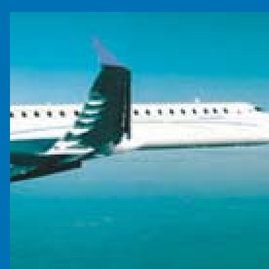
Final Report

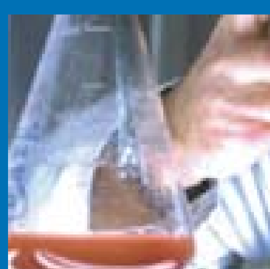
Valuation of Technology Partnerships Canada Benefits

Prepared for:

Audit and Evaluation Branch
Industry Canada

September 16, 2005





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HICKLING ARTHURS LOW
Technology Management, Strategy, and Economics

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Executive Summary

Technology Partnerships Canada (TPC) is a special operating agency of Industry Canada with a mandate to provide funding support for strategic research and development, and demonstration projects that will produce economic, social and environmental benefits for Canadians. TPC's focus is on key technology areas such as environmental technologies, aerospace and defence technologies, and enabling technologies, which include biotechnology, advanced materials, advanced manufacturing, and information and communications technologies.

TPC offers two main delivery mechanisms: TPC R&D, delivered directly by TPC, that is targeted at larger firms, and TPC IRAP, delivered by the National Research Council Industrial Research Assistance Program, that supports small to medium-sized enterprises (SMEs) with projects valued under $3 million. Some 693 projects are reviewed in this study, including 420 projects with SMEs managed by TPC-IRAP.

The objective of this study is the valuation of the economic and non-economic benefits generated by TPC projects. The study uses a socio-economic model to value TPC benefits. Central to the TPC Valuation Model is the TPC Funded Companies that undertake technology development, product development, and eventually production and marketing activities. The TPC Funded Companies receive funding through TPC, and may be influenced and assisted by other government activities, such as the procurement of goods and services, the work of government laboratories, and the efforts of other government programs. The TPC Funded Companies, in turn, influence the rest of Canadian industry through the intentional and unintentional diffusion of skills and knowledge to other companies. The TPC Funded Companies also have economic and non-economic impacts through the Canadian users of their goods and services. In the end, the activities of the TPC Funded Companies, Canadian government, Canadian industry, and Canadian users result in impacts on the Canadian economy in the form of infrastructure improvements, wealth creation, and benefits in the public good.

A number of factors can be taken into account when evaluating the magnitude of the economic impacts:

- **Sales** is the value of sales that will accrue to Canadian companies directly from the TPC funding, through spinoffs within the TPC Funded Companies, and through diffusion to other Canadian companies.

- **Attributed Sales** is the value of sales adjusted for incrementality and attribution, i.e. the fact that some portion of the impact may have been achieved without TPC assistance and that TPC is not the only input to the achievement of sales and therefore should not be credited with the full value of the impacts.

- **Discounted Attributed Sales** adjusts the attributed sales to account for the time-value of money – the preference for impacts that occur sooner rather than later. For example, spinoffs and diffusion impacts can occur many years after the base year. Discounting reduces these impacts by a discount factor.

- **Discounted Impact** adjusts the discounted attributed sales to account for leakage from the economy and displacement of domestic sales. Leakage occurs because some of the value of products sold requires imports of component materials, which is a loss to the Canadian economy. Domestic sales that simply displace sales that would have accrued to other (non-TPC) Canadian companies do not provide a net gain for the economy, and are not counted. The sales that are counted as having impacts, therefore, are exports and incremental domestic sales.

The total economic impact of Technology Partnerships Canada is summarized in Table A. The discounted values are for a base year of 2005 and a discount rate of 10%.

Table A: Total Economic Impact Results*

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$2,797,845,062		$3,741,166,880	$1,909,781,416
Company Expenditures	$8,644,407,620		$11,508,389,309	$5,852,158,379
Total Expenditures	$11,442,252,682		$15,249,556,189	$7,761,939,794
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$281,351,575,336	$84,405,472,601	$40,376,262,087	$14,300,588,608
Spinoff Sales	$72,550,148,095	$21,599,348,749	$11,811,043,559	$4,138,198,907
Diffusion Sales	$152,078,979,821	$4,223,230,959	$942,876,970	$352,850,660
Domestic User Value				$5,697,375,629
TOTAL	$517,422,955,934	$110,228,052,309	$68,379,738,804	**$32,250,953,598**

* As of June 2005.

