

# Methodology

## Phase 3: Generate Innovative Options

***IAMC Toolkit***

*Innovative Approaches for the Sound Management of Chemicals and Chemical Waste*



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION



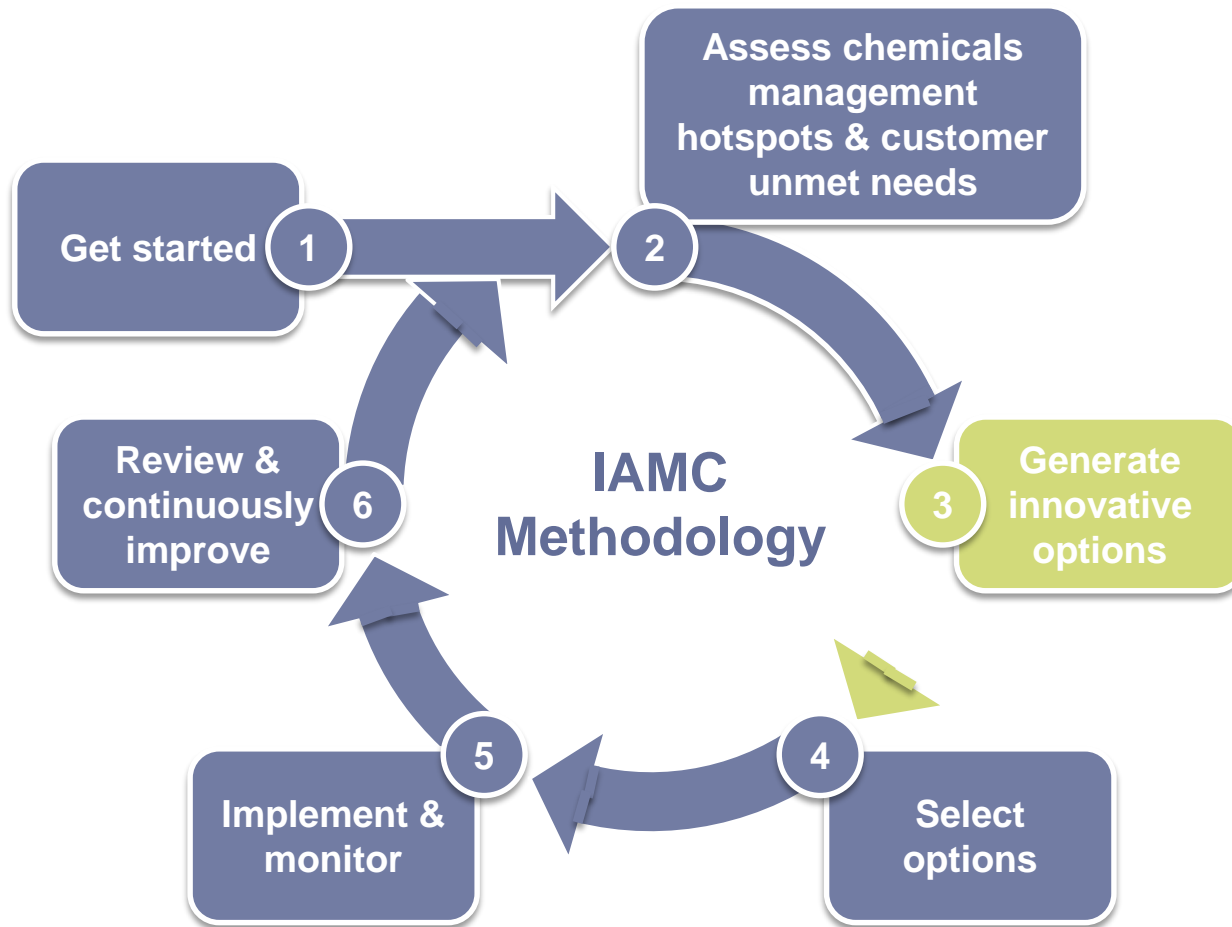
# Content

---

1. Collect Information to Develop Options
2. Generate Innovative Options
3. Capture Options
4. Build an Innovation Network



# Phase 3: Generate Innovative Options



# Introduction: Generate Innovative Options

The aim of this step is to support the company in generating innovative options which address the chemicals management hotspots identified in Phase 2 while creating value for customers.

