



DevTreks –social budgeting that improves lives and livelihoods

## Resource Stock Analysis 1

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**Version: 2.1.4**

### A. Introduction

This reference explains how to start to collect, measure, and analyze basic resource stock data (2\*). DevTreks believes that all resource stock data, from the carbon budgets of Iowan corn fields to student performance indicators for El Salvadoran students, has stories to tell and lessons to teach. Those lessons can only be learned when data about resource stocks is collected, measured, aggregated, analyzed, explained, and saved in online knowledge banks. Full, uniform, and accurate analyses of per capita CO2 emission balances for Beijing firms, food quality ratings for Bangladeshi street vendors, nutrient management budgets for Guatemalan milpa fields, knowledge balance reports for Calexico students, and health care status indicators for Ghana's health sector, should be one or two links away for everyone. If a resource stock expert, business owner, government official, worker, parent, or nonprofit member, needs to make a decision involving resource stocks, they should have ready access to the best data and advice available. This reference introduces another DevTreks way to build these types of knowledge banks.

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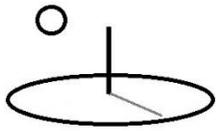
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## **B. Resource Stock Imbalance Mitigation and Adaptation Analysis**

The IPCC WG2 and WG3, Risky Business (2014), U.S. Global Climate Change Research Program (2014), and World Bank (2014) references make it clear that natural resource stock imbalances, particularly Green House Gas (GHG) emissions that cause climate change, have serious consequences on society. Floods will increase, food security will decrease, forest fires will increase, and oceans will rise. The references make the case that moderate expenditure spent today on stock imbalance mitigation and adaptation can save future generations very large expenditures.

The National Research Council (2015) concludes their evaluation of climate change interventions with the following admonition: “society must take advantage as soon as possible of [climate change interventions] that can help avoid the worst effects of warming. We will lose the opportunity if society delays in research and development to lower the technical barriers to efficacy and affordability of [climate change interventions]”. In other words, we have a moral responsibility to take action now. The analyses explained in this reference may help to provide evidence for spending the needed resources wisely.

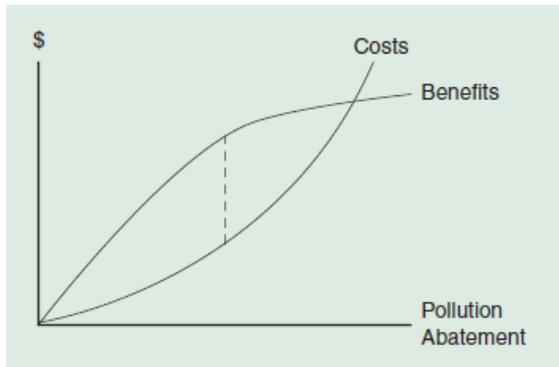
The following images demonstrate the types of economic analyses that can be explained using stock budgets and production function data. In effect, the physical science stock balances are tied to economic measures by quantifying damages avoided, reducing costs, measuring health benefit or lives saved, analyzing changes in output productivity, and similar techniques that add prices to the Inputs and/or Outputs. V. Meyer et al (2013) provide a comprehensive review of many techniques that are appropriate for estimating costs and benefits for climate change-induced disasters.



## Benefit Cost Analysis (EPA, 2010)

Following from the definition in Section A.1, the most economically efficient policy is the one that allows for society to derive the largest possible social benefit at the lowest social cost. This occurs when the *net* benefits to society (i.e., total benefits minus total costs) are maximized. In Figure A.10, this is at the point where the distance between the benefits curve and the costs curve is the largest and positive.

Figure A.10 - Maximized Net Benefits



Note that this is *not* necessarily the point at which:

- Benefits are maximized;
- Costs are minimized;
- Total benefits = total costs (i.e., benefit-cost ratio = 1);
- Benefit-cost ratio is the largest; or
- The policy is most cost-effective.

If the regulation were designed to maximize benefits, then any policy, no matter how expensive, would be justified if it produced any benefit, no matter how small. Similarly, minimizing costs would, in most cases, simply justify no action at all. A benefit-cost ratio equal to one is equivalent to

benefits, even though the first policy produces substantially more net benefit for society.<sup>31</sup> Finally, finding the most cost-effective policy has similar problems because the cost-effectiveness ratio can be seen as the inverse of the benefit-cost ratio. A policy is cost effective if it meets a given goal at least cost — i.e., minimizes the cost per unit of benefit achieved. Cost-effectiveness analysis (CEA) can provide useful information to supplement existing BCA and may be appropriate to rank policy options when the benefits are fixed and cannot be monetized, but it provides no guidance in setting an environmental standard or goal.

Conceptually, net social benefits will be maximized if regulation is set such that emissions are reduced up to the point where the benefit of abating one more unit of pollution (i.e., marginal social benefit)<sup>32</sup> is equal to the cost of abating an additional unit (i.e., marginal abatement cost).<sup>33</sup> If the marginal benefits

<sup>31</sup> Benefit-cost ratios are useful when choosing one or more policy options subject to a budget constraint. For example, consider a case where five options are available and the budget is \$1,000. The first option will cost \$1,000 and will deliver benefits of \$2,000. Each of the other four will cost \$250 and deliver benefits of \$750. If options are selected according to the net benefits criterion, the first option will be selected, because its net benefits are \$1,000 while the net benefits of each of the other options are \$500. However if options are selected by the benefit-cost ratio criterion, the other four options will be selected, as each of their benefit-cost ratios equal 3, versus a benefit-cost ratio of 2 for the first option. In this case, choosing options by the net benefits criterion will yield \$1,000 in total net benefits, while choosing options by the benefit-cost ratio criterion will yield \$500 in total net benefits. In most cases, choosing options in decreasing order of benefit-cost ratios will yield the largest possible net benefits given a fixed budget. This method will guarantee the optimal solution if the benefits and costs of each option are independent, and if each option can be infinitely subdivided: simply select the options in decreasing order of their benefit-cost ratios and once the budget is exceeded subdivide the last option selected such that the budget constraint is met exactly (see Dantzig 1957). Also note that this strategy does not require measuring benefits and costs in the same units, which means that it is directly useful for CEA (Hyman and Leibowitz 2000), while the net-benefit criterion is not.

## Marginal Damage and Marginal Benefit Analysis (EPA, 2010)

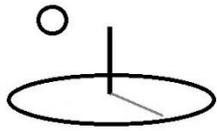
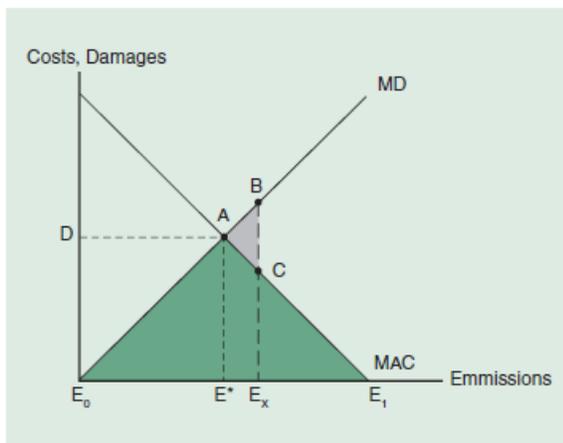


Figure A.11 illustrates why the level of pollution that sets the marginal benefits and marginal costs of abatement equal to each other is efficient.<sup>36</sup> Emissions are drawn on the horizontal axis and increase from left to right. The damages from emissions are represented by the marginal damage (MD) curve. Damages may include the costs of worsened human health, reduced visibility, lower property values, and loss of crop yields or biodiversity. As emissions rise, the marginal damages increase.  $E_1$  represents the amount of emissions in the absence of regulation on firms. The costs of controlling emissions are represented by the marginal abatement cost curve (MAC). As emissions are reduced below  $E_1$ , the marginal cost of abatement rises.

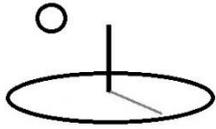
**Figure A.11 - Efficient Level of Pollution**



The total damages associated with emissions level  $E^*$  are represented by the area of the triangle  $AE_0E^*$ , while the total abatement costs are represented by area  $AE_1E^*$ . The total burden on

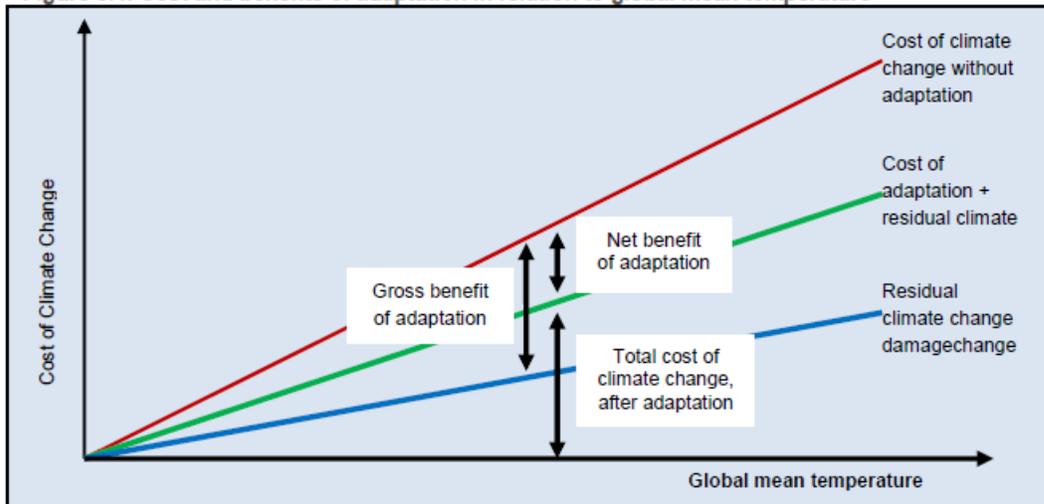
<sup>35</sup> Thus a regulation that requires all firms to achieve the same level of reduction will probably result in different marginal costs for each firm and not be efficient. (See Field and Field 2005 or any other environmental economics text for a detailed explanation and example.)

### Adaptation Cost Benefit Analysis (CAP-NET, UNDP, 2009)



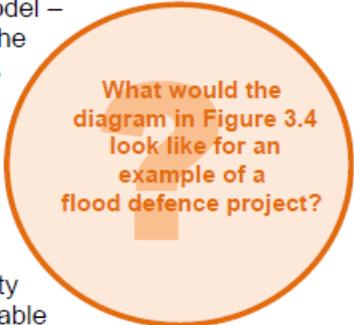
The Stern Review addresses the economic aspects of adaptation that are discussed in Chapter 5 of the report. While avoiding damage from climate change is considered a benefit of adaptation, the review is clear that there can often be a substantial residual damage (or risk). Figure 3.4 provides a substantially simplified model for the economics of adaptation. The relationship between cost of climate change and increases in global mean temperature are shown here as linear, while in reality trends in cost for increasing temperature may be exponential.

Figure 3.4: Cost and benefits of adaptation in relation to global mean temperature



Source: Stern, 2006

The concept of **'net benefits' of adaptation** is crucial to the model – i.e. the damage avoided minus the cost of adaptation. The concept of net benefits as an indicator in policy design is already common practice in a number of climate-related development policies, such as integrated flood management: the net benefits of a flood management strategy are the overall benefits incurred by using the floodplain minus the cost of flood protection and the residual flood damages (WMO, 2004). This implies that in planning decisions there is a need to combine risk management (as a construct of probability and associated consequence) with a perspective on acceptable risk in view of benefits incurred. This perspective helps to avoid maladaptation in the sense of unnecessarily limiting development opportunities crucial for poverty reduction/livelihood generation



### Climate Change Costs and Adaptation Costs Analysis (IPCC, WG2)

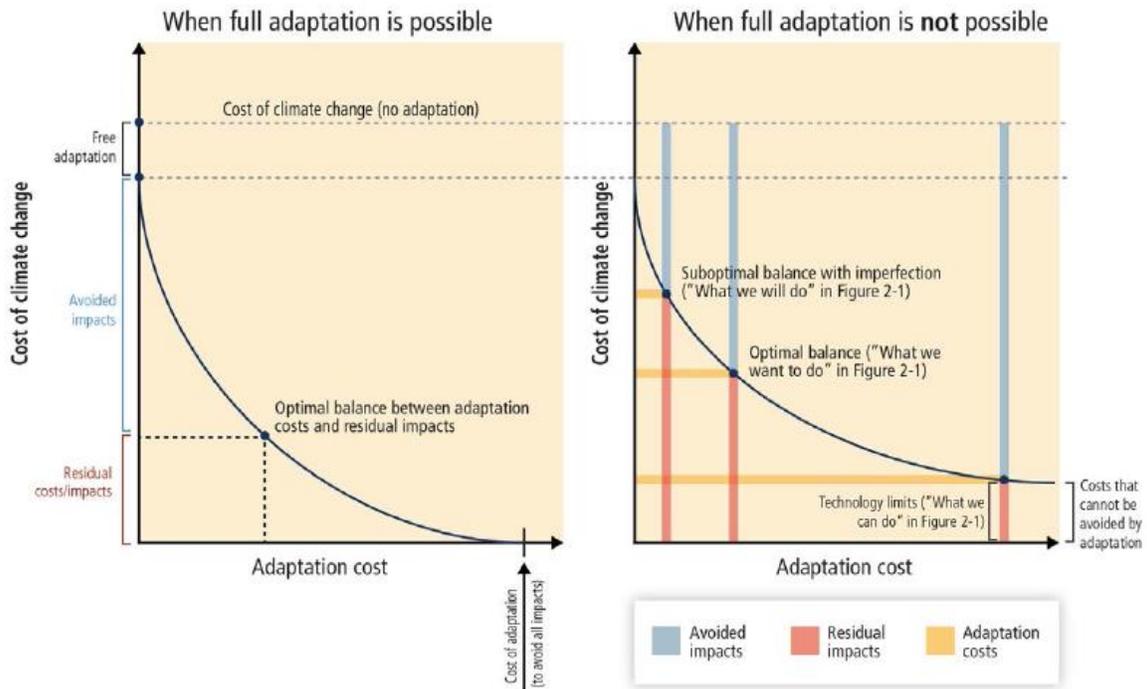
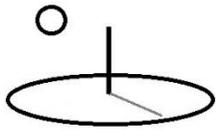
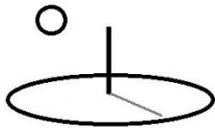


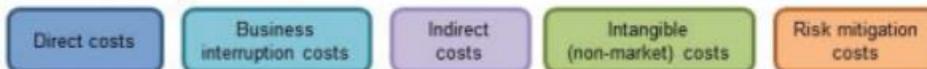
Figure 17-2: Graphical representation of link between the cost of adaptation (on the X-axis) and the residual cost of climate change (on the Y-axis). The left panel represents a case where full adaptation is possible, while the right panel represents a case in which there are unavoidable residual costs.



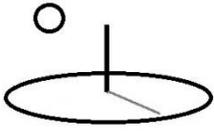
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		Tangible costs	Intangible (non-market) costs
Damage costs	Direct	<ul style="list-style-type: none"> <li>Physical damage to assets:               <ul style="list-style-type: none"> <li>– buildings</li> <li>– contents</li> <li>– infrastructure</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Loss of life</li> <li>Health effects</li> <li>Loss of environmental goods</li> </ul>
	Business interruption	<ul style="list-style-type: none"> <li>Production interruption because of destroyed machinery</li> </ul>	<ul style="list-style-type: none"> <li>Ecosystem services interrupted</li> </ul>
	Indirect	<ul style="list-style-type: none"> <li>Induced production losses of suppliers and customers of companies directly affected by the hazard</li> </ul>	<ul style="list-style-type: none"> <li>Inconvenience of post-flood recovery</li> <li>Increased vulnerability of survivors</li> </ul>
Risk mitigation costs	Direct	<ul style="list-style-type: none"> <li>Set-up of infrastructure</li> <li>Operation &amp; maintenance costs</li> </ul>	<ul style="list-style-type: none"> <li>Environmental damage               <ul style="list-style-type: none"> <li>- due to the development of mitigative infrastructure</li> <li>- or due to a change in agricultural practices</li> </ul> </li> </ul>
	Indirect	<ul style="list-style-type: none"> <li>Induced costs in other sectors</li> </ul>	

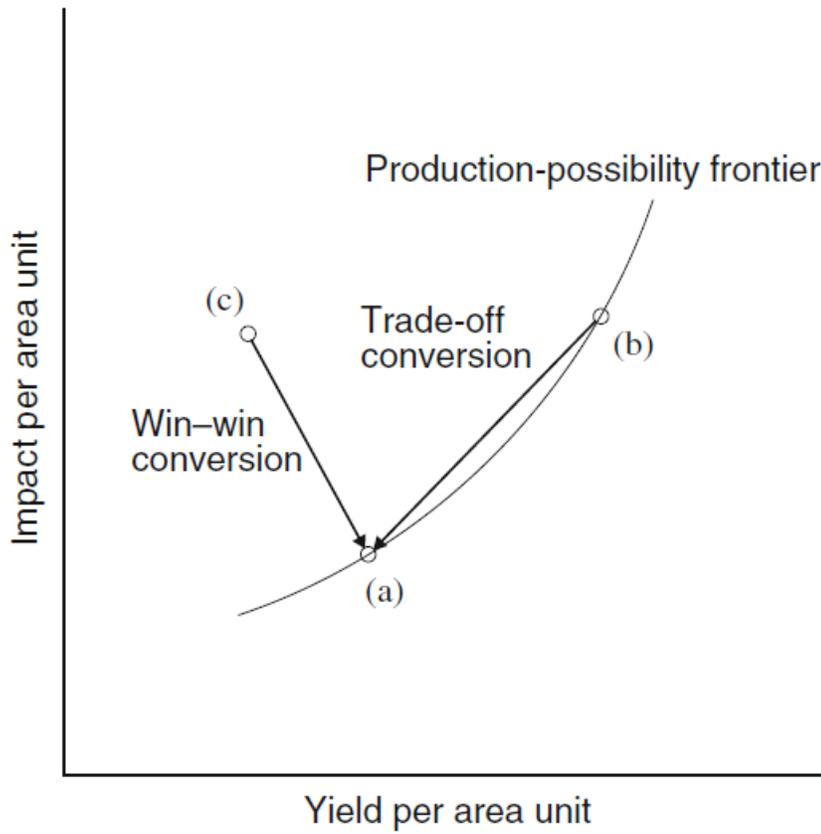
Cost categories applied in this article:



## Tradeoff Analysis (IPCC)

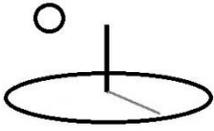


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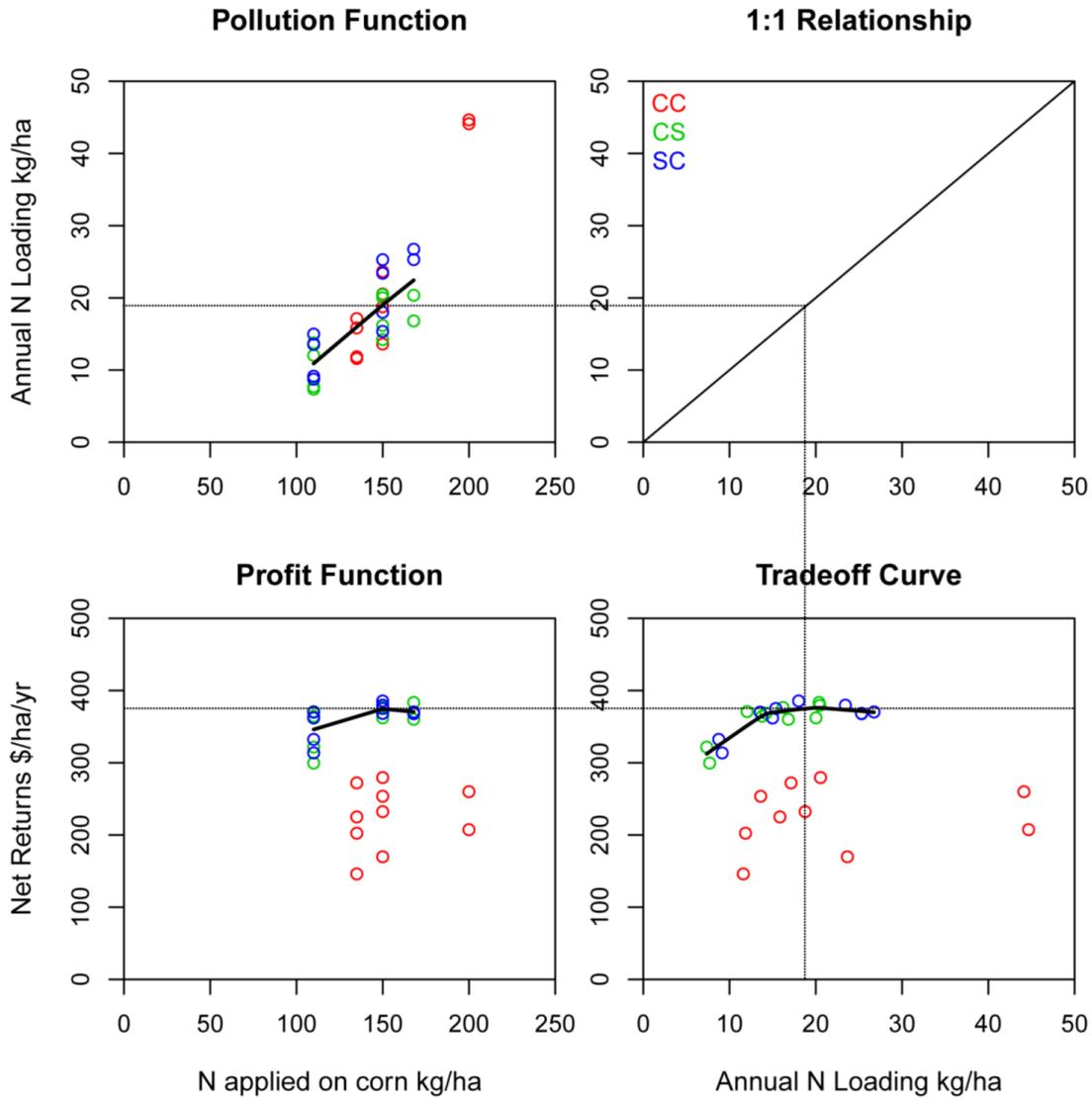


**Fig. 3** Schematic diagram to illustrate why trade-off conversion is common for matured agricultural systems

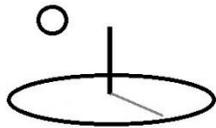
**Tradeoff Analysis (see the Social Budgeting and DevPacks tutorials)**



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### Cost Effectiveness Analysis (IPCC, WG3)



FINAL DRAFT

IPCC WGII AR5 Chapter 11

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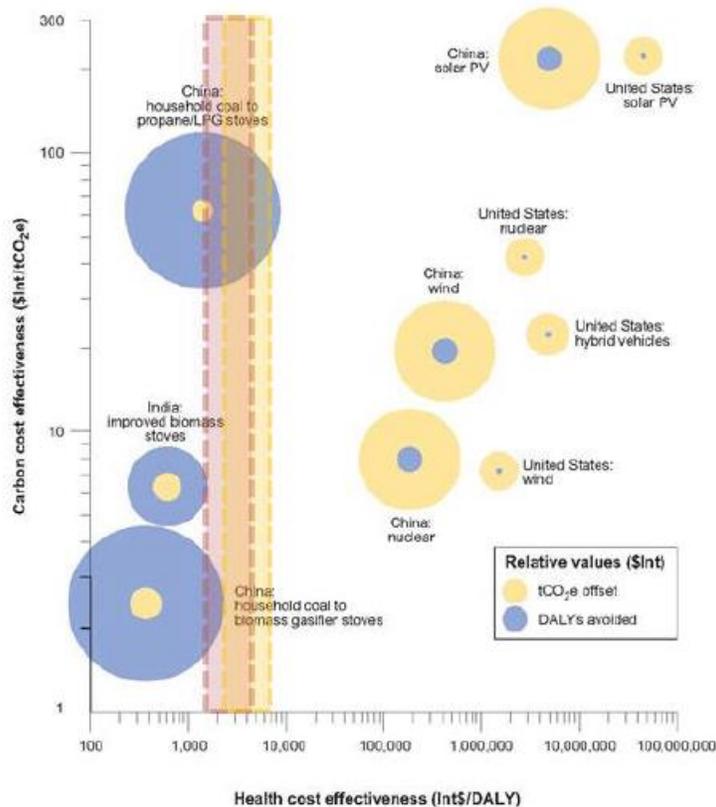
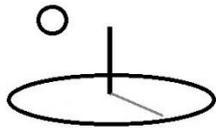


Figure 11-7: Illustrative co-benefits comparison of the health and climate cost-effectiveness of selected household, transport, and power sector interventions (Smith and Haigler, 2008). Area of each circle denotes the total social benefit in international dollars from the combined value of carbon offsets (valued at 10\$/tCO<sub>2</sub>e) and averted DALYs [\$7450/DALY, which is representative of valuing each DALY at the average world GDP (PPP) per capita in 2000]. The vertical bar shows the range of the cut offs for cost-effective and very cost-effective health interventions in India and China using the WHO CHOICE criteria (World Health Organization, 2003). This figure evaluates only a small subset of all co-benefits opportunities and thus should not be considered either current or complete. It does illustrate, however, the kind of comparisons that can help distinguish and prioritize options. Note that even with the log-log scaling, there are big differences among them. For other figures comparing the climate and health benefits of co-benefits actions including those in food supply and urban design, see Haines *et al.* (Haines *et al.*, 2009). See the original reference for details of the calculations in this figure (Smith and Haigler, 2008). [Illustration to be redrawn to conform to IPCC publication specifications.]

## Cost-Effectiveness or Marginal Abatement Cost Analysis (World Bank, 2014)



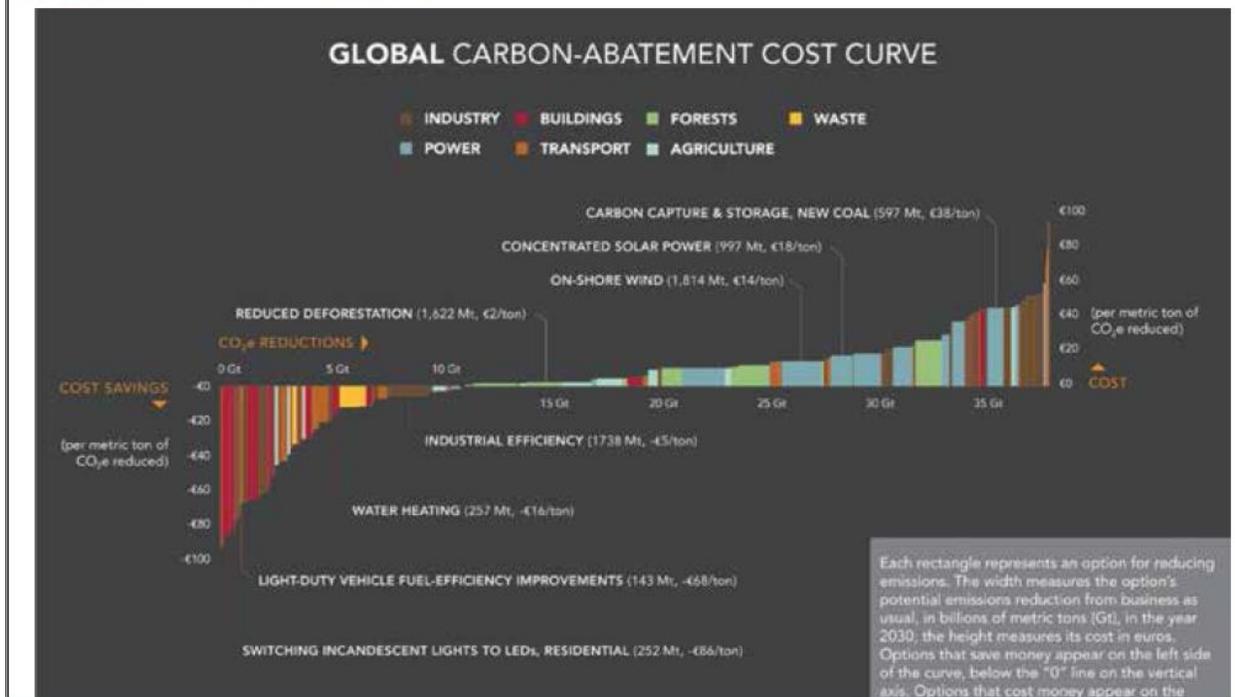
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In graphic representations of MACCs (Figure B.1), policy levers are typically sorted by increasing cost of emissions reduction opportunities in a given year (merit order). The width of each bar represents the potential GHG emissions reduction from that specific intervention (such as a suite of fuel efficiency improvements to the internal combustion engine). This abatement potential is defined as the volume difference between the emissions baseline and the emissions after the lever is applied. To ensure comparability across different sectors and emissions sources, all emissions and sinks (storage) are measured in metric tons of CO<sub>2</sub>e. The height

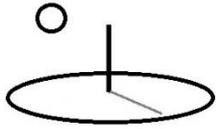
of each bar represents the abatement cost per metric ton of CO<sub>2</sub>e reduced. The abatement costs can therefore be interpreted as pure project costs incurred to install and operate each specific low-emitting technology. Capital availability is not considered a constraint. Other key elements are deliberately excluded from cost calculations: transaction costs, communication/information costs, subsidies or explicit CO<sub>2</sub> costs, taxes, and the consequential economic impacts of significantly investing in low-emitting technology (such as advantages from technology leadership).

MACCs can be interpreted as a supply curve of abatement opportunities, independent of abatement targets, which could in

**Figure B.1:** Global carbon abatement cost curve, 2030

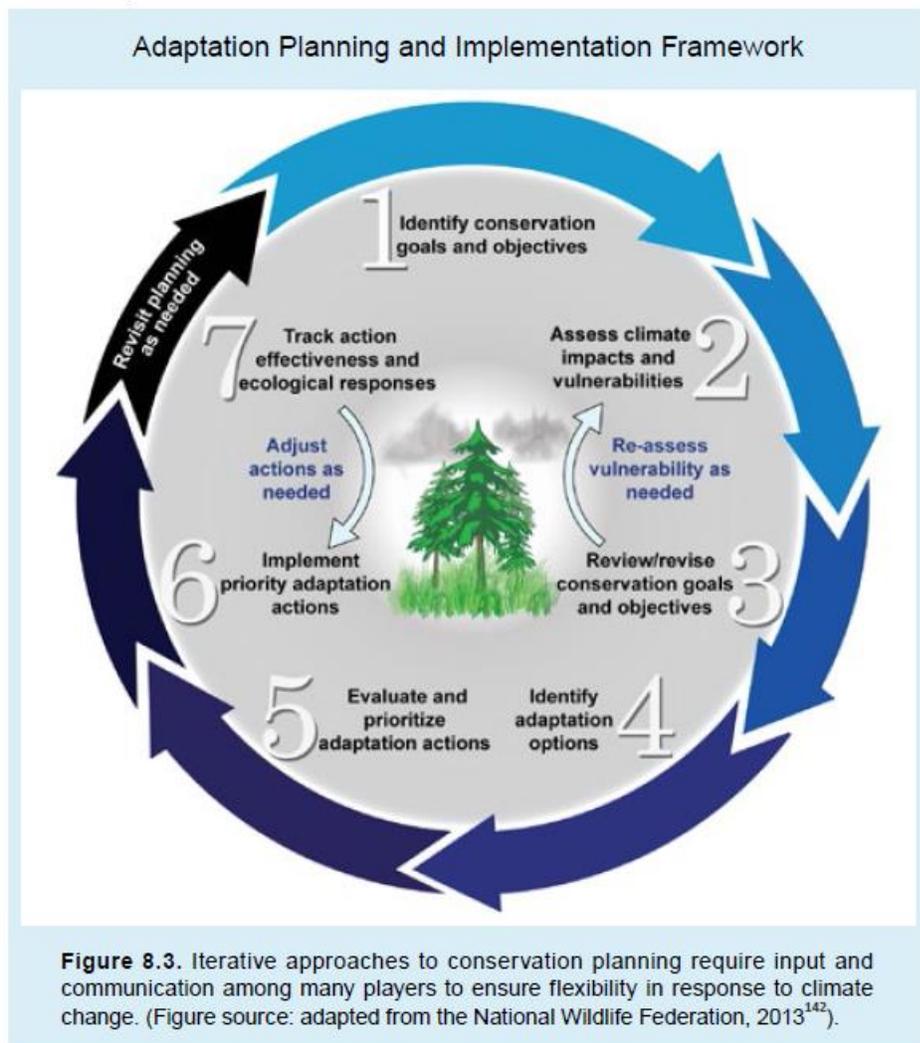


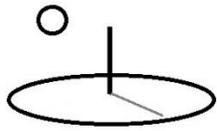
The graphics demonstrate that formal economic analysis frameworks for measuring stock imbalances include Benefit Cost Analysis, Cost Effectiveness Analysis, Climate Change and Adaptation Cost Analysis, Tradeoff Analysis, and Damage Assessment (3\*). Many economists have used these analyses to conclude that one of the most effective and efficient ways to reduce GHG is to put a price on carbon. For example, a carbon tax on gasoline will cause drivers to drive less and to use more fuel efficient vehicles. That point should be remembered, and remembered well, regardless of the frameworks, algorithms, and analyses, which follow.



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The IPCC WG2 and WG3 references (2014) demonstrate that the adaptation to, and mitigation of, resource stock imbalances can be analyzed using more than just economics. They have chapters devoted to analytic frameworks for risk, social capital, institutional capital, equity, and sustainable development. The following image (Groffman et al, 2014) demonstrates that field-oriented *Adaptation Planning and Implementation Frameworks* can be used for natural resources stock improvement. The next section introduces a comprehensive framework for analyzing resource stocks.

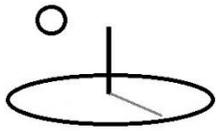




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### **C. Conservation Technology Assessments (CTAs)**

The following images (WHO, 2011) show that the health care sector uses the term, Health Technology Assessment (HTA), as an encompassing framework for assessing the socioeconomic impacts of health care improvement technologies, such as medical devices, on human health states (i.e. human capital stock flows and balances –refer to the SPA3 reference for a more formal definition).

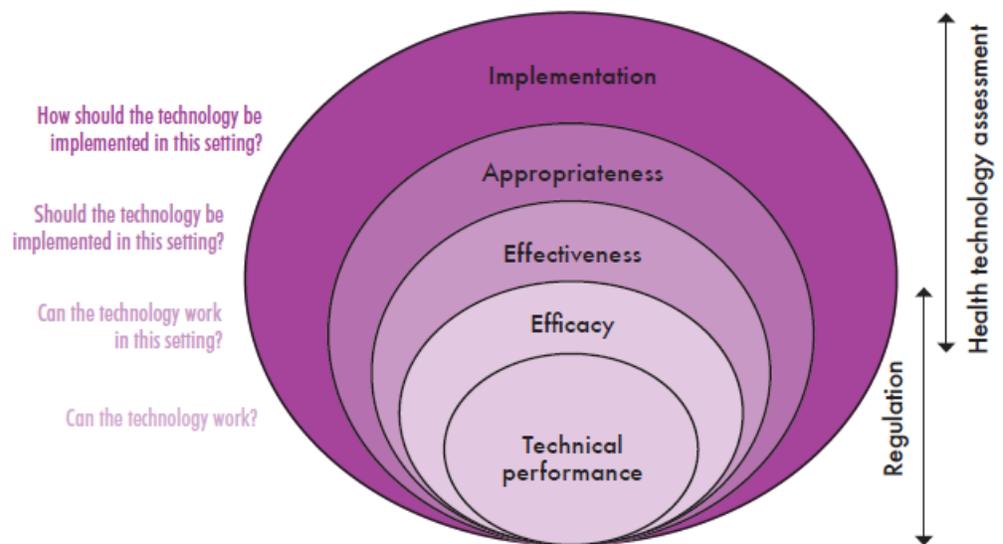


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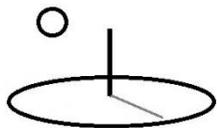
Figure 1. Domains of health technology regulation, assessment and management for drugs and devices



Figure 2. From performance to use in health care: layers of questions



HTAs make extensive use of the meta-analysis of randomized control trial data. The HTA approach has international acceptance and support. Many countries (Denmark, England, Canada, Australia, France, Germany), and international organizations such as WHO, provide extensive guidance explaining how to carry out HTAs. Examples of completed HTAs can be found throughout the scientific health care literature. Governments throughout the world save substantial money and lives by heeding their results. Medical advisory groups use their results to



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advise doctors to stop using some procedures and start using others. For example, the New York Times reported on July 1<sup>st</sup>, 2014, that the American College of Physicians conducted an (HTA) analysis of routine pelvic examinations that caused them to advise doctors to stop carrying out the procedure because no scientific evidence supports its efficacy.