When comparing the economic impact of this program with others, it is important to be careful to compare like measures. **Total Sales is often the measure quoted for other programs in studies of this type, however discounted impact is a more conservative and reasonable measure, and is the focus of this analysis.**

In summary, the combined TPC R&D and TPC IRAP program expenditures of $2.8 billion plus Company Expenditures of $8.6 billion are forecasted to result in $11.4 billion of total expenditures. This is expected to result in $281.2 billion of resulting direct sales. Further, this will develop Canadian experience and capabilities that will be worth $72.6 billion in future sales for TPC Funded Companies (spinoffs), and $152.1 billion in future sales for other Canadian companies (diffusion). Note that the majority of this value is from estimates of direct sales, which are the benefits that are the most certain and which do not depend on the TPC valuation model.

When attribution, discounting, leakage, and displacement are considered, the impacts are as follows. The discounted (to 2005) program cost of $3.7 billion is forecasted to result in $15.2 billion in Canadian company expenditures. These expenditures will have a net impact of $7.8 billion in the Canadian economy and produce direct, spinoff, and diffusion sales representing another $18.8 billion in net impact. Finally it is estimated that these TPC derived products will have an economic benefit worth $5.7 billion to Canadian users. Overall, the net impact on the Canadian economy is estimated to be $32.3 billion, which is 8.6 times the program expenditures.

All forecasts of the future are inherently uncertain. This uncertainty has been addressed by assigning probability distributions to some of the input parameters and generating output distributions using Monte Carlo analysis techniques.

Figure A shows the distribution for Total Sales. The mean[1] is $518 billion with a 90% probability range between $448 billion and $597 billion.

Figure A: Total Sales Probability Distribution

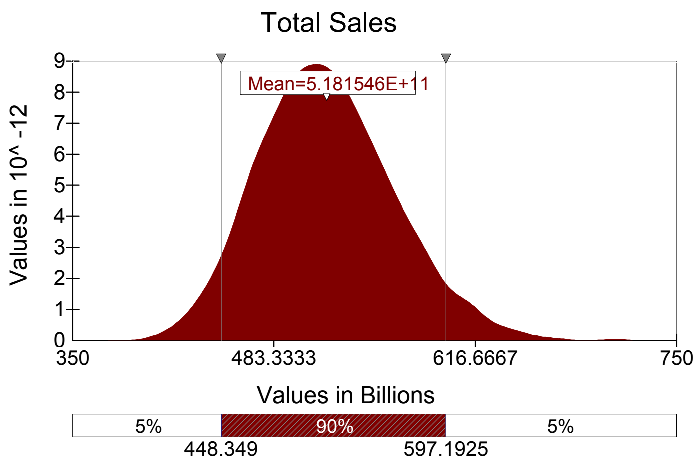


Figure B shows the distribution for the Total Discounted Impact. The mean is $32 billion with a 90% probability range between $30 billion and $35 billion.

1 The Monte Carlo simulation results and the results in Table 4-1 do not agree exactly due to the finite number of simulations (10,000) that were performed. The Monte Carlo results will converge to the results in Table 4-1 as the number of simulations approaches infinity.

Figure B: Total Discounted Impact Probability Distribution

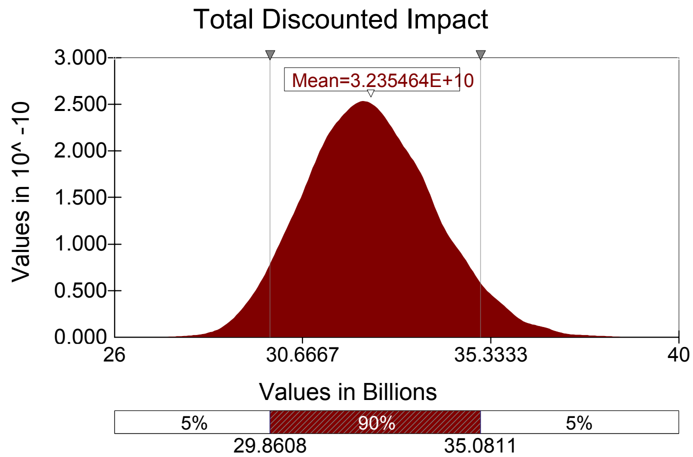
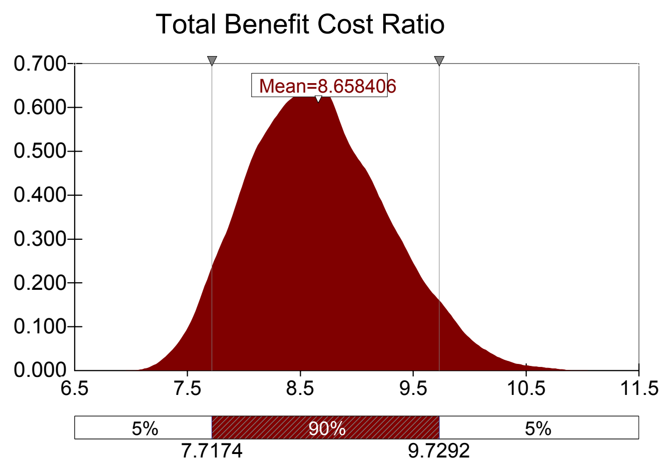