The Toolkit user will learn how to:

- Define expected benefits upon successful implementation
- Develop a plan for implementing selected innovations
- Develop a monitoring plan to ensure implementation progress is measurable, transparent and easy to communicate

# Phase 3: Generate Innovative Options

## Key Tasks

- Collect information necessary to develop options
- Summarize challenges and opportunities for improvement
- Generate innovative options based on chemicals management hotspots and unmet needs
- Capture options
- Build an innovation network

## Deliverables

- Options captured and characterized in a summary table
- Innovation network database



---

# Collect Information to Develop Options



# Collect Information Necessary to Generate Options

Not all necessary information will have been obtained during Phase 2 'Assess Chemicals Management Hotspots and Customer Unmet Needs'.

Get missing information for in order to fully characterize both the priority chemicals management hotspots and the customer unmet needs.

To fill in the missing information, you may need to:

- Perform a more detailed and targeted audit of the company
- Contact and survey customers or end market customers
- Contact and survey material suppliers and technology suppliers
- Survey national or international experts
- Contract consultancy companies or access proprietary databases

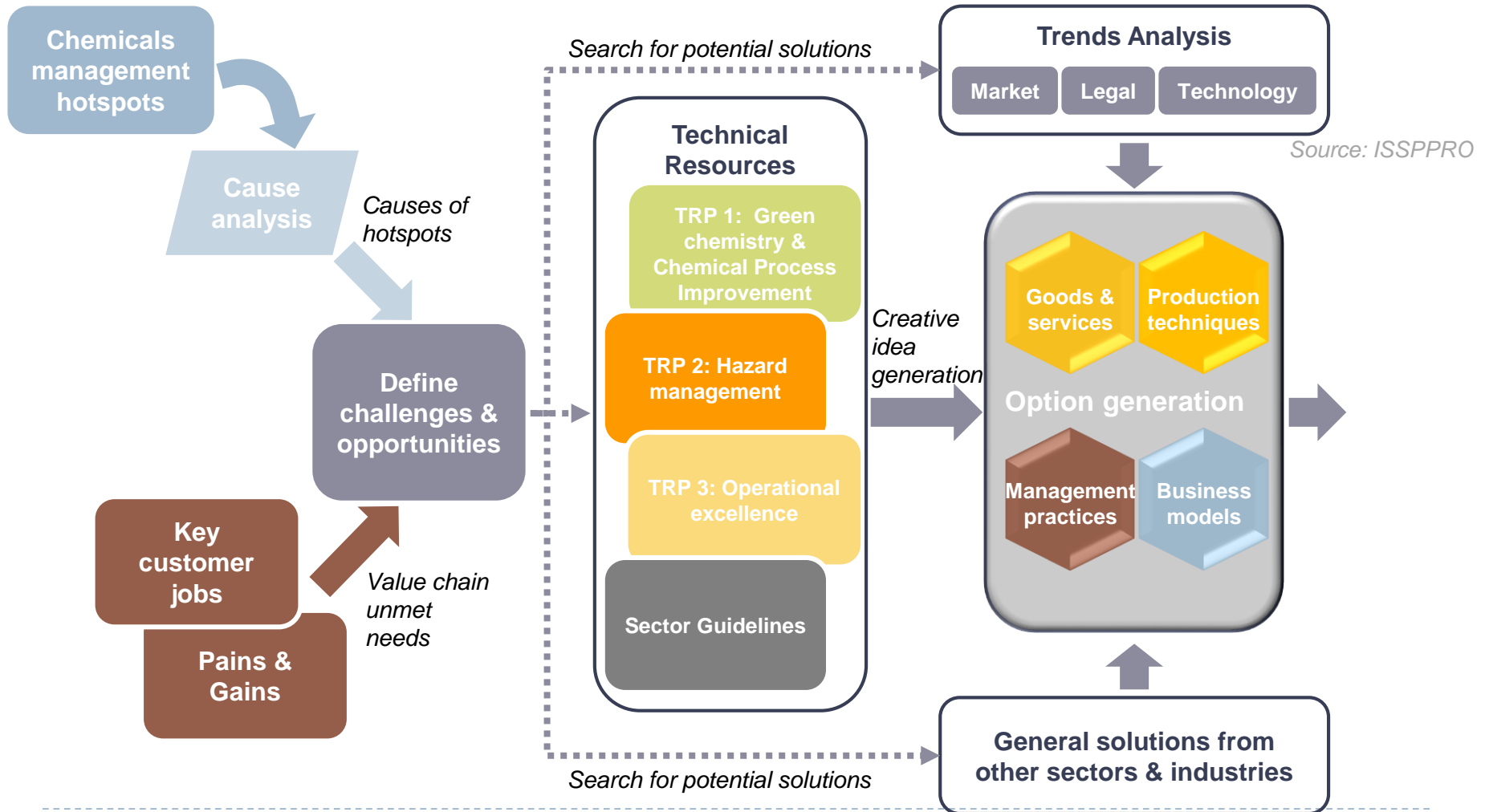
---

# Generate Innovative Options





# Process for Generating Innovative Options (1)



# Process for Generating Innovative Options (2)

Use the following steps to generate and capture innovative options to improve chemicals management:

1. **Define the challenges and opportunities** by summarizing the chemicals management hotspots and the unmet needs in the value chain using a Chemicals Management Innovation Diagram.
2. **Search for potential solutions** according to the hotspots identified (e.g. chemicals of high concern, risk of accidents, water pollution, etc.).
  - Refer to the technical resource packages of this toolkit.
  - Analyze market, legal and technological trends.