The IPCC WG2 use the term *Climate Impact, Adaptation, and Vulnerability*, or CIAV assessment, as a framework for assessing technology adoption decisions. The IPCC WG3 appears to use the term *Integrated Assessment* for a similar purpose. The US Global Change Research Group (Moss et al, 2014) use terms such as *Risk Assessment, Comparative Tradeoff Method, Scenario Planning, Scientific Assessment, and Sustained Assessment*, as decision support frameworks supporting climate change interventions. The *Resource Stock Calculation 1* reference points out that “technology assessments” are similar to the “product systems” analyzed during *Life Cycle Assessments*. But none of these terms are used by the natural resources conservation sector as ubiquitously as HTAs are used in the health care sector. They are also a lot more confusing.

DevTreks adapts the HTA approach to resource stock analysis by introducing the term *Conservation Technology Assessment (CTA)*. CTA is defined as:

*Conservation Technology Assessment is the analysis of resource stock flows and balances, and conservation technologies that are designed to prevent or correct imbalances in the stocks.*

The simplest goal of CTA is to promote conservation technologies that are cost effective and to demote conservation technologies that are not cost effective. The following image (WHO 2011) demonstrates that CTAs can have far more comprehensive goals. CTA provides one term that can encompass related terms such as CIAV assessment, Integrated Assessment, technology assessment, mitigation and adaptation assessment, Life Cycle Assessment, Risk Assessment, Sustained Assessment, and all of the economic assessment terms used in the previous section. In addition, the term CTA is general enough to encompass technology assessments involving human capital (i.e. HTAs), social capital, institutional capital, and cultural capital.

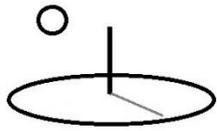
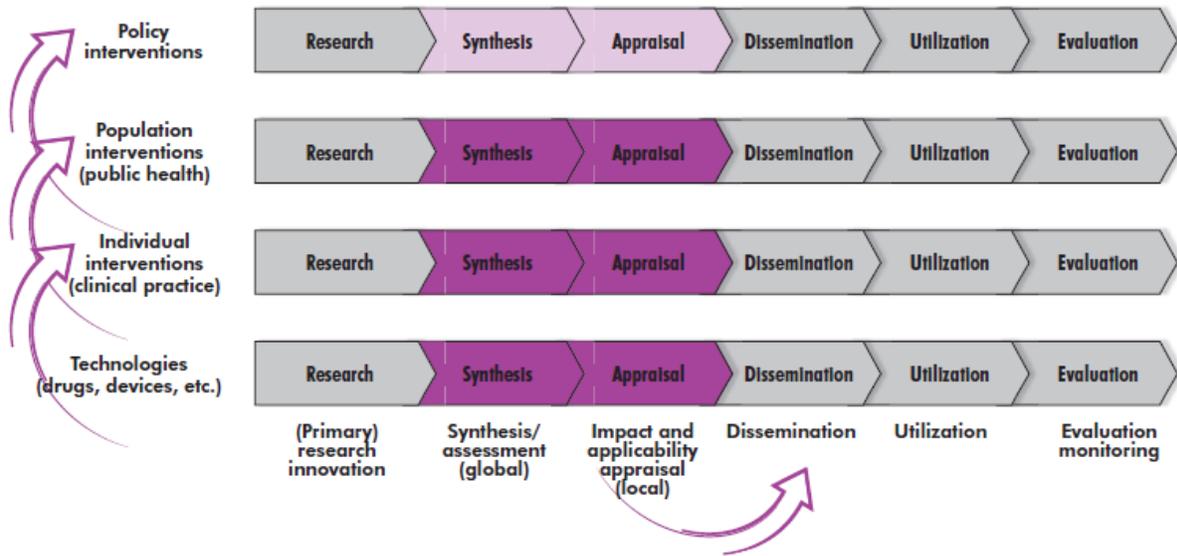


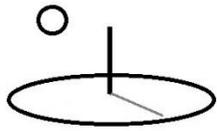
Figure 7. Knowledge chains and learning loops: health technology assessment as a tool



Source: (29)

Although the linkages between local conservation technology and global environmental impacts (carbon cycle, hydrologic cycle) complicates CTAs, an encompassing framework for studying technology and communicating the results can have the same usefulness in the conservation field as they are having in the health care field.

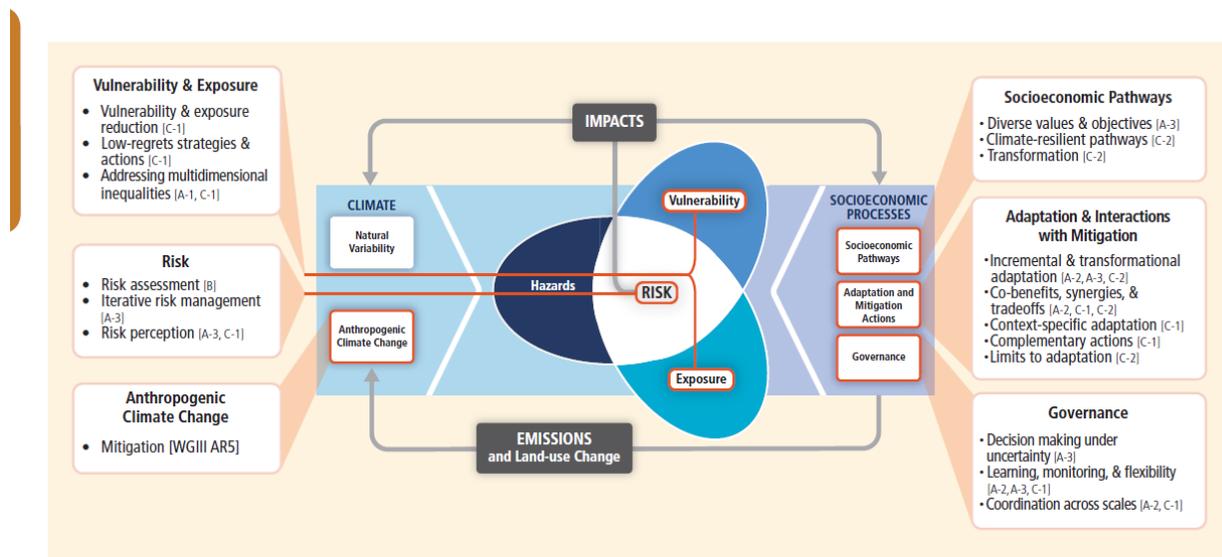
For example, in the United States, the US Global Change Research Group (Jacoby et al, 2014) specifically identify the need for a “consistent framework for assessing [climate change mitigation interventions]”. They (Bierbaum et al, 2014) also point out “the effectiveness of climate change adaptation has seldom been evaluated, because actions have only recently been initiated and comprehensive evaluation metrics do not yet exist”. In addition, they identify the need for “methodologies to evaluate [the costs and benefits of adaptation to climate change], and ... a central and streamlined database of adaptation [technologies]”. Finally, they (Correl et al, 2014) identify the need for “improved characterization of uncertainty ... development of [more and better] indicators, development of [tools that measure the economic consequences of climate



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change] ... development of new tools that [identify the best technologies for adaption] ... [and see Footnote 5\*].

The HTA literature proves that HTAs can't be seriously completed without studying the risk and uncertainty associated with human resource stock data. The IPCC literature makes clear that natural resource stocks can't be seriously studied without communicating changes in their amount in terms of likelihoods. Similarly, CTAs must also incorporate measures of risk and uncertainty, similar to the following IPCC WG2 “solution space”. The CTA and the Monitoring and Evaluation references contain examples demonstrating how to carry out basic resource stock risk analyses.



**Figure SPM.8 |** The solution space. Core concepts of the WGII AR5, illustrating overlapping entry points and approaches, as well as key considerations, in managing risks related to climate change, as assessed in this report and presented throughout this SPM. Bracketed references indicate sections of this summary with corresponding assessment findings.

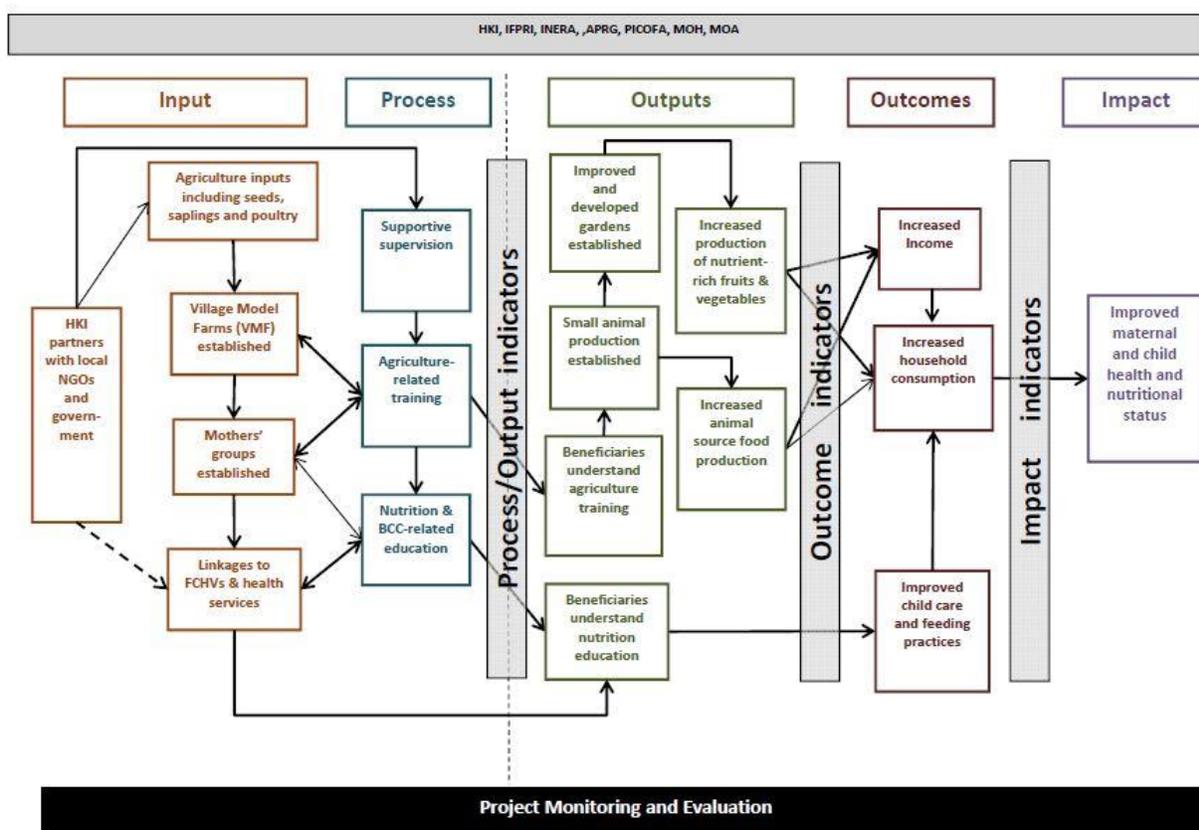
The CTA definition uses the term *Conservation* in a general microeconomic sense –firms, households, and governments can improve lives and livelihoods by allocating scarce resources well. The term *Technology* is also used in a general way –management practices, projects, and policies can also be assessed using CTAs.



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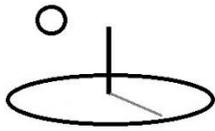
### D. Base Elements

The following image (refer to the *Monitoring and Evaluation* tutorials) illustrates that agricultural and health care technology improvement projects can be assessed using base elements that include Inputs, Processes, Outputs, Outcomes, and Impacts.



The following table demonstrates corresponding base elements used in DevTreks to measure and analyze resource stocks:

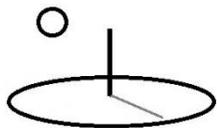
	Base Elements				
	Input	Operation or Component	Output	Outcome	Time Period or Budget



<b>Stock Budgets</b>	Residue	Harvest	N runoff	% Farmers adoption	Change in Water Quality Index
	Native seed	Wildlife Habitat Land Prep	Habitat production index	Habitat restoration	Change in T&E species count
	Orange Conventional	Nutrient Management	Nitrate emission	Orange Crop Production	Change in Eutrophication Potential Equivalents
	Fossil Fuel	Combustion	CO2 emission	Climate Change	Change in CO2 Level

The Inputs and Outputs in these *Stock Budgets* are linked to generic *Stock Indicators* that track resource *stock flows* (i.e. CO2 or NH4 emission debits and credits), resource *stock balances* (i.e. the last column of the previous image), and the *impacts* of the stock flows and balances (i.e. their environmental consequences –have flood intensities increased?). The remaining elements aggregate the Input and Output Indicators with the Time Period element balancing the stocks (i.e. subtracting Output Stock Indicators from Input Stock Indicators). The Stock Indicator data can derive from field measurements, simulated model results, statistical model results, literature reviews, sensing devices, expert opinion, or hypothetical scenarios. The introductory reference discusses the management of resource stock data (i.e. bulk uploads, Data URLs holding TEXT datasets).

The software can be used to supply the basic resource stock accounting that supports very basic CTA analysis, including economic analysis. Basic analysis can still support basically sound decisions. For example, the associated *CTA-Prevention* (CTAP) reference includes examples of CTAPs that demonstrate how to avoid double counting both the value of resource stock flows (i.e. present value of lost rental income or lost social benefits) and the damage to the resource



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stock itself (i.e. the market value of the asset, or the reconstruction costs of the asset –see the World Bank and UN, 2010, reference).

In addition, the software can use the mathematical, statistical, and URL properties of calculators and analyzers to emulate some types of domain-specific models, such as crop nutrient budgeting models, to make basic forecasts, and to carry out more advanced decision making, such as policy evaluations. Future releases will include examples.

#### **E. Data URLs (4\*)**

The introductory reference explains the resource stock calculations and data that will be analyzed in this reference. Analyses measure up to 15 basic, generic resource stock indicators.

All of the analyses displayed in this reference is sample data that demonstrates how to collect and analyze each type of dataset. The Resource Stock Analyzers and sample data demonstrated in this reference can be found at the following URLs. These examples focus on analyzing data – most of the datasets do not have multimedia support.

The Resource Stock Calculation reference introduces the upgraded Version 2.1.4 patterns for using TEXT datasets to run the underlying calculations.

#### **Analyzers URI:**

[https://www.devtreks.org/greentreks/select/carbon/linkedviewgroup/Stock Analyzers/64/none/](https://www.devtreks.org/greentreks/select/carbon/linkedviewgroup/Stock%20Analyzers/64/none/)

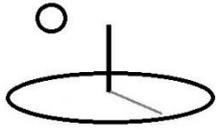
#### **Inputs URI:**

[https://www.devtreks.org/greentreks/preview/carbon/input/2014 Fertilizer, Orange, Conventional/2147397531/none/](https://www.devtreks.org/greentreks/preview/carbon/input/2014%20Fertilizer,%20Orange,%20Conventional/2147397531/none/)

#### **Outputs URI:**

[https://www.devtreks.org/greentreks/preview/carbon/output/2014 Orange, Conventional LCA/2141223454/none/](https://www.devtreks.org/greentreks/preview/carbon/output/2014%20Orange,%20Conventional%20LCA/2141223454/none/)

#### **Components URI:**



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<https://www.devtreks.org/greentreks/preview/carbon/componentgroup/LCA Organic Orange Crop Components/660/none/>

**Operations URI:**

<https://www.devtreks.org/greentreks/preview/carbon/operationgroup/LCA Conventional Orange Crop Operations/760/none/>

**Outcomes URI:**

<https://www.devtreks.org/greentreks/preview/carbon/outcomegroup/LCA Conventional Orange Crop Outcomes/39/none/>

**Capital Budgets URI:**

<https://www.devtreks.org/greentreks/preview/carbon/investment/Conventional Orange Budget/428/none/>

**Operating Budgets URI:**

<https://www.devtreks.org/greentreks/preview/carbon/budgetgroup/LCA Organic vs Conventional Orange Crops/2140761977/none/>

**DevPacks URI:**

<https://www.devtreks.org/greentreks/preview/carbon/devpackgroup/RCT Emissions and Env Performance/48/none/>

**Multimedia URI:**

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Life Cycle Analysis Reference/1534/none/>

**Story URI:**

<https://www.devtreks.org/greentreks/preview/carbon/linkedviewpack/Resource Stock Analysis 1/180/none/>

**F. Multipliers (6\*)**

The final totals generated by Resource Stock calculators can be further adjusted using base element multipliers. These multipliers include Input/Output Amounts and Times, Output



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Composition Amount, Operation/Component/Outcome Amounts, and Time Period Amounts.

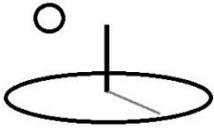
**Appendix A** explains how these multipliers work.

## **G. Analyzers**

Resource stock *Totals, Statistics, Change, and Progress*, Analyzers are available for examining Inputs, Outputs, Operations, Components, Outcomes, Operating Budgets, and Capital Budgets. Standard aggregators (Label, Group Id, and Type Id) can be used to aggregate the data being analyzed (see the *Calculators and Analyzers* tutorial).

When the data being analyzed is observational data stored in Data URL datasets, these analyzers produce automated metadata analysis (analysis of analyses). Metadata analysis of randomized control trial (RCT) data is the primary technique employed in Health Technology Assessments. The CTA reference and Appendix C, DevPacks Stock Analysis, begin to demonstrate how to carry out basic metadata analysis of randomized experimental data.