Figure C shows the distribution for the ratio of discounted impact to discounted program expenditures. The mean is 8.7 with a 90% confidence interval between 7.7 and 9.7.

Figure C: Ratio of Discounted Impact to Discounted Program Expenditures Probability Distribution



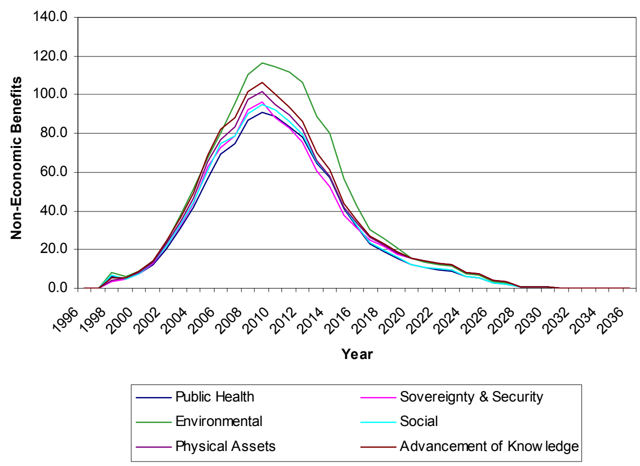
The use of TPC technology brings impacts that include economic benefits, but also extends to other benefits that cannot be expressed in economic terms, such as public health, sovereignty and security, environment, social, physical assets and advancement of knowledge. Some of these impacts accrue to the users of the technology; many also accrue to society in general.

Domestic impacts all accrue to Canada. Foreign impacts accrue to Canada only to the extent that Canadians benefit from impacts in other countries. For example, Canadians may benefit from the advancement of knowledge and contributions to the environment in other countries, but they probably do not benefit from contributions to economics, sovereignty and security, and public policy in other countries. We have only considered domestic non-economic impacts in this analysis.

The magnitude of the impacts depends on the degree of benefit in a particular instance, and the amount of use overall. Figure D shows the distribution of non-economic benefits over time. Interpretation of these numbers must be done with care:

- The numbers have no absolute meaning[2], however comparisons over time do provide an indication of relative impact.
- Comparisons across impact types are not valid; this is because the impact types are inherently different and cannot be compared directly.

Figure D: Time Profile of Non-Economic Benefits



2 Numbers are the product of the value of sales (as a proxy for amount of use) and relative qualitative impact.

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1. Introduction

1.1 Background

Technology Partnerships Canada (TPC) is a special operating agency of Industry Canada with a mandate to provide funding support for strategic research and development, and demonstration projects that will produce economic, social and environmental benefits for Canadians. The program aims to invest in high-risk ventures that are not viable from a strict financial point of view, but are to the benefit of Canada. TPC's focus is on key technology areas such as environmental technologies, aerospace and defence technologies, and enabling technologies, which include biotechnology, advanced materials, advanced manufacturing, and information and communications technologies. In addition to repayments, the program seeks to achieve other benefits including increased technological capability, creation and maintenance of high quality jobs, and an improved environment.

TPC offers two main delivery mechanisms: TPC R&D, delivered directly by TPC, that is targeted at larger firms, and TPC IRAP, delivered by the National Research Council Industrial Research Assistance Program, that supports small to medium-sized enterprises (SMEs) with projects valued under $3 million. Some 693 projects are reviewed in this study, including 420 projects with SMEs managed by TPC-IRAP.

1.2 Study Objective

The objective of this study is the valuation of the economic and non-economic benefits generated by TPC projects.