  - Generalize the problem and look for solutions in other sectors and industries.
3. **Consider** how **different dimensions of innovation** can lead to improvements:
  - Goods and services
  - Production techniques
  - Management practices
  - Innovative business models
4. **Capture the option** and how it can improve chemicals management and fulfil customer needs.

# Define Challenges and Opportunities: Chemicals Management Innovation Diagram (1)

Drawing a **Chemicals Management Innovation Diagram** combining the chemicals management hotspots and the customer unmet needs throughout value chain offers a holistic way to integrate customer value within innovation in chemicals management.

To summarize the challenges and opportunities:

1. Draw a simplified value chain in the middle of a flipchart. Include only the most important processes.
2. You already prioritized both specific chemicals management hotspots and unmet needs in Phase 2. Indicate these on the diagram.
3. Briefly state the economic, environmental and social impacts above the value chain diagram.
4. Briefly state the key and related jobs as well as desired and undesired outcomes below the value chain diagram.
5. Brainstorm ideas to integrate customer value within innovation in chemicals management

**Note:** an example template is shown on the next slide.

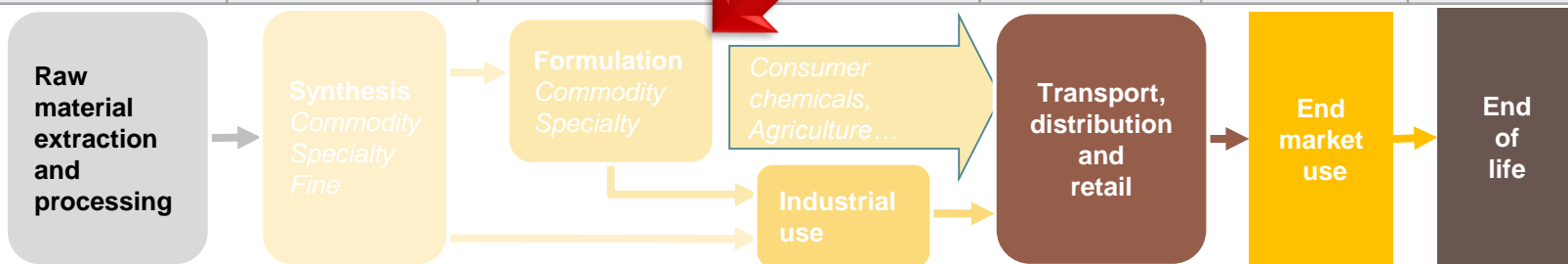


# Define Challenges and Opportunities: Chemicals Management Innovation Diagram (2)

## Chemicals management hotspots

Resource use									
Pollution and ecosystems									
Health, safety, other social									
Economic									

**These are suggested value chain stages. You can use stages which represent your product's value chain the best.**



Key jobs								
Related jobs								
Desired outcomes								
Undesired outcomes								

► Unmet needs

# Search for Potential Solutions to the Identified Challenges (1): Cause Analysis Worksheet

Use the following cause analysis worksheet to summarize the root causes of identified chemical management hotspots. Refer to 'Brainstorming Innovation' for additional tools to help identify causes of hotspots.