The following image shows that, with the exception of Totals Analyses, up to 10 stock indicators can be chosen to analyze. The 10 stock indicator limit is only imposed for indicators that use data intensive algorithms, such as those that use Data URL datasets. Algorithms that use correlated indicator calculations always include the correlated indicators.



LCA Organic vs Conv x

DevTreks [US] <https://www.devtreks.org/greentreks/linkedviews/carbon/budgetgr>

Stats

Intro	1	2	3	Help
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**Step 2 of 3. Analyze**

**+ Relations**

**What If Tag**

**Compare Using:**

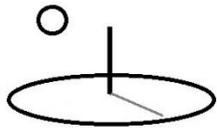
**Aggregate Using:**

**Display Full View:**

**- Stocks to Analyze**

Choose up to 10:

- Indicator 1
- Indicator 2
- Indicator 3
- Indicator 4
- Indicator 5
- Indicator 6
- Indicator 7
- Indicator 8
- Indicator 9



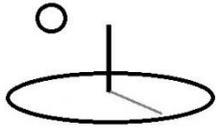
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Indicators should be entered in the base Input and Output calculators in the same order and up to 10 label-dependent Input indicators and Output indicators will be analyzed. The 10 indicator limit can be found throughout DevTreks because the display of more indicators makes the data difficult to understand.

The number of observations shown in the results of analyses reflect the number of indicators being aggregated, not the number of base elements being aggregated. Indicators are aggregated based on their Indicator.Label property. In the case of Time Period elements in budgets, the number of observations is based on the number of Input and Output indicators with the same labels. The properties of indicators determine whether they credit or debit a stock.

The Totals Analyzer displays summations for all the quantitative Stock Indicators (Q1, Q2, Q3, Q4, Q5, QT, QTM, QTU, QTL, Score, ScoreD1, ScoreD2, ScoreM, ScoreL, and ScoreU). The remaining analyzers only aggregate the QTM, ScoreM, ScoreL, and ScoreU properties. The introductory reference demonstrates that, for many calculations, the QTM and ScoreM amounts reflect mean amounts and the ScoreL and ScoreU reflect Score.ConfidenceIntervals around the mean. If the number of observations listed in an analysis appears wrong, the reason can often be traced to inaccurate labels (i.e. N20A vs N2OA). The Totals Analysis can be used to spot the errant Indicators.

The following image makes the point that the 10 stock indicators being studied should be consistent throughout the analyses being conducted.



**Linked View Id : 17633**

Input Stock Calculator

Is Default

DEL UNDEL View Views ▶

**Linked View Id : 17638**

Change by Alternative

Is Default

DEL UNDEL View Views ▶

**Linked View Id : 17639**

Change by Id

Is Default

DEL UNDEL View Views ▶

**Linked View Id : 17640**

Change by Year

Is Default

DEL UNDEL View Views ▶

**Linked View Id : 17641**

Progress

Is Default

DEL UNDEL View Views ▶

**Linked View Id : 17637**

Statistics

Is Default

DEL UNDEL View Views ▶

**Linked View Id : 17636**

Totals

The label, Target Type, and Alternative Type, properties chosen for Operation, Component, and Outcome, Analysis may not be consistent with how those properties are used in Operating and Capital Budgets. For example, a Progress Analysis that compares two budgets needs all of budget 1 Target Types set to benchmark and budget 2 Target Types set to actual.



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These analyzers first order aggregated base elements by Id, and then Date, prior to running any analysis. That convention explains the order of the base elements that are displayed. It also explains how the algorithms used with these analyzers (as of 1.8.8) order their elements.

**Appendix B** explains how the *Totals*, *Statistics*, *Change*, and *Progress* Analyzers work.

## **H. Net Present Value (NPV) Calculation and Analysis**

With the exception of Input and Output Analyses, NPV calculators must be run prior to running these analyzers. DevTreks convention is to use NPV calculators to pull fresh database data together prior to running analyses. The NPV calculators do not rerun resource stock calculations. The NPV results support the economic analysis dimension of CTAs. The associated references contain examples demonstrating how to use Stock Indicators to calculate the uncertainty of costs and benefits.

## **I. Performance Analysis**

Stock budgeting data can be used to carry out other types of Performance Analysis, such as the amount of energy per dollar income, CO2 emissions per unit energy, and environmental damage per unit CO2. The IPCC WG1 2013 reference describes how Net Primary Productivity crop studies, that make use of water and nutrient budgeting techniques, will play increasingly important roles in future efforts to adapt to climate change impacts on crop productivity (and decreased pollution from runoff). The Performance Analysis 1 tutorial explains additional types of performance measurement. The Social Performance Analysis tutorial demonstrates algorithms that begin to measure social performance (7\*).

## **J. Custom Analysis (7\*)**

This reference explains how to analyze base element resource stock data. The structure of base element data may not support many types of analyses, such as CTAs that use randomized control trial data or comparisons of base elements that are not siblings. Three options for custom analysis can be used to overcome this shortfall:



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1. **DevPacks:** The *DevPacks* tutorial introduces base elements that allow analysis of arbitrary structures of hierarchical data, including randomized control trial data and non-sibling base elements. **Appendix C, DevPacks Stock Analysis** begins to demonstrate how to use them to analyze resource stock data (10\*).
2. **Data URLs:** The introductory reference introduces the Data URL properties of calculators and analyzers that allow custom datasets to be linked directly to calculators and analyzers.
3. **Packages:** The *Calculators and Analyzers* and *Performance Analysis* references explain that datasets can be packaged, downloaded as zip files, cleaned up, imported into statistical packages, and further analyzed.

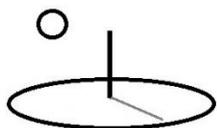
The *Conservation Technology Assessment* tutorial explains these techniques further. Future releases and references will also explain these techniques further.

## **K. Knowledge Bank Standards**

All resource stock data should be entered into online knowledge banks (i.e. production servers as contrasted to development servers) that can be used to analyze resource stocks. That structured evidence must be passed down to future generations. These knowledge banks aggregate and analyze all of the data in a network. Future references will discuss how these knowledge banks will evolve (i.e. semantic data, forecasts) to support future decision making needs. The flexibility offered by DevTreks in documenting resource stocks means that networks need to develop “rules” explaining the “standards” that should be followed by clubs in their network. The “standards” make it possible to build knowledge banks. The IPCC and FAO references provide guidance for natural resource stock data standards. The U.S. CMS and WHO are developing human capital stock data standards that can support health care knowledge banks.

## **Summary and Conclusions**

Clubs using DevTreks can start to carry out the basic analysis of resource stocks. Clubs can solicit help understanding resource stocks better and share structured evidence explaining the



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best technologies and practices for managing resource stocks. Networks can build knowledge banks that explain the management of resource stocks and pass that knowledge down to future generations. The result may be Indian smallholders who adapt effectively to changing monsoons, Somali health care administrators who deliver more cost effective medical treatments, Philippine city managers who mitigate rising typhoon intensity more efficiently, California vegetable growers who manage water wisely, Egyptian municipalities that manage energy distribution better, Chilean mariners who adopt sustainable fish stock management practices faster, and people who improve their lives and livelihoods.

## Footnotes

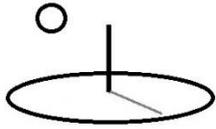
1. While working as an agricultural economist for the USDA, Natural Resources Conservation Service, the author trained conservation professionals in conservation planning. These training sessions included guidance about the principles of natural resource conservation stock budgeting that underlie the natural resource examples used in this reference. In 1996, while working for the same group, he built a desktop software program, The Community Conservation Toolbox, which automated much of that agency's conservation planning (and that provided another interesting case study about the hurdles faced in technology adoption and diffusion, or the power of inertia).
2. Analysts have developed a large number of techniques and tools for analyzing resource stocks (i.e. the climate change models in the IPCC references). This reference introduces basic stock budgeting analysis. Additional techniques will be included in future releases.
3. The natural resources references make it clear that stocks can't be seriously analyzed without considering the uncertainty, or riskiness, of their measurement. The introductory reference includes examples showing how to conduct a basic stock risk analysis. The *Conservation Technology Assessment* tutorial provides additional examples of risk analysis. Future releases of the *Performance Analysis* tutorial will include additional examples that demonstrate how to measure risk and environmental performance.
4. A small, limited amount of natural resources conservation data was used to test the analyzers in this reference. In addition, not every feasible way to run an analysis was



tested (i.e. 44 stock calculators and analyzers have to be tested on three platforms). These analyzers will continue to be tested with additional datasets in future upgrades.

5. Although significant portions of Chapters 26, 27, 28, 29, 30, and Appendix 6, in the U.S. Global Climate Change Research Program (USGCCRP) references might sound like prescriptions for CTAs, the key difference from our perspective is that these efforts (and funding) should not be limited to research organizations. The author began this project while working as an official US scientist for the USDA. He disagrees with the USGCCRP researchers' primary recommendations to mainly use research institutions to develop and deliver the needed climate change data services. Two reasons stand out:
  - a. **Professional analysts can deliver professional CTA data services:** The researchers don't appear to recognize that information technology will eventually automate most of what they currently do by hand (and much of which, by modern IT standards, is obsolescent). The assistance of anyone who has the skills, or can be trained, to complete a professional CTA is needed and should be sought. Some CTAs will require completion by researchers, but many analyses, such as cost benefit analyses of new mitigation technologies, can be completed by professional analysts.
  - b. **Professional information technologists can develop and deliver professional CTA data services:** Given the importance of information, information technologists may need to be hiring researchers as consultants, rather than vice versa. Many very, very talented software developers do not work in research organizations but may be highly motivated to assist with the tremendous amount of software development needed to deliver all of the missing climate change data services. These developers should not end up suspecting that a narrow cabal of research peers are their main beneficiary –they will work to help their neighbors, communities, and future generations, but not so that a researcher can get another paper published (unless the researchers pay them enough money to do so).

Although this difference in opinion is a potential reason why researchers may ignore the obvious (i.e. this technology exists, albeit imperfectly, and like most new technology



companies, outside conventional institutions), the same researchers make the convincing case that the planet really does need all of the help it can get.

6. The IPCC (2006) and FAO (2014) references use the term Activity Data (AD) in a manner similar to these multipliers. They define AD as “Activity Data describe the magnitude of human activity resulting in emissions or removals of greenhouse gases, taking place during a given period of time and over a specified period”. This number is multiplied by an emissions factor, which is taken from an IPCC reference, to calculate total emissions or removals. National statistics agencies use this technique to build inventories of emissions data. The *Resource Stock Calculation* reference demonstrates one way to build these types of inventories and to account for their uncertainty.
7. Version 2.1.6 began investigating the development of lighter weight versions of DevTreks. For example, storing TEXT datasets in document databases, and then using a general metadata user interface for running the calculations and analyses. This alternative software design may be more appropriate for the purposes introduced in the Social Performance Analysis references. Specifically to rate the social soundness of companies (i.e. consumers scan bar codes before making purchases or use the app to develop their shopping lists) and public executives (i.e. voters inspect the ratings before making decisions). This design may be a logical complement to the existing relational database design, but consumer-oriented software for conducting consequential digital activism may be more appropriate for better funded and networked organizations (i.e. but then again).
8. The IPCC WG 1 reference makes extensive use of “scenarios” in explaining the impacts of climate change. They define a scenario as “A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about the key driving forces (e.g. rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful to provide a view of the implications of developments and actions.” In DevTreks parlance, a base or benchmark comparator is a base scenario from which alternative scenarios are compared (i.e. using



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Change by Alternative analyses). The same reference uses the terms “time trend” and “inventory trend” in a manner consistent with Change by Year analyses.

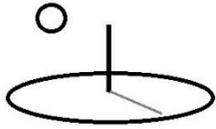
9. The IPCC WG 1 reference defines a storyline as “A narrative description of a scenario (or family of scenarios), highlighting the main scenario characteristics, relationships between key driving forces and the dynamics of their evolution”.
10. DevPacks Analyses are somewhat harder to carry out than standard analyses. Consider using them when resources are particularly scarce, money really does need to be saved, and evidence has to be easily accessible that proves outcomes. A casual glance at newspaper stories suggests these circumstances seldom happen in some countries (and households, and firms, and agencies, and research organizations, and villages, and cities, and counties, and states) –in many cases, accountability for budget expenditures is mostly a talking point. UN GAR (2015) suggests that “[by holding the parties responsible for the decisions they make about the investments in their communities] the subsequent losses and impacts will become a societal issue that can be subject to societal discussion and negotiation”.
11. These types of analyses are based on the general principle “is it better to give a community another ‘expert’ analysis, or is it better to give them the tools needed to build the analyses and make the decisions themselves about consequent courses of action?”.
12. The metadata analysis of RCT data conducted in HTAs has more complexity (and richness) than these examples of basic CTA analyses. Basic RCT analysis is still a good place to start.

## References

The references used in this tutorial can be found in the introductory reference, *Resource Stock Calculation 1*.

## References Note

We try to use references that are open access or that do not charge fees.



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### **Improvements, Errors, and New Features**

Please notify DevTreks (devtrekkers@gmail.com) if you find errors in these references. Also please let us know about suggested improvements or recommended new features.

### **A video tutorial explaining this reference can be found at:**

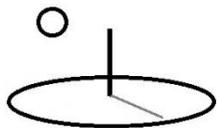
<https://www.devtreks.org/commonstreks/preview/commons/resourcepack/Resource Stock Analysis 1/1525/none/>

### **Video Errata:**

The video used earlier versions of the Stock Calculators and Analyzers. They've matured a lot since this video was made.

The World Bank publication endorsed by Nobel Prize winners is actually:

World Bank and United Nations. Natural hazards, unnatural disasters: the economics of effective prevention. 2010



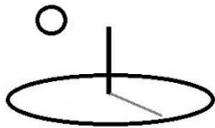
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## Appendix A. Multipliers

The following examples use an Operating Budget Analysis of an organic orange crop to explain how multipliers work. Multipliers work similarly to the Indicators that are aggregated in a Totals Analysis. Aggregate indicators sum all Q1s, Q2s, Q3s, Q4s, Q5s, QTs, and Scores that have the same label. Multipliers are then applied to these aggregated Qxs. Analysts are expected to interpret the aggregations and summations appropriately. Oftentimes, the only properties that are important, and used by the Statistical, Change, and Progress Analyzers, are the QTM, ScoreM, ScoreL, and ScoreU properties.

The IPCC 2066 reference points out that activity data, which is equivalent to these multipliers, is often collected in a way that already accounts for its uncertainty (i.e. census data). Under these circumstances, base element multipliers can be used as the activity data. As an alternative to base element multipliers, the associated CTA tutorial explains how uncertain multiplier indicators can be used in the calculations.

The following image (Version 1.7.6) displays the initial fertilizer Input example explained in the introductory reference. The Input and Output stock indicators were calculated as “unit stocks” (i.e. 1 kg fertilizer/ha and 1 ton yield/ha). The Resource Stock Input and Output calculators have been run but no multipliers have been used yet with these calculations. The multipliers are only used with calculated results, meaning that Math Expressions can’t be used with the multiplied variables in the Expression (but can be used with QTs and Scores). Although not shown, the Output N indicator QTM equals 1.5047.



Budget :

+ Indicators

Time Period : 2012 Organic Orange Crop

+ Indicators

Outcomes

Outcome : 2012 Organic Orange Crop Outcome(Amount: 1.000; Date: 12/31/2012)

+ Indicators

Output : 2012 Orange, Organic

+ Indicators

Operations

Operation : 2012 Organic Orange Crop Operation

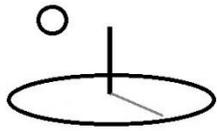
+ Indicators

Input : 2012 Fertilizer, Orange, Organic

- Indicators

Score Most Amount: 0.7251  
Score Low Amount: 0.1663  
Score High Amount: 1.0908  
Math Expression:  $14+i5+i6+i7+i8/5$   
**Indic 1 Name:** Nitrate Loss  
Date: 12/31/2014  
Math Type: algorithm1  
Q1 Amount: 87.5800  
Q2 Amount: 97.6400  
Q3 Amount: 30.0000  
Q4 Amount: 88.1000  
Q5 Amount: 0.0000  
Math Express:  $((Q1/Q2)*Q3)/Q4$   
Q6 Amount: 0.3576  
Q6 D1 Amount: 0.2500  
Q6 D2 Amount: 0.3560  
Q6 Most Amount: 0.3653

Score Most Unit: most likely  
Score Low Unit: low estimate  
Score High Unit: high estimate  
Iterations: 1000  
Label: NO3  
Rel Label: NO3  
Dist Type: triangle  
Q1 Unit: kg N / ha applied  
Q2 Unit: kg N / ha total  
Q3 Unit: kg N03-N / ha  
Q4 Unit: kg N / ha applied  
Q5 Unit: none  
Math Operator: equalto  
Q6 Unit: kg N03-N / ha  
Q6 D1 Unit: low estimate  
Q6 D2 Unit: high estimate  
Q6 Most Unit: Mean

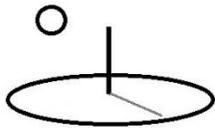


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The following image shows that when the Input.OCAmount property is changed from 1 to 100 (kg N/ha applied), all of the final indicator Qx properties increase proportionately. Note that most analyses are primarily interested in the QT and Score properties (final emissions and environmental performances). Also note that the Nitrate Indicator uses a triangular distribution with a monte carlo sampling algorithm –the numbers change slightly each time a new calculation is run because the same sample is not used with each calculation (i.e. the Score.RandomSeed = 0).

Operations (and Operating Budgets) multiply the stock indicators by the Input.OCAmount and the Input.Times properties. Components (and Capital Budgets) multiply the stock indicators by the Input.CAPAmount and the Input.Times properties. Under some circumstances it may be appropriate to use the Input.AOHAmount to allocate resource indicators to overhead, but this allocation is not currently supported.

Although not shown, the Output.Amount property was also changed from 1 ton/ha to 100 ton/ha (for ease of computation) and the Output indicator properties increased by that factor (QTM = 150). Outcomes (and both Operating Budgets and Capital Budgets) multiply the stock indicators by the Output.Amount, Output.CompositionAmount, and Output.Times properties.