The value of TPC projects comes from both the production of the technologies and their subsequent use. Potential benefits are of three types: economic, quality of life, and infrastructure. The production of technologies can result in economic benefits (such as revenue and jobs). The use of technologies can result in economic benefits (such as cost savings and quality improvements) and quality of life benefits (such as health improvements, sovereignty and security contributions, environmental benefits, social improvements, and advancement of knowledge). Infrastructure consists of things such as physical assets, improved skills, and new techniques that will result in economic or quality of life benefits in the future.

Benefits flow directly from the technologies that are developed, through spinoffs into other products and services within the contracted firm, through diffusion to other firms within the Canadian economy, and finally through the utilization of the products and services that embody the technologies by users within the economy.

With the exception of limited infrastructure benefits, there are benefits from projects to the extent that the technologies developed are eventually bought and used. Therefore, sales by the contracted firm are an important indicator of all the downstream benefits.

1.3 Report Structure

The model used for valuing the benefits from TPC is introduced in Chapter 2 and described in more detail in Appendix A.

The implementation of the model and the parameters values used in the analysis are described in Chapter 3.

The results from the model are summarized in Chapter 4, with the details provided in Appendix B.

2. TPC Valuation Model

This chapter introduces a socio-economic model to value TPC benefits. A technical description of the model is contained in Appendix A. Similar models have been used to assess the impact of a number of programs and the model has been calibrated and validated as a result. The model incorporates the following considerations:

- Stages of development of the R&D process from basic research through market development to commercialization;
- Assessments of increased R&D activity induced by the supported activity (the budget enhancement effect);
- Assessments of incrementality whereby the impacts are reduced by what would have happened in absence of the program;
- Assessments of attribution whereby contributions to the success of R&D are explicitly recognized so that the sponsoring program is not attributed all the benefits;
- Spin-off activity (broad implementation of R&D results) in organizations that engage in supported R&D activity;
- Diffusion of technology, innovations and information that extends the impacts of the results of R&D beyond the program participating organizations;
- Time response of implementation or commercial sales from different stages of R&D and engineering activity; and
- Assessment of both economic and non-economic impacts.

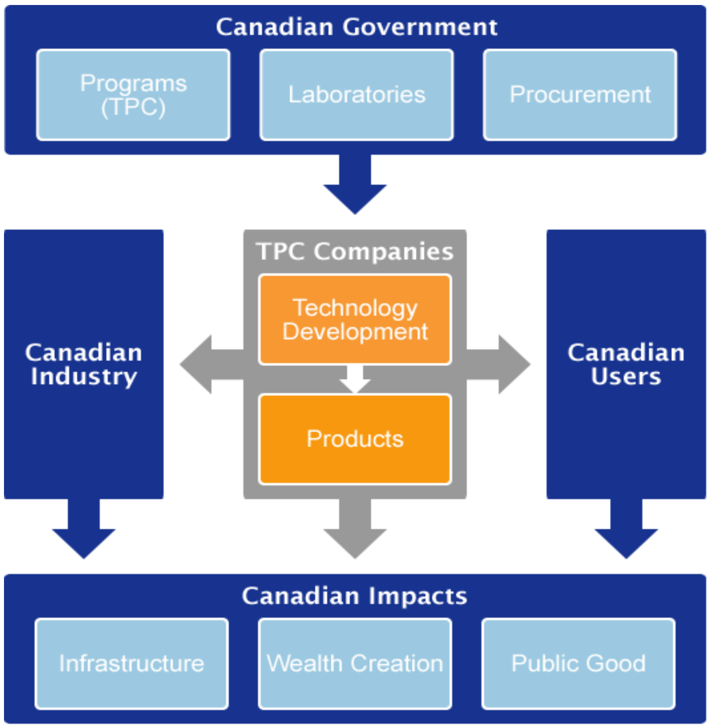
2.1 Structure

The TPC Valuation Model can be thought of in terms of a framework with five main parts (Figure 1). Central to the framework are the TPC Funded Companies that undertake technology development, product development, production and marketing activities. The TPC Funded Companies receive funding through TPC, and may be influenced and assisted by other government activities, such as the procurement of goods and services, the work of government laboratories, and the efforts of other government programs. The TPC Funded Companies, in turn, influence the rest of Canadian industry through the intentional and unintentional diffusion of skills and knowledge to other companies. The TPC Funded Companies also have economic and non-economic impacts through the Canadian users of their goods and services. In the end, the activities of the TPC Funded Companies, Canadian government, Canadian industry, and

Canadian users result in impacts on the Canadian economy in the form of infrastructure improvements, wealth creation, and benefits in the public good.