Hotspot	Cause	Innovative option
1. Description of waste stream I	a. Cause 1 of the waste stream	Option 1 to cause 1 of waste stream I
		Option 2 to cause 1 of waste stream I
	b. Cause 2 of the waste stream	Option 1 to cause 2 of waste stream I
		Option 2 to cause 2 of waste stream I
2. Description of chemical consumption		
3. Description of Chemical of High Concern used in product XYZ		
4. Description of accidents related to chemicals handling		



# Search for Potential Solutions to the Identified Challenges (2)

Use the three following approaches to find potential solutions:

- ⇒ Refer to the technical resources of this toolkit:
  - **TRP 1 Green Chemistry & Chemical Process Improvement** for how to improve resource efficiency, reduce pollution, use and make safer chemical products
  - **TRP 2 Hazard Management** for how to make processes safer and reduce risks for workers and downstream users
  - **TRP 3 Operational Excellence** for how to improve business performance and minimize impacts to the environment and human health by implementing operational excellence
- ⇒ Revisit and analyze sector trends identified in Phase 1 'Get Started'.
  - Market (consumer), legal and technological trends can point to ways of improving chemicals management hotspots and creating more value for customers.
- ⇒ Generalize the problem and look for solutions in other sectors and industries. Similar problems have often already been solved and can be adapted to specific situations.



# Toolkit Map

Refer to the toolkit map to understand which technical resources provide input to the different methodology phases

The toolkit map:

- Provides an overview of toolkit technical resources
- Indicates which topics can provide input to specific phases of the methodology
- Indicates the type of innovations covered by the topics (e.g. process optimization, chemical substitution, accident prevention, etc.)





**TOOLKIT MAP v01** Note: Folders with brackets, e.g. "[folder path]" denote a folder that is planned for future elaboration.

B_Module 3_IAMC Methodology	B11_Get Started	B12_Assess Chemicals Management Hotspots & Customer Unmet Needs	Optimized Process Technologies	Improved Techniques	Chemical Substitution	Occupational Health & Safety	Accident Prevention & Response	B14_Select Options	B15_Implement & Monitor	B16_Review & Continuously Improve
<b>Submodule Content</b>										
<b>C0_ Module 2 Overview</b>										
<b>C1_Green Chemistry</b>										
(C11_Chemical route and material selection)				X	X	X	X	X		
(C12_Substitution of chemicals)		X			X	X	X	X		
(C13_Renewable feedstocks and bioprocesses)		X			X			X		
(C14_Secondary raw materials)		X						X		
<b>C2_Green Engineering</b>										
(C21_Resource efficiency potential in the chemical industry)		X	X	X				X		
(C22_Green reaction and separation technologies)			X	X				X		
(C23_Green process synthesis and integration)			X	X				X		
(C24_Cleaning of process equipment and products)		X	X		X	X		X		
<b>C3_Checklists</b>										
<b>D_ Module 3_Hazard Management</b>										
<b>D0_ Module 3 Overview</b>										
<b>D1_Risk Identification and Safety</b>										
D11_Chemical classification and labelling		X				X	X	X		
D12_Risk identification		X				X	X	X		
D13_Safety rules		X				X	X	X		
D14_Personal safety equipment		X				X	X	X		
D15_Skin protection		X				X	X	X		
D16_Emergency escape ways		X				X	X	X		
D17_Solvents, acids, bases handling		X				X	X	X		
D18_Safety in gas tank handling		X				X	X	X		
<b>D2_Transport and Storage</b>										
D21_Internal transport of chemicals		X				X	X	X		
D22_Internal person traffic		X				X	X	X		
D23_Storage		X				X	X	X		
<b>D3_Fire and Explosion Protection</b>										
D31_Fire protection		X				X	X	X		
D32_Fire protection in welding and cutting operations		X				X	X	X		
D33_Explosion protection		X				X	X	X		
D34_Container cleaning		X				X	X	X		
D4_Emergency Response		X				X	X	X	X	X
<b>D5_Checklists</b>										
<b>E_ Module 4_Sustainable Enterprise Management</b>										
<b>E0_ Module 4 Overview</b>										
<b>E1_Operational Excellence and Management Techniques</b>										
(E11_Introduction to operational excellence)				X						X
(E12_Value stream mapping in the chemical industry)		X	X							X
(E13_Improving chemical transitions)			X	X						X
(E14_Total productive maintenance)			X	X						X
(E15_Contaminated sites)			X	X						X
<b>E2_Sustainable Business Models</b>										
(E21_Chemical leasing)			X	X	X	X	X			X
(E22_Examples of innovative business models)			X	X						X
<b>E3_Checklists</b>										