Budget :

+ Indicators

Time Period : 2012 Organic Orange Crop

+ Indicators

Outcomes

Outcome : 2012 Organic Orange Crop Outcome(Amount: 1.000; Date: 12/31/2012)

+ Indicators

Output : 2012 Orange, Organic

+ Indicators

Operations

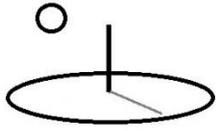
Operation : 2012 Organic Orange Crop Operation

+ Indicators

Input : 2012 Fertilizer, Orange, Organic

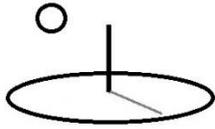
- Indicators

Score Most Amount: 70.1100	Score Most Unit: most likely
Score Low Amount: 11.8400	Score Low Unit: low estimate
Score High Amount: 109.0600	Score High Unit: high estimate
Math Expression: $14+i5+i6+i7+i8/5$	Iterations: 1000
<b>Indic 1 Name:</b> Nitrate Loss	Label: NO3
Date: 12/31/2014	Rel Label: NO3
Math Type: algorithm1	Dist Type: triangle
Q1 Amount: 8,758.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 9,764.0000	Q2 Unit: kg N / ha total
Q3 Amount: 3,000.0000	Q3 Unit: kg N03-N / ha
Q4 Amount: 8,810.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: none
Math Express: $((Q1/Q2)*Q3)/Q4$	Math Operator: equalto
Q6 Amount: 35.7600	Q6 Unit: kg N03-N / ha
Q6 D1 Amount: 25.0000	Q6 D1 Unit: low estimate
Q6 D2 Amount: 35.6000	Q6 D2 Unit: high estimate
Q6 Most Amount: 36.6900	Q6 Most Unit: Mean



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The following image shows that when the Input.Times property is changed from 1 to 2, all of the Input and Operation properties double. Although not shown, the Output.CompositionAmount property was also changed from 1 to 2 and the the Output.Times property was also changed from 1 to 2. The Output indicator properties quadrupled (QTM = 603).



Budget :

+ Indicators

Time Period : 2012 Organic Orange Crop

+ Indicators

Outcomes

Outcome : 2012 Organic Orange Crop Outcome(Amount: 1.000; Date: 12/31/2012)

+ Indicators

Output : 2012 Orange, Organic

+ Indicators

Operations

Operation : 2012 Organic Orange Crop Operation

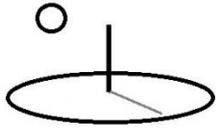
+ Indicators

Input : 2012 Fertilizer, Orange, Organic

- Indicators

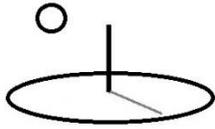
Score Most Amount: 141.6200  
Score Low Amount: 29.5000  
Score High Amount: 215.0800  
Math Expression: I4+i5+i6+i7+i8/5  
**Indic 1 Name:** Nitrate Loss  
Date: 12/31/2014  
Math Type: algorithm1  
Q1 Amount: 17,516.0000  
Q2 Amount: 19,528.0000  
Q3 Amount: 6,000.0000  
Q4 Amount: 17,620.0000  
Q5 Amount: 0.0000  
Math Express: ((Q1/Q2)\*Q3)/Q4  
Q6 Amount: 71.5200  
Q6 D1 Amount: 50.0000  
Q6 D2 Amount: 71.2000  
Q6 Most Amount: 73.0600

Score Most Unit: most likely  
Score Low Unit: low estimate  
Score High Unit: high estimate  
Iterations: 1000  
Label: NO3  
Rel Label: NO3  
Dist Type: triangle  
Q1 Unit: kg N / ha applied  
Q2 Unit: kg N / ha total  
Q3 Unit: kg N03-N / ha  
Q4 Unit: kg N / ha applied  
Q5 Unit: none  
Math Operator: equalto  
Q6 Unit: kg N03-N / ha  
Q6 D1 Unit: low estimate  
Q6 D2 Unit: high estimate  
Q6 Most Unit: Mean



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The following image shows that when the Operation.Amount property is changed from 1 to 2, the Input and Operation indicator properties double. Although not shown, the Outcome.Amount property was also changed from 1 to 2 resulting in the Output indicator properties doubling (QTM = 1195).



Budget :

+ Indicators

Time Period : 2012 Organic Orange Crop

+ Indicators

Outcomes

Outcome : 2012 Organic Orange Crop Outcome(Amount: 2.000; Date: 12/31/2012)

+ Indicators

Output : 2012 Orange, Organic

+ Indicators

Operations

Operation : 2012 Organic Orange Crop Operation

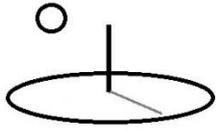
+ Indicators

Input : 2012 Fertilizer, Orange, Organic

- Indicators

Score Most Amount: 286.2400	Score Most Unit: most likely
Score Low Amount: 56.0400	Score Low Unit: low estimate
Score High Amount: 439.2000	Score High Unit: high estimate
Math Expression: $I4+i5+i6+i7+i8/5$	Iterations: 1000
<b>Indic 1 Name:</b> Nitrate Loss	Label: NO3
Date: 12/31/2014	Rel Label: NO3
Math Type: algorithm1	Dist Type: triangle
Q1 Amount: 35,032.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 39,056.0000	Q2 Unit: kg N / ha total
Q3 Amount: 12,000.0000	Q3 Unit: kg N03-N / ha
Q4 Amount: 35,240.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: none
Math Express: $((Q1/Q2)*Q3)/Q4$	Math Operator: equalto
Q6 Amount: 143.0400	Q6 Unit: kg N03-N / ha
Q6 D1 Amount: 100.0000	Q6 D1 Unit: low estimate
Q6 D2 Amount: 142.4000	Q6 D2 Unit: high estimate

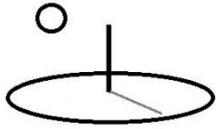
The following before and after images show that when the TimePeriod.Amount property is changed from 1 to 2, the Input and Operation properties don't change but the TimePeriod Input



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and Output indicator properties all double (QTM = 2,401). Again, the before-aggregated TimePeriod multipliers are used.

Before



Budget :

+ Indicators

Time Period : 2012 Organic Orange Crop

- Indicators

Score Most Amount: 972.8000	Score Most Unit: most likely
Score Low Amount: 602.3600	Score Low Unit: low estimate
Score High Amount: 1,088.1600	Score High Unit: high estimate
Math Expression: (I1+I2)/2	Iterations: 1000
<b>Indic 1 Name:</b> Nitrate Loss	Label: NO3
Date: 12/31/2014	Rel Label: NO3
Math Type: algorithm1	Dist Type: triangle
Q1 Amount: 35,032.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 39,056.0000	Q2 Unit: kg N / ha total
Q3 Amount: 12,003.0000	Q3 Unit: kg N03-N / ha
Q4 Amount: 35,243.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: none
Math Express: ((Q1/Q2)*Q3)/Q4	Math Operator: equalto
Q6 Amount: 143.0400	Q6 Unit: kg N03-N / ha
Q6 D1 Amount: 100.0000	Q6 D1 Unit: low estimate
Q6 D2 Amount: 142.4000	Q6 D2 Unit: high estimate
Q6 Most Amount: 146.5600	Q6 Most Unit: Mean
Q6 Low Amount: 100.2400	Q6 Low Unit: Minimum
Q6 High Amount: 140.9200	Q6 High Unit: Maximum
Math Result Type:	Observations: 3.0
Indic 1 Description: Nitrate emissions derived from organic fertilizer. Measurement for field has been adjusted to NO3 emission per kg fertilizer applied, as follows: 0.29 kg NH3-N / ha : ((87 kg N per ha applied fertilizer / 93 kg N per ha total) 27 kg N03) / 87 kg N per	
Math Result:	
<b>Indic 2 Name:</b> Ammonia Loss	Label: NH3
Date: 12/31/2014	Rel Label: CO2
Math Type: algorithm1	Type: none
Q1 Amount: 34,800.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 37,200.0000	Q2 Unit: kg N / ha total
Q3 Amount: 1,483.0000	Q3 Unit: kg NH3-N / ha
Q4 Amount: 35,203.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: none
Math Express: ((Q1/Q2)*Q3)/Q4	Math Operator: equalto
Q6 Amount: 11.6000	Q6 Unit: kg NH3-N / ha
Q6 D1 Amount: 0.0000	Q6 D1 Unit: low
Q6 D2 Amount: 0.0000	Q6 D2 Unit: high
Q6 Most Amount: 11.6000	Q6 Most Unit: Most Likely Estimate
Q6 Low Amount: 0.0000	Q6 Low Unit: Low Estimate
Q6 High Amount: 0.0000	Q6 High Unit: High Estimate
Math Result Type:	Observations: 1.0
Indic 2 Description: Ammonia emissions derived from organic fertilizer. Measurement for field has been adjusted to	

After



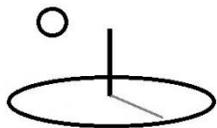
Budget :

+ Indicators

Time Period : 2012 Organic Orange Crop

- Indicators

Score Most Amount: 1,945.2000	Score Most Unit: most likely
Score Low Amount: 1,229.6800	Score Low Unit: low estimate
Score High Amount: 2,150.8800	Score High Unit: high estimate
Math Expression: (I1+I2)/2	Iterations: 1000
<b>Indic 1 Name:</b> Nitrate Loss	Label: NO3
Date: 12/31/2014	Rel Label: NO3
Math Type: algorithm1	Dist Type: triangle
Q1 Amount: 70,064.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 78,112.0000	Q2 Unit: kg N / ha total
Q3 Amount: 24,005.0000	Q3 Unit: kg N03-N / ha
Q4 Amount: 70,485.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: none
Math Express: ((Q1/Q2)*Q3)/Q4	Math Operator: equalto
Q6 Amount: 286.0800	Q6 Unit: kg N03-N / ha
Q6 D1 Amount: 200.0000	Q6 D1 Unit: low estimate
Q6 D2 Amount: 284.8000	Q6 D2 Unit: high estimate
Q6 Most Amount: 293.4400	Q6 Most Unit: Mean
Q6 Low Amount: 201.2000	Q6 Low Unit: Minimum
Q6 High Amount: 284.4800	Q6 High Unit: Maximum
Math Result Type:	Observations: 3.0
Indic 1 Description: Nitrate emissions derived from organic fertilizer. Measurement for field has been adjusted to NO3 emission per kg fertilizer applied, as follows: 0.29 kg NH3-N / ha : ((87 kg N per ha applied fertilizer / 93 kg N per ha total) 27 kg N03) / 87 kg N per	
Math Result:	
<b>Indic 2 Name:</b> Ammonia Loss	Label: NH3
Date: 12/31/2014	Rel Label: CO2
Math Type: algorithm1	Type: none
Q1 Amount: 69,600.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 74,400.0000	Q2 Unit: kg N / ha total
Q3 Amount: 2,965.0000	Q3 Unit: kg NH3-N / ha
Q4 Amount: 70,405.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: none
Math Express: ((Q1/Q2)*Q3)/Q4	Math Operator: equalto
Q6 Amount: 23.2000	Q6 Unit: kg NH3-N / ha
Q6 D1 Amount: 0.0000	Q6 D1 Unit: low
Q6 D2 Amount: 0.0000	Q6 D2 Unit: high
Q6 Most Amount: 23.2000	Q6 Most Unit: Most Likely Estimate
Q6 Low Amount: 0.0000	Q6 Low Unit: Low Estimate
Q6 High Amount: 0.0000	Q6 High Unit: High Estimate
Math Result Type:	Observations: 1.0
Indic 2 Description: Ammonia emissions derived from organic fertilizer. Measurement for field has been adjusted to NH3 emission per kg fertilizer applied, as follows: .25 kg NH3-N / ha : ((87 kg N per ha applied fertilizer / 93 kg N	



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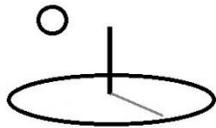
## Appendix B. Resource Stock Analyzers

### a. Totals Analyses

A *Totals Analysis* sums all stock indicators with the same labels for every base element in an analysis. All analyzers run this analysis for each aggregated base element before carrying out additional calculations. Version 2.0.4 stopped rerunning Resource Stock Input or Output calculations prior to summing the calculations because the original base element calculations aren't changed during analyses. **Appendix A** explains how to use multipliers to adjust the original base element calculations.

The analyzers associated with these calculators, explained in the introductory reference, sum the base Input and Output Stock Indicators into their ancestor Operations, Components, Outcomes, Time Periods, and Budgets. In addition, they are multiplied by the multipliers (i.e. Amounts) found in those elements (see Appendix A. Multipliers). In this regard, they behave the same as benefit and cost data which gets cumulatively summed and multiplied throughout budgets. In fact, they were designed in this manner to better support cost and benefit data analysis techniques such as cost effectiveness analysis.

The following Input Totals Analysis shows that summations of Input Series have been aggregated into a parent Input. In this example of a Life Cycle Analysis of orange production, emissions are being aggregated into emission indicators with the same label, and environmental impacts are being aggregated into impact indicators with the same label. The Observations reflect the number of indicators being aggregated. The first indicator being aggregated sets the Name, Description, Labels, Units, and Mathematical properties.



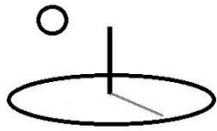
← → ↻ [DevTreks \[US\] https://www.devtreks.org/greentreks/preview/carbon/in](https://www.devtreks.org/greentreks/preview/carbon/in)

Input Group: LCA Nutrients, Organic Crops

Input : 2014 Fertilizer, Orange, Conventional

**Indicators**

Math Expression: (I4.QTM+I5.QTM+I6.QTM+I7.QTM+I8.QTM)/5	Observations: 3.0
Score Amount: 45.1677	Score Unit: environmental performance
Score D1 Amount: 45.2000	Score D1 Unit: mean
Score D2 Amount: 4.6500	Score D2 Unit: sd
Distribution Type: normal	Math Type: algorithm1
Score Most Amount: 45.2289	Score Most Unit: mean
Score Low Amount: 45.1529	Score Low Unit: lower 90% ci
Score High Amount: 45.3049	Score High Unit: upper 90% ci
Iterations: 10000	Score Math Sub Type: subalgorithm1
Score Math Result: sampled descriptive statistics N,Total,Mean,Median,StdDev,Var,Min,Max 10000, 148093.3526, 14.8093, 14.8233, 1.4863, 2.2092, 9.0377, 20.0766, sampled cumulative density function 0.00,0.10,0.20,0.30,0.40,0.50,0.60,0.70,0.80,0.90,1.00 9.0377,12.9130,13.5503,14.0282,14.4398,14.8234,15.1917,15.6026,16.0625,16.7111,20.0766	
<b>Indic 1 Name:</b> Nitrate Loss	Label: NO3
Date: 01/01/2014	Rel Label: CO2A, NO2A, SO2
Math Type: algorithm1	Dist Type: triangle
Q1 Amount: 366.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 360.0000	Q2 Unit: kg N / ha total
Q3 Amount: 90.0000	Q3 Unit: kg N03-N / ha
Q4 Amount: 333.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: kg N03-N / ha
Math Express: ((I1.Q1/ I1.Q2) * I1.Q3) / I1.Q4	Math Operator: equalto
QT Amount: 0.8243	QT Unit: kg N03-N / ha
QT D1 Amount: 67.5000	QT D1 Unit: low
QT D2 Amount: 120.0000	QT D2 Unit: high
QT Most Amount: 40.5282	QT Most Unit: kg N03-N / ha
QT Low Amount: 40.0647	QT Low Unit: lower 90% ci
QT High Amount: 40.9917	QT High Unit: upper 90% ci
Math Sub Type: subalgorithm1	Base IO: none
Observations: 3.0	
Indic 1 Description: Nitrate emissions derived from fertilizer. Measurement for field has been adjusted to NO3 emission per kg fertilizer applied, as follows: .25 kg NH3-N / ha : ((111 kg N per ha applied fertilizer / 120 kg N per ha total) 30 kg N03) / 111 kg N per ha ap	
<b>Indic 2 Name:</b> Ammonia Loss	Label: NH3
Date: 01/01/2014	Rel Label: SO2A, SO2B
Math Type: algorithm1	Type: normal
Q1 Amount: 366.0000	Q1 Unit: kg N / ha applied
Q2 Amount: 360.0000	Q2 Unit: kg N / ha total
Q3 Amount: 19.3500	Q3 Unit: kg NH3-N / ha
Q4 Amount: 333.0000	Q4 Unit: kg N / ha applied
Q5 Amount: 0.0000	Q5 Unit: kg N03-N / ha
Math Express: ((I2.Q1/ I2.Q2) * I2.Q3) / I2.Q4	Math Operator: equalto
QT Amount: 0.4772	QT Unit: kg N03-N / ha



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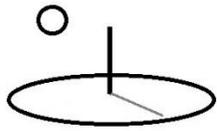
The following stylized Operating Budget Analysis demonstrates that *no* Output indicators have the same label as an Input indicator, so their full amounts appear in the Time Period totals (N and P). This life cycle analysis wanted full information about emissions and environmental impacts, rather than just balances (i.e. N balance), so it used different labels for the Output indicators. The Totals analysis displays up to 15 aggregated Input and Output indicators. The USEPA reference (2006) includes an example of a LCA for auto emissions that includes dozens of stock indicators. Use more than one Input or Output when more than 15 indicators are needed. The analysis is stylized because Version 1.7.8 upgraded just enough indicators to test the calculations.