The following sections examine these five parts of the TPC Valuation Model

Figure 1: The TPC Valuation Model Structure



2.1.1 Canadian Government

Government can assist in technology development and commercialization through a number of mechanisms; for example procurement, laboratories, and programs (such as TPC). In the early stages of the technology development cycle, government assistance often plays a major role. The rationale for this assistance is twofold:

- The private sector typically under-invests in research and development because the benefits that accrue to this kind of activity cannot be adequately captured by the firm (improved understanding cannot be readily marketed or patented). Also, the level of risk and uncertainty about activity costs and likely outcomes is such that one firm often cannot afford to undertake the activity.

- Barriers to the successful market development of a major new product or system may exist when reliability, performance, and cost are not well enough known or not yet demonstrated. Government assistance or involvement in demonstration projects can effectively address these barriers to the benefit of all firms in the industry and the market segments involved.

The justification for government assistance is that the increased (or accelerated) economic and social benefits that accrue because of the government intervention exceed the economic and social costs.

In the later stages of the development cycle, government assistance often involves more general enterprise development. The reason for government intervention here is generally industrial development, regional development, employment generation, etc. that are consistent with government and social priorities and objectives.

2.1.2 TPC Funded Companies

TPC spending on technology development provides some immediate impact, however economic returns from technology come primarily from the commercialization and application of the technology rather than from its development. When assessing the potential payoff from technology development, it is these downstream impacts that must be identified and estimated.

These downstream impacts are of two types. First, the sale of new goods and services resulting directly from the TPC funded projects, and second, the longer-term spinoffs that result from the increased expertise and experience TPC Funded Companies acquire in undertaking the TPC work. Possession of a skilled and experienced labour force, production facilities, technological and project management expertise, and so on, will make a significant contribution to the future competitiveness of the TPC Funded Company.

Factors that characterize the relationship between contracted activity, direct sales, and spinoffs include:

- The capability of firms that undertake the contracted activity to pursue commercialization; and

- A long list of product and market development factors (time lags due to certification, registration, patenting, etc., competition from foreign sources, market conditions, business conditions, etc.) that impact whether the resulting product becomes a profitable venture.

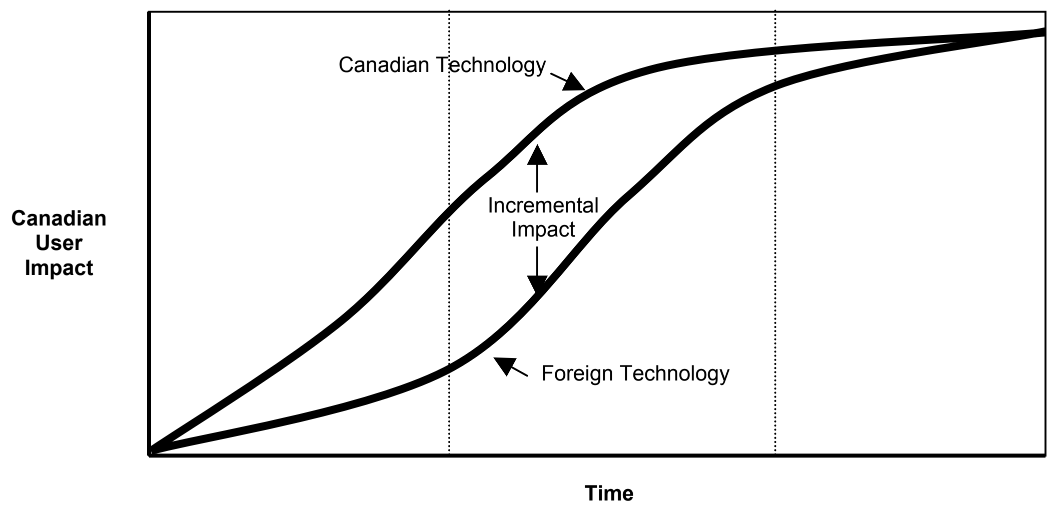
2.1.3 Other Canadian Industry

Through diffusion, other companies, which do not have a relationship with TPC, can gain people, technology, or concepts from TPC Funded Companies that will have a beneficial impact on their own capabilities to develop and commercialize technologies. Diffusion occurs through mechanisms such as strategic partnerships, patenting, published papers, movement of personnel, and reverse engineering.

