's, to date the Foundation has committed more than $210 million in grants in support of its mission.

Recognizing the complex challenges faced around the globe, the Foundation supports an ecosystem to address problems that are worth solving and not just problems that can be solved. This emphasis on impact inventing targets inventors and inventions that have positive social impact, are environmentally responsible and are capable of becoming financially self-sustaining products and enterprises. Through the work of our grantees, programs drive adoption of invention education in K-12 and higher education settings and foster strong entrepreneurship ecosystems in both the U.S. and developing countries.

Visit www.lemelson.org to learn more.