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<b>Nitrogen (6.0)</b>		N	01/01/2014		algorithm1	normal	n	
9,491.0000	kg N / ha	8,628.0000	tons / ha	57.0000	none	0.0000	n	
361.0991	kg N / ton	36,140.0000	4,923.0000	36,139.7144	kg N / ton	36,059.4260	lc ci	
This indicator measures annual nitrogen per ton of output yield.								
I1.Q1/I1.Q2								
<b>Phosphorous (6.0)</b>		P	01/01/2014		algorithm1	triangle	n	
1,312.9000	kg P / ha	6,252.0000	tons / ha	4.4400	none	0.0000	n	
66.9294	kg P / ton	4,784.0000	11,144.0000	3,747.9658	kg P / ton	3,705.0969	lc ci	
This indicator measures annual phosphorous per ton of output yield.								
I2.Q1/I2.Q2								
Budget : Conventional Orange Budget, Brazil								
Score	Score Unit	Score D1 Amount	Score D1 Unit	Score D2 Amount	Score D2 Unit	Iterations	C	
Score Most Amount	Score Most Unit	Score Low Amount	Score Low Unit	Score High Amount	Score High Unit	Distribution Type	M	
20,320.4735	env performance	20,093.0000	mean	2,144.1500	sd	10000		
20,104.4206	mean	20,069.4731	lower 90% ci	20,139.3681	upper 90% ci	normal	a	
(I1.QTM+I2.QTM)/2								
sampled descriptive statistics N,Total,Mean,Median,StdDev,Var,Min,Max 10000, 550302.1852, 55.0302, 55.0050								
sampled cumulative density function 0.00,0.10,0.20,0.30,0.40,0.50,0.60,0.70,0.80,0.90,1.00								
32.5144,47.4841,50.0692,51.9360,53.5344,55.0055,56.5288,58.1234,59.9692,62.5652,77.2198								
Name (N)		Label	Date	Rel Label	Math Type	Dist Type		
Q1 Amount	Q1 Unit	Q2 Amount	Q2 Unit	Q3 Amount	Q3 Unit	Q4 Amount		
QT Amount	QT Unit	QT D1 Amount	QT D2 Amount	QT Most Amount	QT Most Unit	QT Low Amount		
<b>Nitrate Loss (3.0)</b>		NO3	01/01/2014		CO2A, NO2A, SO2	algorithm1	triangle	3
41,780.0000	kg N / ha applied	41,160.0000	kg N / ha total	10,290.0000	kg N03-N / ha	38,073.0000	kg a	
94.0965	kg N03-N / ha	7,722.5000	12,720.0000	4,622.6278	kg N03-N	4,580.6427	lc ci	

## b. Statistics Analyses

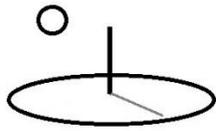


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A *Statistics Analysis* uses the Totals calculations to measure basic statistical properties of up to 10 aggregated resource stock indicator properties. Total, Median, Mean, Variance, and Standard Deviation statistics are generated for all of the stock indicators in aggregated base elements.

Indicators are aggregated in two stages. The first stage uses the standard aggregators to aggregate the base elements. The second stage aggregates the same resource stock indicators within each aggregated base element. The number of observations reflects the number of individual indicators being aggregated.

The following Input Statistical Analysis shows that the digital precision displayed by analyzers is 4 digits. The digital precision of analyses is important because this type of emissions and environmental impact data is often aggregated across regions or populations. Some of the analytic results for very small amounts show no numeric changes, yet they still have percentage changes. The 4 digit precision doesn't display the amount change, but still displays the correct percent change. If warranted, the digital precision may be increased in future releases.



LCA Organic vs Conv x

DevTreks [US] <https://www.devtreks.org/greentreks/linkedviews/carbon/budgetgroup/LCA%20Organic%20>

Input Group									
LCA Nutrients, Organic Crops									
Input									
2014 Fertilizer, Orange, Conventional									
Observations	Score Most Likely	Unit	Score Mean	Score Median	Score Variance	Score Std Dev	Score Low Unit	Score High Unit	
Score Low	Score Low Mean	Score Low Median	Score Low Variance	Score Low Std Dev	Score High	Score High Mean	Score High Median	Score High Variance	Score High Std Dev
3.0	1.4223	environmental performance	0.4741	0.6074	0.0782	0.2797	low estimate	high estimate	
0.5956	0.1985	0.2500	0.0079	0.0891	0.1937	0.0646	0.0000	0.0125	0.1118
Observations	Name	Label	Total	Unit	Mean	Median	Variance	Std Dev	
3.0	Nitrate Loss	NO3E	0.7334	Mean	0.2445	0.2379	0.0005	0.0233	
3.0	Ammonia Loss	NH3E	0.1603	Most Likely Estimate	0.0534	0.0538	0.0000	0.0049	
3.0	Nitrous Oxide Emissions	N2OE	0.0397	Most Likely Estimate	0.0132	0.0133	0.0000	0.0012	
3.0	Global Warming	CO2	1.9194	Mean	0.6398	0.6240	0.0059	0.0767	
6.0	Acidification	SO2	0.0415	Most Likely Estimate	0.0069	0.0137	0.0000	0.0054	
6.0	Eutrophication	NO3	0.0801	Most Likely Estimate	0.0134	0.0265	0.0001	0.0104	
Input Series : 2012 Fertilizer, Orange, Conventional									
Observations	Score Most Likely	Unit	Score Mean	Score Median	Score Variance	Score Std Dev	Score Low Unit	Score High Unit	
Score Low	Score Low Mean	Score Low Median	Score Low Variance	Score Low Std Dev	Score High	Score High Mean	Score High Median	Score High Variance	Score High Std Dev
1.0	0.1527	environmental performance	0.1527	0.1527	0.0000	0.0000	low estimate	high estimate	
0.0956	0.0956	0.0956	0.0000	0.0000	0.1937	0.1937	0.1937	0.0000	0.0000
Observations	Name	Label	Total	Unit	Mean	Median	Variance	Std Dev	

The following Operating Budget Statistical Analysis demonstrates that the resource stock composition of Outputs and Inputs can be included in an analysis by setting their labels differently. Alternatively, the balance of the stocks will be shown at the Time Period element if the Input and Output indicators have the same labels.



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Budget Group : LCA Organic vs Conventional Orange Crops						
Observations	Score Most Likely	Unit	Score Mean	Score Median	Score Variance	Score Std Dev
Score Low	Score Low Mean	Score Low Median	Score Low Variance	Score Low Std Dev	Score High	Score High Mean
12.0	33,567.3775	mean	2,797.2815	16,783.6888	37,572,154.3542	6,129.6129
33,512.8013	2,792.7334	16,756.4007	37,447,354.7207	6,119.4244	33,621.9537	2,801.8295
Observations	Name	Label	Total	Unit	Mean	Median
6.0	Nitrate Loss	NO3	8,380.5127	kg N03-N / ha	1,396.7521	4,190.2564
6.0	Ammonia Loss	NH3	2,852.4924	kg N03-N / ha	475.4154	1,426.2462
6.0	Nitrous Oxide Emissions	N2O	880.9087	kg N2O-N / ha	146.8181	440.4544
6.0	Global Warming	CO2A	42,599.9431	kg CO2 equivalents	7,099.9905	21,299.9716
6.0	Acidification	SO2A	1,144.1820	kg SO2 equivalents	190.6970	572.0910
6.0	Eutrophication	NO3A	2,177.1297	kg N03 equivalents	362.8550	1,088.5649
6.0	Eutrophication	NO3B	699.6845	kg N03 equivalents	116.6141	349.8423
6.0	Acidification	SO2B	430.0029	kg SO2 equivalents	71.6672	215.0015
6.0	Nitrogen	N	36,139.7144	kg N / ton	6,023.2857	18,069.8572
6.0	Phosphorous	P	3,747.9658	kg P / ton	624.6610	1,873.9829
Budget : Conventional Orange Budget, Brazil						
Observations	Score Most Likely	Unit	Score Mean	Score Median	Score Variance	Score Std Dev
Score Low	Score Low Mean	Score Low Median	Score Low Variance	Score Low Std Dev	Score High	Score High Mean
6.0	20,104.4206	mean	3,350.7368	3,066.6973	23,224,333.3723	4,819.1631
20,069.4731	3,344.9122	3,061.5823	23,142,271.9581	4,810.6415	20,139.3681	3,356.5614

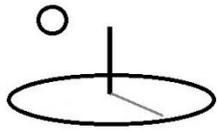


### c. Change Analyses

Change Analyzers can examine incremental changes in 10 resource stock totals or statistical means. A *Change by Year Analysis* measures incremental changes between aggregated stock indicators that have different Years. A *Change by Id Analysis* measures incremental changes between stock indicators that have different Ids. A *Change by Alternative Type Analysis* measures incremental changes between aggregated stock indicators that have different Alternative Types. Changes are analyzed in ascending order (Id = 1,2,3; Year = 2000, 2001, 2002; AlternativeType = A, B, C). The first member of the sequence will be used as a “Base” element to make comparisons. The sibling sequence member immediately before the current sequence member will be used as an “x-1” (x minus 1) element to make comparisons. Gaps in the sequence, such as a missing Year, will be ignored.

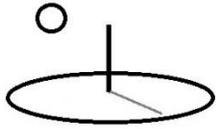
Stock budgeting analysis often use a “base scenario” as the most important comparator in an analysis (8\*). Particular attention must be paid to define the base comparators in these types of analyses. Further details about how Change Analyzers work can be found in the *Change Analysis* tutorial.

[As of 1.9.2 the following feature is being retained, but not debugged, until more advanced RCT algorithms are developed that can either replace, or enhance, this feature. The following image demonstrates that Version 1.8.8 expanded the properties of Change Analyzers to include Math Type, Math Sub Type, Math Expression, Confidence Interval, and Math Result, properties. These properties were added to leverage the algorithms used in Resource Stock Calculators. More specifically, they were added to support RCT analysis, a key technique used in HTAs and CTAs. Note how they compare statistical means, rather than totals. The CTA reference and **Appendix C, DevPacks Stock Analysis** begin to demonstrate how to use these properties to



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carry out basic metadata analysis of RCT data. An important convention to remember when using this type of analysis is how base elements are ordered –first by Id and then by Date.]



Input Stock Change by Id

Intro	1	2	3	Help
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**Step 2 of 3. Analyze**

**+ Relations**

**What If Tag**

Base Resource (Input) Calculations To Analyze Type:

**Compare Using:**

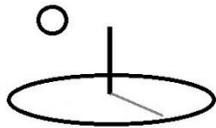
**Math Type**  **Math Sub Type**

**Confidence Interval**

**Math Expression**

**Math Result**

```
anova results
source    df      SS      MS      F
treats    2      198772.4667  99386.2333  3.4819
error     27      770670.9000  28543.3667
total     29      969443.3667
F Crit treats  3.35413  F > F Critical  true
estimate  mean diff  lower 95%  upper 95%
Treat 1 Mean  229.6000  119.9789  339.2211
xminus1 1    80.3000  -74.7276  235.3276
base 1      80.3000  -74.7276  235.3276
xminus1 2   117.9000  -37.1276  272.9276
base 2     198.2000  43.1724  353.2276
```

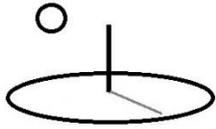


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The following three year Input Change by Year Analysis tracks annual changes in stock indicators. Under what circumstance might stock indicators change?

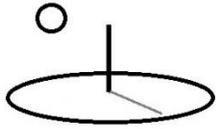
**Double check Score High Amount in this image.**

Input Series	All	Alt. 0	Alt. 1	Alt. 2
<b>Name</b>	2012 Fertilizer, Orange, Conventional	2013 Fertilizer, Orange, Conventional	2014 Fertilizer, Orange, Conventional	
<b>Label</b>	A1001C	A1001C	A1001C	
Indicators	All	Alt. 0	Alt. 1	Alt. 2
<b>Alternative</b>	A	B	C	
<b>Date</b>	07/16/2012	07/16/2013	07/16/2014	
<b>Score Observations</b>	1.0	1.0	1.0	
<b>Score Amount</b>	0.1535	0.6074	0.6622	
<b>Score Unit</b>	environmental performance	environmental performance	environmental performance	
<b>Score Amount Change</b>	0.0000	0.0000	0.0548	
<b>Score Percent Change</b>	0.0000	0.0000	9.0221	
<b>Score Base Change</b>	0.0000	0.4539	0.5087	
<b>Score Base Percent Change</b>	0.0000	295.7003	331.4007	
<b>Score Low Amount</b>	0.0959	0.2500	0.2500	
<b>Score Low Unit</b>	low estimate	low estimate	low estimate	
<b>Score Low Amount Change</b>	0.0000	0.0000	0.0000	
<b>Score Low Percent Change</b>	0.0000	0.0000	0.0000	
<b>Score Low Base Change</b>	0.0000	0.1541	0.1541	
<b>Score Low Base Percent Change</b>	0.0000	160.6882	160.6882	
<b>Score High Amount</b>	0.1950	0.0000	0.0000	
<b>Score High Unit</b>	high estimate	high estimate	high estimate	
<b>Score High Amount Change</b>	0.0000	0.0000	0.0000	
<b>Score High Percent Change</b>	0.0000	0.0000	0.0000	
<b>Score High Base Change</b>	0.0000	-0.1950	-0.1950	
<b>Score High Base Percent Change</b>	0.0000	-100.0000	-100.0000	
<b>Indicator Observations</b>	1.0	1.0	1.0	
<b>Name</b>	Nitrate Loss	Nitrate Loss	Nitrate Loss	



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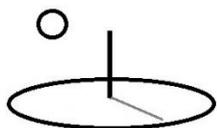
The following Capital Budget Change by Year Analysis measures incremental changes in resource stock characteristics for three years of budgets. Year 2014 is being compared to Year 2013 and Year 2012. Capital Budgets can be used to analyze durable resource stocks, while Operating Budgets can be used to analyze expendable resource stocks. Agricultural crops are normally analyzed using Operating Budgets. Building construction is normally analyzed using Capital Budgets. The Ag Production and Building Construction Tutorials demonstrate how to analyze both stock types using either of the two budgets.



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Time Period	All	Alt. 0	Alt. 1	Alt. 2
<b>Name</b>		2012 Conventional Orange Crop	2013 Conventional Orange Crop	2014 Conventional Orange Crop
<b>Date</b>		12/31/2012	12/31/2013	12/31/2014
<b>Label</b>		A1001C	A1001C	A1001C
Indicators	All	Alt. 0	Alt. 1	Alt. 2
<b>Alternative</b>				
<b>Date</b>		12/31/2012	12/31/2013	12/31/2014
<b>Score Observations</b>		2.0	2.0	2.0
<b>Score Amount</b>		1,302.4041	1,256.4118	12,383.6462
<b>Score Unit</b>		mean	mean	mean
<b>Score Amount Change</b>		0.0000	0.0000	11,127.2343
<b>Score Percent Change</b>		0.0000	0.0000	885.6359
<b>Score Base Change</b>		0.0000	-45.9923	11,081.2420
<b>Score Base Percent Change</b>		0.0000	-3.5313	850.8298
<b>Score Low Amount</b>		1,300.2832	1,254.2429	12,361.6606
<b>Score Low Unit</b>		lower 90% ci	lower 90% ci	lower 90% ci
<b>Score Low Amount Change</b>		0.0000	0.0000	11,107.4177
<b>Score Low Percent Change</b>		0.0000	0.0000	885.5874
<b>Score Low Base Change</b>		0.0000	-46.0403	11,061.3774
<b>Score Low Base Percent Change</b>		0.0000	-3.5408	850.6899
<b>Score High Amount</b>		1,304.5251	1,258.5808	12,405.6317
<b>Score High Unit</b>		upper 90% ci	upper 90% ci	upper 90% ci
<b>Score High Amount Change</b>		0.0000	0.0000	11,147.0510

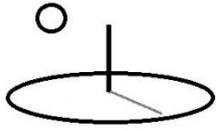
The following Operating Budget Change by Alternative Analysis measures incremental changes in resource stock characteristics for two alternative budgets. What may be the significance of



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having this type of data for every complementary cropping system in the world? Other than institutional factors, is there any technical reason why such data can't be collected?

Budget Group : LCA Organic vs Conventional Orange Crops ; 07/16/2014			
Budget	All	Alt. 0	Alt. 1
<b>Name</b>		Conventional Orange Budget, Brazil	Organic Orange Budget, Brazil
<b>Date</b>		11/06/2015	11/06/2015
<b>Label</b>		A100C	A100C
Indicators	All	Alt. 0	Alt. 1
<b>Alternative</b>	A		B
<b>Date</b>		11/06/2015	11/06/2015
<b>Score Observations</b>		6.0	6.0
<b>Score Amount</b>		20,104.4206	13,462.9569
<b>Score Unit</b>		mean	mean
<b>Score Amount Change</b>		0.0000	0.0000
<b>Score Percent Change</b>		0.0000	0.0000
<b>Score Base Change</b>		0.0000	-6,641.4637
<b>Score Base Percent Change</b>		0.0000	-33.0348
<b>Score Low Amount</b>		20,069.4731	13,443.3282
<b>Score Low Unit</b>		lower 90% ci	lower 90% ci
<b>Score Low Amount Change</b>		0.0000	0.0000
<b>Score Low Percent Change</b>		0.0000	0.0000
<b>Score Low Base Change</b>		0.0000	-6,626.1449
<b>Score Low Base Percent Change</b>		0.0000	-33.0160
<b>Score High Amount</b>		20,139.3681	13,482.5856
<b>Score High Unit</b>		upper 90% ci	upper 90% ci
<b>Score High Amount Change</b>		0.0000	0.0000
<b>Score High Percent Change</b>		0.0000	0.0000
<b>Score High Base Change</b>		0.0000	-6,656.7825
<b>Score High Base Percent Change</b>		0.0000	-33.0536



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The Time Periods in the analysis line up because of the way both Alternative Type and Label properties were set. Time Periods begin to use aggregate Stock indicators (Input and Outputs, with the properties of indicators determining whether they credit or debit the stock).

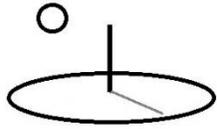
Time Period	All	Ait. 0	Ait. 1
<b>Name</b>		2012 Conventional Orange Crop	2012 Organic Orange Crop
<b>Date</b>		12/31/2012	12/31/2012 12:00:00 AM
<b>Label</b>		A1001C2012	A1001C2012
Indicators	All	Ait. 0	Ait. 1
<b>Alternative</b>	A		B
<b>Date</b>	12/31/2012		12/31/2012
<b>Score Observations</b>	6.0		6.0
<b>Score Amount</b>	20,104.4206		13,462.9569
<b>Score Unit</b>	mean		mean
<b>Score Amount Change</b>	0.0000		0.0000
<b>Score Percent Change</b>	0.0000		0.0000
<b>Score Base Change</b>	0.0000		-6,641.4637
<b>Score Base Percent Change</b>	0.0000		-33.0348
<b>Score Low Amount</b>	20,069.4731		13,443.3282
<b>Score Low Unit</b>	lower 90% ci		lower 90% ci
<b>Score Low Amount Change</b>	0.0000		0.0000
<b>Score Low Percent Change</b>	0.0000		0.0000
<b>Score Low Base Change</b>	0.0000		-6,626.1449
<b>Score Low Base Percent Change</b>	0.0000		-33.0160
<b>Score High Amount</b>	20,139.3681		13,482.5856
<b>Score High Unit</b>	upper 90% ci		upper 90% ci
<b>Score High Amount Change</b>	0.0000		0.0000
<b>Score High Percent Change</b>	0.0000		0.0000
<b>Score High Base Change</b>	0.0000		-6,656.7825
<b>Score High Base Percent Change</b>	0.0000		-33.0536
<b>Indicator Observations</b>	3.0		3.0



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The Outcomes and Operations line up because of the way both Alternative Type and Label properties were set.