2.1.4 Canadian Users

There are also economic impacts resulting from the application of TPC technology by users in the form of improved product quality or lower costs of production that improve the competitiveness of these firms. It is recognized, however, that many such new technologies would likely be eventually available from outside of Canada. Therefore the incremental benefit comes mainly from the advanced timeliness of such developments or the application of technology in manners particularly suited to Canadian conditions, resulting in an accelerated adoption rate and greater penetration for Canadian users, as shown in Figure 2.

Figure 2: Technology Use



However, some of the economic benefits to users are negated by the price that users pay for the products and services. The benefit of interest here is the consumer surplus – the value of the product over and above its cost.

In calculating the economic benefit of the use of TPC technology, it has been assumed that users on average will buy technology at a price where their return on investment (ROI) for the goods or services equals the minimum acceptable ROI for the organization. Therefore, the economic benefit to Canadian users is at a minimum the expected ROI for investments in the user industry.

In addition (unlike the production and sale of products), the use of a technology may also have non-economic benefits for the environment, sovereignty & security, social welfare, health, and the advancement of knowledge. Since these are non-economic by nature, it is not practical to try to reduce them to monetary terms. Instead, we have estimated the magnitude of these impacts by assigning a qualitative weight to the relative degree of impact and multiplying it by the value of sales (as a proxy for amount of use).

2.1.5 Canadian Impacts

To summarize, the impacts from TPC projects come from three sources:

1. Research and development of the technology,

2. Production and sales of products and services that embody the technology, and

3. Use of technology (embodied in goods and services).

While perhaps obvious, it is important to note that the benefits from technology production and use are directly proportional to the degree of use – if end users do not buy and use the technologies, there will be no benefits.

To the extent that spending on technology development and production occurs in Canada, there will be benefits to Canada. Less obviously, some portion of the work done in Canada will 'leak' out in the form of payments for component parts and services that are not available domestically.

Traditionally, impacts have been thought of in terms of direct wealth creation - stimulating the economy through the production and sale of tangible goods or services in the economy, usually by the private sector. In addition, we know that technology can enhance the social well-being of a country (the public good), and the infrastructure. Infrastructure improvements, such as faster communications systems or improved methods and codes, will ultimately contribute to productivity, wealth creation, and the public good.

2.2 Considerations

When analyzing the results of a program, the following considerations should be kept in mind.

2.2.1 Incrementality

The impacts and effects to be considered are those that are directly due to the government action under review – TPC. These impacts and effects are called incremental, which is defined as the difference between what did happen with the government action (the TPC program), and what would have happened if the action had not been taken. If nothing changes as a result of the action, impacts and effects are the same with and without the action, and incrementality is zero.

2.2.2 Attribution

A concept related to incrementality is that of attribution. Even if TPC makes incremental differences in impacts, some fraction of the impacts may logically be attributable to other programs, funding sources, organizations, or stimulants. Impacts and effects may have benefited from more than one government program or policy. Such incremental activities may give rise to impacts and effects that are not wholly (or fairly) attributable to TPC. In these cases, if the other programs or activities are to be credited with some of the impacts, these impacts must be attributed to the various contributing programs in some way. To the extent these other sources can be identified, they should share in the allocation of impacts and effects associated with TPC.

2.2.3 Time

Time frame plays an important role in the assessment of impacts. The major benefits attributable to R&D and technology transfer will accrue to society long after completion of particular government activities and over many years into the future.

This causes difficulties for identifying and measuring impacts and attributing them to the originating activity. These difficulties involve:

- The uncertainty as to whether the program-assisted development will actually be implemented commercially to take advantage of the potential benefits;
- The uncertainty as to whether the technology will perform after implementation as expected based on results from prototype or demonstration experience;
- The lack of knowledge on the unintended or unexpected effects of introducing new technologies or changing existing processes; and
- The uncertainty of the level of benefits and costs from any particular implementation of technology.

Also, there is a preference to have benefits sooner rather than later, so that future benefits have less value than present benefits, and should be discounted accordingly.

3. TPC Valuation Model Implementation

3.1 Overview

The TPC Valuation Model that has been outlined in the Chapter 2, and detailed in Appendix A, has been implemented as a computer program in an Excel spreadsheet using the @Risk analysis software. @Risk allows input parameters to be specified as probability distributions. Using a technique known as Monte Carlo analysis, the model is iterated thousands of times for many parameter values, creating output variables that are probability distributions.

The contents of the Excel spreadsheet are contained in Appendix B. The spreadsheet contains 14 worksheets, each concerned with a different aspect of the model.

The choices of input parameters for the model are described in the following sections.