# Dimensions of Innovative Solutions for Improving Chemicals Management

The IAMC Methodology provides a flexible framework for generating and applying innovative solutions across the chemical products' value chain.

Dimensions of innovation		Examples
	<b>Products and applications</b> <i>What is offered to customers</i>	<b>Goods</b> New applications of products such as polymers or carbon fibres replacing traditional materials such as steel or aluminium to make light-weight materials
		<b>Services</b> Services improving resource efficiency, health and safety and value creation for the direct customer and end market
	<b>Production techniques</b> <i>How the products are made</i>	New synthesis route for producing simvastatin that increases yield, reduces the use of hazardous and toxic substances and reduces hazardous waste
	<b>Management practices</b> <i>How effectively the business achieves its objectives</i>	Improving production planning and transitions between chemical products to increase productivity and reduce raw material loss and hazardous waste
	<b>Business models</b> <i>How value is created, delivered and captured</i>	A sustainable business model such as chemical leasing that delivers functionality rather than ownership, e.g. cleaning of high performance metal parts with PER



# Product (goods & services) Innovation



Innovations in **products and applications** (*what is offered to customers*) can be categorized as:

- **Input material change**: substitution of ingredients with non-toxic chemicals, renewable feedstocks, secondary (recycled) raw materials and materials with a longer service life-time
- **Product modification**: modification of product characteristics to minimize impacts to the environment and human health over its life cycle
- **Upgrading of by-products**: transformation of waste or low-value by-products into materials that can be sold on the market
- **New applications**: e.g. using materials for new applications such as replacing steel by polymers or carbon composites
- **Services**: services improving e.g. resource efficiency, health and safety, cost efficiency and value creation for the direct customer and the end market

# Innovation in Production Techniques



Innovations in **production techniques** (*how the goods and services are made*) can be categorized as:

- **On-site recycling or recovery**: recover and reuse waste material (e.g. solvent)
- **Process change**: replace or modify process (e.g. new synthesis route) or processing sequence to improve resource productivity, decrease risk and pollution intensity
- **Equipment modification**: replace or modify chemical processing or infrastructure equipment to achieve higher resource productivity and reduce pollution and risk
- **Optimization of process control and process conditions**: control existing processes to optimize their performance and minimize adverse environmental, health and economic impacts

# Innovation in Management Practices



Innovation in **management practices** (*how effectively the organization achieves its objectives*) can be categorized as:

- **Occupational health and safety management system** (e.g. risk assessment, chemical storage rules, workplace rules, emergency response plan)
- **Overall improvement programmes** like ISO 9000 (quality management)
- **Functional improvement programmes** such as reliability and maintenance, value stream mapping, standard work, chemical transitions and production planning

# Business Model Innovation



Innovations in **business models** (*how value is created, delivered and captured*) can be categorized as:

There are many types of sustainable business models that can be considered:

- **Technological**: maximize resource efficiency, create value from waste and substitute with renewable and natural processes
- **Social**: deliver functionality rather than ownership, adopt a stewardship role and encourage sufficiency
- **Organization**: repurpose for society/environment: develop scale-up solutions

---

# Capture Options



# Capture Options: Characterize chemicals management benefits and value for customers (1)

Each option is characterized according to how it improves chemicals management and creates value for customers. This information feeds into Phase 4 'Select Options'.