Outcome	All	Alt. 0	Alt. 1
<b>Name</b>		2012 Conventional Orange Crop Outcome	2012 Organic Orange Crop Outcome
<b>Date</b>		12/31/2012	12/31/2012 12:00:00 AM
<b>Label</b>		A1001C2012	A1001C2012
Indicators	All	Alt. 0	Alt. 1
<b>Alternative</b>	A		B
<b>Date</b>		12/31/2012	12/31/2012
<b>Score Observations</b>		1.0	1.0
<b>Score Amount</b>		1,300.6540	3,322.8198
<b>Score Unit</b>		mean	mean
<b>Score Amount Change</b>		0.0000	0.0000
<b>Score Percent Change</b>		0.0000	0.0000
<b>Score Base Change</b>		0.0000	2,022.1658
<b>Score Base Percent Change</b>		0.0000	155.4730
<b>Score Low Amount</b>		1,298.5360	3,317.2110
<b>Score Low Unit</b>		lower 90% ci	lower 90% ci
<b>Score Low Amount Change</b>		0.0000	0.0000
<b>Score Low Percent Change</b>		0.0000	0.0000
<b>Score Low Base Change</b>		0.0000	2,018.6750
<b>Score Low Base Percent Change</b>		0.0000	155.4578
<b>Score High Amount</b>		1,302.7720	3,328.4286
<b>Score High Unit</b>		upper 90% ci	upper 90% ci
<b>Score High Amount Change</b>		0.0000	0.0000
<b>Score High Percent Change</b>		0.0000	0.0000
<b>Score High Base Change</b>		0.0000	2,025.6566
<b>Score High Base Percent Change</b>		0.0000	155.4882
<b>Indicator Observations</b>		1.0	1.0



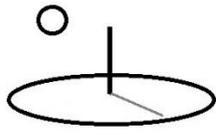
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#### **d. Progress 1 Analyses**

A *Progress 1 Analysis* uses the Totals calculations to measure actual versus planned progress for up to 10 aggregated resource stock indicator properties. Base elements that have a Target Type property set to “benchmark” act as a comparator for base elements using a Target Type property set to “actual”. Only base elements with the same label are analyzed.

Stock budgeting analysis often use a “benchmark scenario” as the most important comparator in an analysis (7\*). Particular attention must be paid to define the benchmark comparators in this type of analysis. Further details about how Progress Analyzers work can be found in *the Earned Value Management Analysis* tutorial.

The following three year Input Analysis shows that the benchmark comparator is a 2012 Input. Both the 2013 and 2014 actual Inputs are being compared to the 2012 comparator.

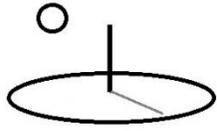


← → ↻ [DevTreks \[US\] https://www.devtreks.org/greentreks/search/watershed/input/none/0/n](https://www.devtreks.org/greentreks/search/watershed/input/none/0/n)

**Input Series: 2013 Fertilizer, Orange, Conventional**

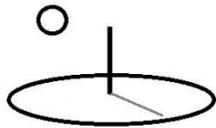
Observations ; Label	Plan Period	Plan Full	Plan Cumul	Actual Period	Actual Cumul	Actual Period Change	Actual Cumul Change	Plan P Percent ; Plan C Percent	Plan Full Percent
1.0; mean	15.9103	13.5238	13.5238	14.5093	14.5093	-1.4010	0.9855	91.1944 ; 107.2872	107.2872
Low : lower 90% ci	15.8833	13.5238	13.5238	14.4848	14.4848	-1.3985	0.9610	91.1952 ; 107.1060	107.1060
High : upper 90% ci	15.9373	13.5238	13.5238	14.5338	14.5338	-1.4035	1.0100	91.1936 ; 107.4683	107.4683
Name (Observations)	Plan Period	Plan Full	Plan Cumul	Actual Period	Actual Cumul	Actual Period Change	Actual Cumul Change	Plan P Percent ; Plan C Percent	Plan Full Percent
Date : 07/16/2013 ; Target : actual									
Nitrate Loss (1.0)	13.5238	13.5238	13.5238	13.5094	13.5094	-0.0144	-0.0144	99.8935 ; 99.8935	99.8935
Ammonia Loss (1.0)	6.4034	6.4034	6.4034	5.9034	5.9034	-0.5000	-0.5000	92.1916 ; 92.1916	92.1916
Nitrous Oxide Emissions (1.0)	1.6009	1.6009	1.6009	1.4709	1.4709	-0.1300	-0.1300	91.8796 ; 91.8796	91.8796
Global Warming (1.0)	74.4467	74.4467	74.4467	69.0467	69.0467	-5.4000	-5.4000	92.7465 ; 92.7465	92.7465
Acidification (1.0)	1.1006	1.1006	1.1006	0.9706	0.9706	-0.1300	-0.1300	88.1883 ; 88.1883	88.1883
Eutrophication (1.0)	2.1011	2.1011	2.1011	1.8611	1.8611	-0.2400	-0.2400	88.5774 ; 88.5774	88.5774
Eutrophication (1.0)	1.2006	1.2006	1.2006	0.2606	0.2606	-0.9400	-0.9400	21.7058 ; 21.7058	21.7058
Acidification (1.0)	0.6003	0.6003	0.6003	0.1403	0.1403	-0.4600	-0.4600	23.3716 ; 23.3716	23.3716
<b>Input Series: 2014 Fertilizer, Orange, Conventional</b>									
								Plan P	

The following three year Operation Analysis compares a 2012 Operation benchmark comparator to 2013 and 2014 actual Operations. Note that most progress analyses have the same number of



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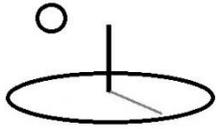
planned and actual base elements (which cause the planned analytic properties to be comparable to the actual analytic properties). Although these stocks are related to agriculture, what if the stocks were related to human capital -what may be the significance of having student resource stock indicator data for every school in the world, or health care status indicators for every hospital? Other than institutional factors, is there any technical reason why such data can't be collected?



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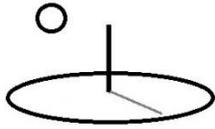
← → ↻ DevTreks [US] <https://www.devtreks.org/greentreks/search/watershed/input/none/0/n> ☆

Operation Group : LCA Conventional Orange Crop Operations ; A1001C				
Operation	All	Alt. 0	Alt. 1	Alt. 2
<b>Name</b>		2012 Conventional Orange Crop Operation	2013 Conventional Orange Crop Operation	2014 Conventional Orange Crop Operation
<b>Date</b>		12/31/2012	12/31/2013	12/31/2014
<b>Label</b>		A1001C2012	A1001C2013	A1001C2014
Indicators	All	Alt. 0	Alt. 1	Alt. 2
<b>Target</b>		benchmark	actual	actual
<b>Date</b>		12/31/2012	12/31/2013	12/31/2014
<b>Score Observations</b>		1.0	1.0	1.0
<b>Score Plan Period</b>		1,766.0433	1,668.5695	1,732.6881
<b>Score Unit</b>		mean	mean	mean
<b>Score Plan Full</b>		1,501.1418	0.0000	0.0000
<b>Score Plan Cumul</b>		1,501.1418	0.0000	0.0000
<b>Score Actual Period</b>		0.0000	1,668.5695	1,732.6881
<b>Score Actual Cumul</b>		0.0000	1,668.5695	3,401.2576
<b>Score Actual Period Change</b>		0.0000	0.0000	0.0000
<b>Score Actual Cumul Change</b>		0.0000	1,668.5695	3,401.2576
<b>Score Plan P Percent</b>		0.0000	100.0000	100.0000
<b>Score Plan C Percent</b>		0.0000	0.0000	0.0000
<b>Score Plan Full Percent</b>		0.0000	0.0000	0.0000
<b>Score Low Plan Period</b>		1,763.0463	1,665.7520	1,729.8216
<b>Score Low Unit</b>		lower 90% ci	lower 90% ci	lower 90% ci
<b>Score Low Plan Full</b>		1,501.1418	0.0000	0.0000
<b>Score Low Plan Cumul</b>		1,501.1418	0.0000	0.0000



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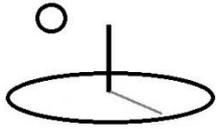
The following three year Capital Budget Analysis compares a 2012 benchmark comparator with 2013 and 2014 actual Budgets. All three Time Periods are being compared because they have the same Labels and the 2012 Time Period has a Target Type = “benchmark” while 2013 and 2014 have Target Types = “actual”. Note that most real Progress analyses include a second planned year (that’s why planned progress numbers don’t change).



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<b>Name</b>	Nitrous Oxide Emissions	Nitrous Oxide Emissions	Nitrous Oxide Emissions
<b>Label</b>	N2O	N2O	N2O
<b>Plan Period</b>	0.1761	0.1761	0.1761
<b>Unit</b>	kg N2O-N / ha	kg N2O-N / ha	kg N2O-N / ha
<b>Plan Full</b>	0.1761	0.1761	0.1761
<b>Plan Cumul</b>	0.1761	0.1761	0.1761
<b>Actual Period</b>	0.0000	0.1765	0.1689
<b>Actual Cumul</b>	0.0000	0.1765	0.3454
<b>Actual Period Change</b>	0.0000	0.0004	-0.0072
<b>Actual Cumul Change</b>	0.0000	0.0004	0.1693
<b>Plan P Percent</b>	0.0000	100.2271	95.9114
<b>Plan C Percent</b>	0.0000	100.2271	196.1386
<b>Plan Full Percent</b>	0.0000	100.2271	196.1386
<b>Observations</b>	1.0	1.0	1.0
<b>Name</b>	Global Warming	Global Warming	Global Warming
<b>Label</b>	CO2A	CO2A	CO2A
<b>Plan Period</b>	8.1891	8.1891	8.1891
<b>Unit</b>	kg CO2 equivs	kg CO2 equivs	kg CO2 equivs
<b>Plan Full</b>	8.1891	8.1891	8.1891
<b>Plan Cumul</b>	8.1891	8.1891	8.1891
<b>Actual Period</b>	0.0000	8.2856	8.7558
<b>Actual Cumul</b>	0.0000	8.2856	17.0414
<b>Actual Period Change</b>	0.0000	0.0965	0.5667
<b>Actual Cumul Change</b>	0.0000	0.0965	8.8523
<b>Plan P Percent</b>	0.0000	101.1784	106.9202
<b>Plan C Percent</b>	0.0000	101.1784	208.0986

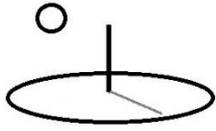
The online Operating Budget Analysis, found using the Operating Budget URI, compares progress using a benchmark Budget 1 with 3 Time Periods and an actual Budget 2 with 3 Time



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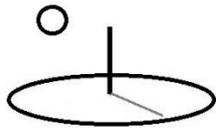
Periods. At the Budget Level of this analysis, the cumulative progress of actual Budget 2 are displayed.

Budget Group : LCA Organic vs Conventional Orange Crops ; 07/16/2014			
Budget	All	Alt. 0	Alt. 1
<b>Name</b>		Conventional Orange Budget, Brazil	Organic Orange Budget, Brazil
<b>Date</b>		11/06/2015	11/06/2015
<b>Label</b>		A100C	A100C
Indicators	All	Alt. 0	Alt. 1
<b>Target</b>		benchmark	actual
<b>Date</b>		11/06/2015	11/06/2015
<b>Score Observations</b>		2.0	2.0
<b>Score Plan Period</b>		6,187.2188	6,187.2188
<b>Score Unit</b>		mean	mean
<b>Score Plan Full</b>		6,187.2188	6,187.2188
<b>Score Plan Cumul</b>		6,187.2188	6,187.2188
<b>Score Actual Period</b>		0.0000	30,500.6802
<b>Score Actual Cumul</b>		0.0000	30,500.6802
<b>Score Actual Period Change</b>		0.0000	24,313.4614
<b>Score Actual Cumul Change</b>		0.0000	24,313.4614
<b>Score Plan P Percent</b>		0.0000	492.9627
<b>Score Plan C Percent</b>		0.0000	492.9627
<b>Score Plan Full Percent</b>		0.0000	492.9627
<b>Score Low Plan Period</b>		6,187.2188	6,187.2188
<b>Score Low Unit</b>		lower 90% ci	lower 90% ci
<b>Score Low Plan Full</b>		6,187.2188	6,187.2188
<b>Score Low Plan Cumul</b>		6,187.2188	6,187.2188
<b>Score Low Actual Period</b>		0.0000	30,451.2190
<b>Score Low Actual Cumul</b>		0.0000	30,451.2190
<b>Score Low Actual Period Change</b>		0.0000	24,264.0002



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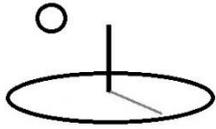
The Time Periods in the analysis line up because of the way both Target Type and Label properties were set. At the Time Period Level of this analysis, actual Budget 2's Time Periods are being compared to benchmark Budget 1's Time Periods (2012 Time Period Labels = A1002012, 2013 Time Period Labels = A1002013 ...).



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Plan Full Percent	0.0000	104.6271	
Time Period	All	Alt. 0	Alt. 1
<b>Name</b>	2012 Conventional Orange Crop	2012 Organic Orange Crop	
<b>Date</b>	12/31/2012	12/31/2012 12:00:00 AM	
<b>Label</b>	A1001C2012	A1001C2012	
Indicators	All	Alt. 0	Alt. 1
<b>Target</b>	benchmark	actual	
<b>Date</b>	12/31/2012	12/31/2012	
<b>Score Observations</b>	2.0	2.0	
<b>Score Plan Period</b>	3,902.6518	3,902.6518	
<b>Score Unit</b>	mean	mean	
<b>Score Plan Full</b>	6,187.2188	6,187.2188	
<b>Score Plan Cumul</b>	1,501.1418	1,501.1418	
<b>Score Actual Period</b>	0.0000	4,888.8633	
<b>Score Actual Cumul</b>	0.0000	4,888.8633	
<b>Score Actual Period Change</b>	0.0000	986.2115	
<b>Score Actual Cumul Change</b>	0.0000	3,387.7215	
<b>Score Plan P Percent</b>	0.0000	125.2703	
<b>Score Plan C Percent</b>	0.0000	325.6763	
<b>Score Plan Full Percent</b>	0.0000	79.0155	
<b>Score Low Plan Period</b>	3,902.6518	3,902.6518	
<b>Score Low Unit</b>	lower 90% ci	lower 90% ci	
<b>Score Low Plan Full</b>	6,187.2188	6,187.2188	
<b>Score Low Plan Cumul</b>	1,501.1418	1,501.1418	
<b>Score Low Actual Period</b>	0.0000	4,880.6880	
<b>Score Low Actual Cumul</b>	0.0000	4,880.6880	
<b>Score Low Actual Period Change</b>	0.0000	978.0362	

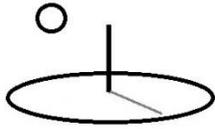
The Outcomes and Operations in the analysis line up because of the way both Target Type and Label properties were set. At the Outcome and Operations Level of this analysis, actual Budget 2's Outcomes are being compared to benchmark Budget 1's Outcomes (Budget 1, 2012 Time



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Period OC 1 Label = A1001012, Budget 2, 2012 Time Period OC 1 Label = A1001012 ...). In fact, on localhost the 2013 and 2014 Outcomes and Operations don't line up because their Target Type properties were set up to test the Operation and Outcome Analyzers.

The order of the two Investments matter. The benchmark's Ids have to come before the actual. They should also appear in the search engine before the actual.



**Outcome Name, Date, Label**

Alt0: 2012 Conventional Orange Crop Outcome  
Alt0: 12/31/2012  
Alt0: A1001C2012

Alt1: 2012 Organic Orange Crop Outcome  
Alt1: 12/31/2012 12:00:00 AM  
Alt1: A1001C2012

**+ Indicators**

**Operations**

**Operation Name, Date, Label**

Alt0: 2012 Conventional Orange Crop Operation  
Alt0: 12/31/2012  
Alt0: A1001C2012

Alt1: 2012 Organic Orange Crop Operation  
Alt1: 12/31/2012 12:00:00 AM  
Alt1: A1001C2012

**+ Indicators**

**Time Period Name, Date, Label**

Alt0: 2013 Conventional Orange Crop  
Alt0: 12/31/2013  
Alt0: A1001C2013

Alt1: 2013 Organic Orange Crop  
Alt1: 12/31/2013 12:00:00 AM  
Alt1: A1001C2013

**+ Indicators**

**Outcomes**

**Outcome Name, Date, Label**

Alt0: 2013 Conventional Orange Crop Outcome  
Alt0: 12/31/2013  
Alt0: A1001C2013

Alt1: 2013 Organic Orange Crop Outcome  
Alt1: 12/31/2013 12:00:00 AM  
Alt1: A1001C2013

**+ Indicators**

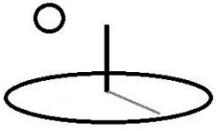
**Operations**

**Operation Name, Date, Label**

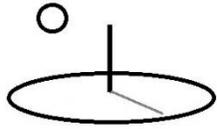
Alt0: 2013 Conventional Orange Crop Operation  
Alt0: 12/31/2013  
Alt0: A1001C2013

Alt1: 2013 Organic Orange Crop Operation  
Alt1: 12/31/2013 12:00:00 AM  
Alt1: A1001C2013

**+ Indicators**



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## **Appendix C. DevPacks Stock Analysis (11\*)**

DevPacks support the analysis of arbitrary hierarchies of data, such as randomized control trial data. They also support a variety of custom analyses, such as the comparisons of base elements that are not siblings. When the data being analyzed is observational resource stock data stored in Data URL TEXT files, the resultant metadata analysis can provide scalable and powerful decision support. This appendix contains examples demonstrating different ways to use DevPacks to conduct Resource Stock Analysis. The *DevPacks* tutorial should be read prior to this appendix.