3.2 Data Sources

Table 1 presents an overview of the data requirements for the TPC Valuation Model and the sources for the data. The sources are the project databases kept by TPC-R&D and TPC-IRAP, economic statistics from Statistics Canada and other sources, and interviews with a selection of firms. In some cases, parameter values will be based on multiple sources of information. Where possible, the reporting burden for companies was minimized by obtaining data from other sources.

Table 1: Data Requirements and Sources

Data Requirements	TPC-R&D and TPC-IRAP Databases	Economic Statistics	Company Interviews
Technology Area	▲		
Project Stage of Development	▲		
TPC Contribution	▲		
Company Contribution	▲		
Other Contributions	▲		

Data Requirements	TPC-R&D and TPC-IRAP Databases	Economic Statistics	Company Interviews
Probability of Success	▲		
Incrementality			▲
Attribution	▲		▲
Sector Number of Firms		▲	
Sector Size of Firms		▲	
Sector Linkages			▲
Project Sales	▲		▲
Sales Delay	▲		
Sales Period	▲		
Exports		▲	▲
Import Substitution		▲	
Employment	▲		
Contribution Repayment	▲		
Expected ROI		▲	
Discount Factor		▲	

3.3 TPC R&D Data

3.3.1 Program Expenditures

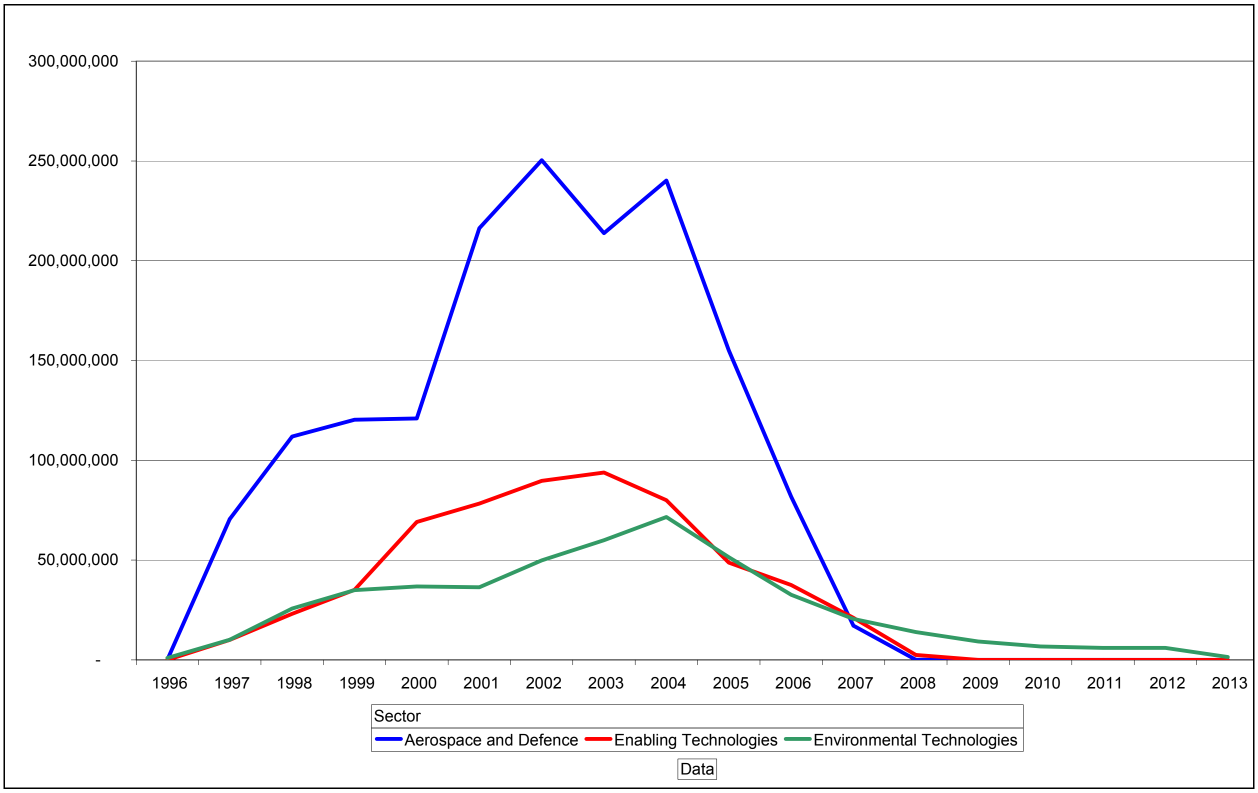
The analysis of the TPC R&D program included 273 projects with a total authorized assistance of $2,641,108,284. The distribution of these projects among the three technology areas (aerospace and defence, enabling technologies, environmental technologies) is shown in Table 2. The H2 Early Adopters technology area, containing five projects worth $18,410,868, was omitted from the analysis because of limited data availability. Note that the full authorized assistance is not necessarily completely distributed to companies; however, in this analysis it has been assumed that it will be.