## 1. Characterize the main features of the innovative option:

- Give the option a name.
- Categorize the option according to the categories in the previous step (e.g. production techniques: on-site recycling and recovery).
- Describe the main concept of the option in three sentences or less.
- List important partners who could help develop and implement the option.
- Which key customer and end market JTBD, if any, does the option address? How important are jobs to the customer?
- Which desired and undesired outcomes (gains and pains) for the direct customer, the end market and the company does the option address? How important are they?
- Is it pioneering, offering something new or unique to the target market?

# Capture Options: Characterize chemicals management benefits and value for customers (2)

## 2. Characterize how the option improves chemicals management throughout the life cycle, specifically:

- How is **resource use** improved (e.g. decreased resource use, more renewables used)?
- How are **ecosystem impacts due to pollution** improved (e.g. decreased environmental impact caused by the company and its products)?
- How are **health, safety and other social factors** improved (e.g. reduced risks of accidents, elimination of toxic chemicals)?
- How are **economic factors** improved (e.g. added value to customer and end market, growth potential, increased profitability for the company)?

## 3. Finally, characterize the effort involved in implementation. Is the option:

- **Financially viable** (e.g. being reasonably affordable)? If not, what is preventing the option from being financially viable?
- **Technically viable**? If not, what is preventing the option from being technically viable?
- Consider any **key assumptions** to be tested when developing the option.



---

# Build an Innovation Network



# Build a Chemicals Management Innovation Network

**Lacking expertise and know-how was probably identified during the generation of innovative options.** Building or expanding your innovation network can help you fill in the know-how gaps to develop and implement the option.

**Important partners could be:** suppliers, strategic customers, retailers, academia or research institutes, industry associations, government agencies, business or marketing consultants, certification bodies, etc.

**Build your chemicals management innovation network** as follows:

- Map out your current network of important partners.
- Specify the expertise or knowledge gaps (e.g. perhaps it is the sustainability impacts or key customer jobs in the end market) for the option. Convert this to a list of key words.
- Use the keywords to search for new partners.
- Screen partners according to geography and value added.
- Create a database

## Where to Find More Information: Business Model Innovation

UNIDO's Chemical Leasing Toolkit provides guidance for implementing the Chemical Leasing business model:

<http://www.chemicalleasing.com/>

UNEP's Eco-innovation Manual provides guidance and tools for developing sustainable business models:

<http://www.unep.org/resourceefficiency/Business/Eco-Innovation/TheEco-InnovationProject/Eco-innovationManual/tabid/1059803/Default.aspx>

The Business Model Canvas is a tool simplifying the process of characterizing and innovating business models:

<http://www.businessmodelgeneration.com/canvas/bmc>

## Where to Find More Information: General

OECD Sustainability Manufacturing Toolkit providing information and guidance on how to examine the relationship between environmental effects of the company processes and production characteristics:

<http://www.oecd.org/innovation/green/toolkit/>

UNEP & Delft University of Technology “Design for Sustainability” provides guidance and case studies on designing products to improve sustainability performance: <http://www.d4s-sbs.org/>

UNEP’s Eco-innovation Manual provides guidance and tools for developing sustainable business models:

<http://www.unep.org/resourceefficiency/Business/Eco-Innovation/TheEco-InnovationProject/Eco-innovationManual/tabid/1059803/Default.aspx>

UNIDO Cleaner Production Toolkit on the implementation of cleaner production programmes:

<http://www.unido.org/en/resources/publications/energy-and-environment/industrial-energy-efficiency/cp-toolkit-english.html>

U.S. Department of Commerce’s Sustainable Manufacturing 101 Module is closely linked to the OECD Sustainability Manufacturing Toolkit and provides an overview on sustainable manufacturing practices:

<http://trade.gov/green/sm-101-module.asp>



---

# Sources

# Sources

- CSD Engineers, Switzerland/ISSPPRO, Germany, 2015



# Disclaimer

This presentation was prepared with the requested diligence and with the generally accepted principles of the relevant field.

If a third party uses the contents of the presentation in order to take decisions, the authors disclaim any liability for any kind of direct or indirect (consequential) damage.