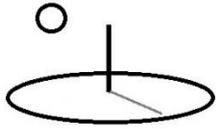
### **Example 1. Change by Alternative (non-sibling Operating Budget base element analysis)**

#### **URL**

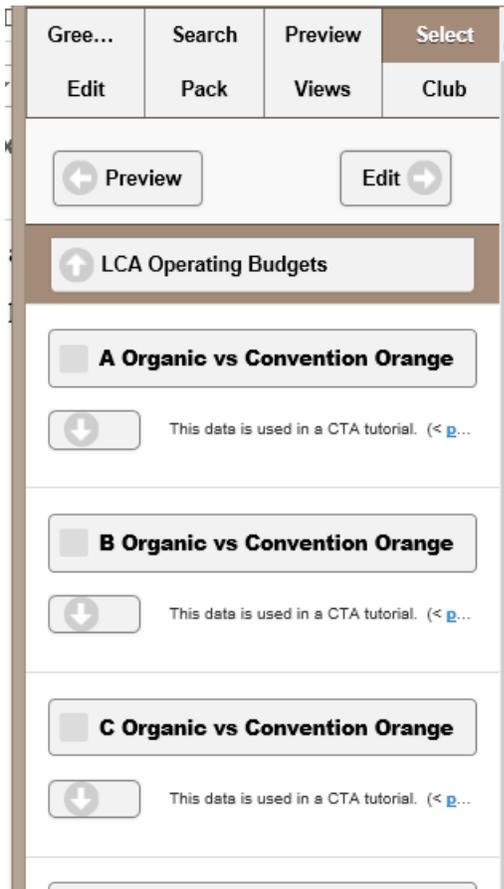
<https://www.devtreks.org/greentreks/preview/carbon/devpackgroup/RCT Emissions and Env Performance/48/none>

3 Sibling Orange Conventional

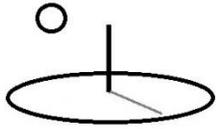
The following image shows that an Operating Budget data service has several different children Budget Groups. The Groups named A, B, and C, have been organized by some expert logic, such as geographic region, technology type, biophysical factors, or the need to comply with a professional WBS.



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In this analysis, they have been organized to demonstrate how to compare non-sibling budgets. The budgets in Budget Group A are not siblings of Budget Group B or Budget Group C. How can budgets from the latter groups be compared to budgets in A? The following image shows that 3 sibling DevPack Part base elements have been built to hold the budgets needing comparison.



3 Sibling Orange Conventional

DevPackParts

2012 Conv Orange

This data is used in a CTA tutorial. (< [preview IRI](#))

2013 Conv Orange

This data is used in a CTA tutorial. (< [preview IRI](#))

2014 Conv Orange

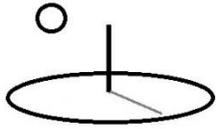
This data is used in a CTA tutorial. (< [preview IRI](#))

The following steps are taken to compare the stock characteristics of the 3 non-sibling budgets. These steps should first be followed for a small sample of the total data being analyzed because several iterations will be needed before the steps are carried out correctly. Although this example uses Operating Budgets, the same steps will work for all base element analyses, including Inputs, Outputs, Operations, Components, Outcomes, and Capital Budgets (but full tests are still needed).

1. **Set Correct Properties for an Analysis:** The properties of each budget being compared was checked for accuracy. A Change by Alternative Analysis is needed, meaning their AlternativeType properties had to be set to A, B, and C, particularly at the Budget, Time Period, Operation, and Outcome elements. In addition, the Label property of each comparable base element in the budgets had to match because that property is used to determine which base elements to compare. The Budget, Time Period, Outcome, and Operation, Labels had to be the same for each respective base element in each budget. If these properties have already been set to carry out existing analyses, they should not be changed –instead Step 4 should be used to edit the budgets.



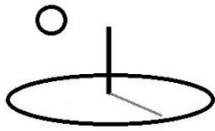
2. **Run New NPV Calculations:** After all corrections were made, new NPV calculations were run for each budget and saved. The NPV calculations had been inserted in the children Time Periods and their AlternativeType properties were double-checked to ensure they had the correct A, B, and C properties. The resultant analyses will be stored in an xml file. That file is the file that will be copied to a DevPack Part. This particular analysis is primarily interested in the Stock analysis, not the NPV totals, so they do not represent a real orange crop budget.
3. **Download Packages:** The 3 budgets needing comparisons were packaged separately and downloaded separately. The DevPacks tutorial explains how to find the calculated NPV file. Often, the NPV xml file will be the file with the greatest size.
4. **Make Final Edits:** The downloaded budgets were double checked to make sure they could be compared. In this case, the AlternativeType properties of each budget were checked to make sure that the 3 budgets had respective A, B, and C values for each AlternativeType property. One change had to be made in budget 2 and budget 3. The Labels had been set correctly. This is also the correct time to change any property needed for any purpose, such as random control trial adjustments (of prices, output amounts, input amounts). Oftentimes, randomized control trial budgets contain 95% or more of the same properties –existing budgets can be copied and edited for each observation in the trial.
5. **Upload Files to DevPack Parts:** Each budget was uploaded to a corresponding DevPack Part.
6. **Run DevPack Part NPV Calculators (optional):** NPV calculators were linked to each DevPack Part and each calculator was run and saved. The resultant files become the base documents that will be further analyzed. They contain all of the linked views for all of the base elements within budgets, including their associated multipliers. In this analysis, the most important linked views are the Input and Output stock calculations. Version 1.8.8 made this an optional step –if good NPV documents have already been uploaded to the DevPackPart, the analyzer will use those to run the analysis.
7. **Run DevPack Resource Stock Analyzers:** The parent DevPack is used to compare the 3 budgets. Resource Stock Totals and Change by Alternative Analyzers were linked to the



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parent DevPack (NPV calculators are only used with the DevPack Parts). The analyses were run and saved. The Resource Stock Analyzers should coincide with the base elements being compared (if Inputs are being compared, choose Input Stock Analyzers rather than Operating Budget Stock Analyzers).

The following images show the resultant Change by Alternative Stock Analysis. This analysis was carried out by combining the 3 budgets into 1 file and then analyzing the aggregated file. This technique will not scale to handle thousands of files (yet). An existing, scalable technique, is to use budgets that contain meta-data analysis of Data URL TEXT datasets. Future releases will address scalability further.



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RCT Emissions and Env Performance | DevTreks [US] | <https://www.devtreks.org/greentreks/preview/carbon/devpackgroup/RCT>

GreenTreks Edit	Search Pack	Preview Views	Select Club
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Select

Edit Linked Views

Media Mobile  Desktop

Dataset: [3 Sibling Orange Conventional IR!](#) This data is used in a CTA tutorial.

3 Sibling Orange Conventi

Change by Alternative----

Intro	1	2	3	Help
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**Resource Stock Operating or Capital Budget Analyzer Views**

**Change by Alternative**

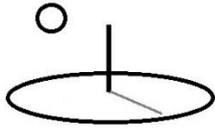
**Introduction**  
This tool generates a variety of basic resource stock stock statistics for DevTreks capital budgets and operating budgets.

**Calculation View Description**  
v192a

Version: 1.9.0

[Feedback About carbon/devpackgroup/RCT Emissions and Env Performance/48/none](#)

Budget Group : C Organic vs Convention Orange ; 06/11/2015				
Budget	All	Alt. 0	Alt. 1	Alt. 2
<b>Name</b>		A Conventional Orange	B Conventional Orange	C Conventional Orange
<b>Date</b>		06/11/2015	06/11/2015	06/11/2015
<b>Label</b>		A1	A1	A1
Indicators	All	Alt. 0	Alt. 1	Alt. 2
<b>Alternative</b>		A	B	C
<b>Date</b>		06/11/2015	06/11/2015	06/11/2015



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Media Mobile  Desktop

Dataset: [3 Sibling Orange Conventional IR!](#) This data is used in a CTA tutorial.

3 Sibling Orange Conventi  **Get**

Change by Alternative----  **Get**

Intro	1	2	3	Help
<p><b>Your analysis has been saved. The analysis can be viewed whenever this analyzer addin is opened.</b></p>				
<p>Budget Group : C Organic vs Convention Orange ; 06/10/2015</p>				
Budget	All	Alt. 0	Alt. 1	Alt. 2
<b>Name</b>		A Conventional Orange	B Conventional Orange	C Conventional
<b>Date</b>		06/11/2015	06/11/2015	06/11/2015
<b>Label</b>		A1	A1	A1
Indicators	All	Alt. 0	Alt. 1	Alt. 2
<b>Alternative</b>		A	B	C
<b>Date</b>		06/11/2015	06/11/2015	06/11/2015
<b>Score Observations</b>		2.0	2.0	2.0
<b>Score Amount</b>		267.4032	9.2697	18.3722
<b>Score Unit</b>		mean	mean	mean
<b>Score Amount Change</b>		0.0000	0.0000	9.1025
<b>Score Percent Change</b>		0.0000	0.0000	98.1963
<b>Score Base Change</b>		0.0000	-258.1335	-249.0310



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<b>Name</b>		Phosphorous	Phosphorous	Phosphorous
<b>Label</b>		P	P	P
<b>Total</b>		3.9980	4.2769	4.6825
<b>Unit</b>		mean	mean	mean
<b>Amount Change</b>		0.0000	0.0000	0.4056
<b>Percent Change</b>		0.0000	0.0000	9.4835
<b>Base Change</b>		0.0000	0.2789	0.6845
<b>Base Percent Change</b>		0.0000	6.9760	17.1211
<b>Outcome</b>	<b>All</b>	<b>Alt. 0</b>	<b>Alt. 1</b>	<b>Alt. 2</b>
<b>Name</b>		2012 Conventional Orange Crop Outcome	2013 Conventional Orange Crop Outcome	2014 Conventional Orange Crop Outcome
<b>Date</b>		12/31/2012	12/31/2013 12:00:00 AM	12/31/2014 12:00:00 AM
<b>Label</b>		A111	A111	A111
<b>Indicators</b>	<b>All</b>	<b>Alt. 0</b>	<b>Alt. 1</b>	<b>Alt. 2</b>
<b>Alternative</b>		A	B	C
<b>Date</b>		12/31/2012	12/31/2013	12/31/2014
<b>Score Observations</b>		1.0	1.0	1.0
<b>Score Amount</b>		11.9920	11.4019	14.9950
<b>Score Unit</b>		mean	mean	mean
<b>Score Amount Change</b>		0.0000	0.0000	3.5931
<b>Score Percent Change</b>		0.0000	0.0000	0.0000
<b>Score Base Change</b>		0.0000	-0.5901	3.0030
<b>Score Base Percent Change</b>		0.0000	-4.9208	25.0417
<b>Score Low Amount</b>		11.9840	11.3943	14.9850
<b>Score Low Unit</b>		lower 90% ci	lower 90% ci	lower 90% ci
<b>Score Low Amount Change</b>		0.0000	0.0000	3.5907



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**Example 2. Change by Id with Algorithm (Input or Output base element randomized data)  
(12\*)**

**URL**

<https://www.devtreks.org/greentreks/preview/carbon/devpackgroup/RCT Emissions and Env Performance/48/none>

**3 Sibling Input Stocks**

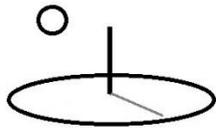
This was not a priority for version 1.9.2+ and has not been debugged.

The previous example demonstrated that optional NPV calculations were run for Operating Budgets (or Operations, Components, Outcomes, and Capital Budgets) after uploading them to DevPackParts. Inputs and Outputs don't use NPV calculators. This example demonstrates that the base element documents uploaded into a DevPackPart, can be used directly, without requiring any additional DevPackPart calculation. In this example, those base documents are the files generated from running Input Stock Calculators.

If needed, the files can be edited in the usual manner (by hand) prior to being uploaded. If needed, they can also be recalculated in the DevPackPart (the files that are analyzed always look for files with the newest calculations). Version 2.0.4 stopped running stock calculations during analyses, so care must be taken to ensure the latter calculation is current.

The base elements that will be analyzed are the same 3 Input Series used with Example 1ma in the CTA reference. Each series member had an Input Stock calculator run and saved. The calculations derive from random experimental data stored using Data URL TEXT files. This example will analyze the aggregated calculations using Example 1m's Analysis of Variance (ANOVA) algorithm (algorithm1, subalgorithm8).

The following image shows that an Input Resource Stock Change by Id Analysis has been run for the DevPack containing the 3 DevPackParts. This DevPack analysis is identical to the results demonstrated for Example 1ma, Method 3, in the CTA reference.



3 Non-Sibling Input Stock ▼

Get

Input Stock Change by Id ▼

Get

Intro	1	2	3	Help
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Step 2 of 3. Analyze

Run

Cancel

Close

+ Relations

**What If Tag**

none

Base Resource (Input) Calculations To Analyze Type:

Resource Stock Calculator 1 ▼

**Compare Using:**    None    Compare Only

Math Type Math Sub Type

algorithm1 ▼

subalgorithm8

Confidence Interval

95

Math Expression

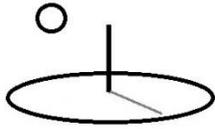
I1.Q1.treatment

**Math Result**

```

anova results
source    df      SS      MS      F
treats    2      198772.4667  99386.2333  3.4819
error     27      770670.9000  28543.3667
total     29      969443.3667

F Crit treats  3.35413    F > F Critical  true
estimate      mean diff  lower 95%    upper 95%
Treat 1 Mean  229.6000    119.9789     339.2211
xminus1 1     80.3000    -74.7276     235.3276
base 1       80.3000    -74.7276     235.3276
          
```



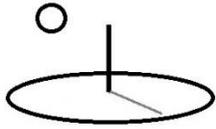
The following image confirms that the comparative analysis of this Resource Stock data is also the same as Example 1m of the CTA reference. This analysis was carried out by combining the 3 input documents into 1 file and then analyzing the aggregated file. This technique will not scale to handle thousands of files or input/output series (yet). An existing, scalable technique, is to use Inputs and Outputs that contain meta-data analysis of Data URL TEXT datasets. Future releases will address scalability further.

As a side point, this analysis ran incorrectly until all aggregated base elements used in Stock Analyzers were reordered first by Id and then Date (a point to remember when analyzing non-sibling base elements).

<b>Score High Base Percent Change</b>	0.0000	34.7800	86.9599
<b>Indicator Observations</b>	1.0	1.0	1.0
<b>Name</b>	Anova randomized data	Anova randomized data	Anova randomized data
<b>Label</b>	D1	D1	D1
<b>Total</b>	229.6000	309.9000	427.8000
<b>Unit</b>	mean debt	mean debt	mean debt
<b>Amount Change</b>	3.4819	0.0000	117.9000
<b>Percent Change</b>	3.3541	0.0000	155.0276
<b>Base Change</b>	229.6000	80.3000	198.2000
<b>Base Percent Change</b>	109.6211	155.0276	155.0276
<a href="#">Feedback About carbon/devpackgroup/Carbon Budgeting DevPack Group/43/none</a>			

**Search IRIs:**

<https://localhost:44300/greentreks/linkedviews/carbon/devpackgroup/Carbon Budgeting DevPack Group/43/none>



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### **Example 3. Change by Id with Algorithm (Operation base element randomized data)**

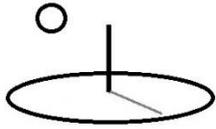
#### **URL**

<https://www.devtreks.org/greentreks/preview/carbon/devpackgroup/RCT Emissions and Env Performance/48/none>

Operation Stock Algo

This was not a priority for version 1.9.2+ and has not been debugged.

This example adds the same Inputs used in Example 2 to three Operation base elements, runs NPV calculations for each of the Operations, copies the resultant calculated document to a DevPackPart, and runs the same ANOVA algorithm. The following image displays the Change by Id analyzer settings used in the analysis.



Op Change by Id-----

Intro	1	2	3	Help
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**Step 2 of 3. Analyze**

**Success. Please review the calculations below.**

**+ Relations**

**What If Tag**

Base Resource (Input) Calculations To Analyze Type:

**Compare Using:**

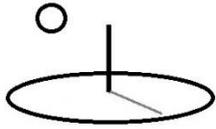
Math Type:  Math Sub Type:

Confidence Interval:

Math Expression:

**Math Result**

```
anova results
source  df      SS      MS      F
treats  2      198772.4667  99386.2333  3.4819
error   27      770670.9000  28543.3667
total   29      969443.3667
F Crit treats  3.35413  F > F Critical  true
estimate  mean diff  lower 95%  upper 95%
Treat 1 Mean  229.6000  119.9789  339.2211
xminus1 1    80.3000  -74.7276  235.3276
base 1     80.3000  -74.7276  235.3276
```



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The following image demonstrates that this analysis generates the same confidence intervals as shown in Example 2. Although not tested yet, this technique should work for all base elements, including Outcomes, Components, Operating Budgets, and Capital Budgets.

<b>Score High Base Percent Change</b>	0.0000	34.7800	86.9599
<b>Indicator Observations</b>	1.0	1.0	1.0
<b>Name</b>	Anova randomized data	Anova randomized data	Anova randomized data
<b>Label</b>	D1	D1	D1
<b>Total</b>	229.6000	309.9000	427.8000
<b>Unit</b>	mean debt	mean debt	mean debt
<b>Amount Change</b>	3.4819	0.0000	117.9000
<b>Percent Change</b>	3.3541	0.0000	155.0276
<b>Base Change</b>	229.6000	80.3000	198.2000
<b>Base Percent Change</b>	109.6211	155.0276	155.0276
<a href="#">Feedback About carbon/devpackgroup/Carbon Budgeting DevPack Group/43/none</a>			

**Search IRIs:**

<https://localhost:44300/greentreks/linkedviews/carbon/devpackgroup/Carbon Budgeting DevPack Group/43/none>