Table 2: Authorized Assistance

Technology Areas	Number of Projects	Authorized Assistance	Average Assistance
Aerospace and Defence	161	$ 1,577,873,748	$ 9,800,458
Enabling Technologies	63	$ 588,868,270	$ 9,347,115
Environmental Technologies	49	$ 474,366,266	$ 9,680,944
Total	273	$ 2,641,108,284	$ 9,674,389

Information was available from the TPC R&D database on the contract start and end dates, but not on the specific disbursement of money over that period. Therefore, it was assumed that the money was disbursed evenly over the life of each project. The resulting spending profile for the program is shown in Figure 3.

Figure 3: Assumed Authorized Assistance Disbursement



Information was also available on each company's contribution, which was assumed to be disbursed in the same profile as the program funding. The average company contribution multiplier (the amount the company contributed as a multiple of the program authorized assistance), the company contribution, and the total expenditures for the three technology areas are shown in Table 3.

Table 3: Company Contribution and Total Expenditures

Technology Area	Multiplier	Company Contribution	Total Expenditures
Aerospace and Defence	2.17	$ 4,604,199,211	$ 6,202,848,930
Enabling Technologies	3.25	$ 2,313,006,109	$ 2,902,012,774
Environmental Technologies	2.66	$ 1,425,375,279	$ 1,899,563,784
Total	2.51	$ 8,342,580,599	$ 11,004,425,489

3.3.2 Repayment Terms

TPC R&D contributions are repayable based on terms negotiated separately with each company. The contract files for each project were reviewed to determine the repayment terms. While there were variations among all of the contracts, in general they could be classified into six types:

- Type A: Conditional Repayment
- Type B1: Repayment based on the value of product sales
- Type B2: Repayment based on the value of company sales
- Type C: Repayment based on quantity sold
- Type D: Unconditional repayment
- Type X: Contract cancelled
- Type NA: Information not available

Descriptions of each of these repayment terms types follow.

Type A: Conditional Repayment – 15% of the Contribution disbursed is repaid in each year of the repayment period, provided that the two conditions are met: 1) the company has achieved more than 10% growth in gross revenues over the previous year, and 2) the proponent's gross revenues are higher than the 'base amount' defined as the revenues the year prior to the first repayment year. These payments continue until 115% of the Contribution disbursed has been paid, or 10 years has elapsed, whichever comes first. These repayment terms only apply to the Supplier Development Initiative (SDI), part of TPC's Aerospace and Defence program.

Type B1: Repayment based on value of product sales – A percentage of gross *project* revenues is repaid in each year of the repayment period. If by the end of the repayment period, the total cumulative repayments equal or exceed a multiple of the contribution, no further repayments are due. However, if this amount has not been repaid, the payments continue for a further limited period or until the repayments equal the contribution multiple.

Type B2: Repayment based on value of company sales – A percentage of gross *company* revenues is repaid in each year of the repayment period. If by the end of the repayment period, the total cumulative repayments equal or exceed a multiple of the contribution, no further repayments are due. However, if this amount has not been repaid, the payments continue for a further limited period or until the repayments equal the contribution multiple.

Type C: Other – The repayment terms do not fit into the other categories. Many of the contracts of this type have repayments terms based on the quantity (rather than value) of a product sold.

Type NA: Information not available

Type U: Unconditional Repayment – The Contribution amount is repaid in 7 to 15 equal and consecutive annual payments, with the first repayment being payable two years after completion of the work.

Type X: Contract Cancelled – The contract has been cancelled and no further repayment is expected. In some cases, some money has been repaid, often in a lump sum.

The distribution, total value, and average value of the different contract types is shown if Table 4. The frequency of contract types among the three technology sectors is shown in Table 5.

Table 4: Value of Contract Types

Contract Type	Number	Total Contribution	Average Contribution
A – Conditional Repayment	31	$ 18,605,667	$ 600,183
B1 – Product Sales	124	$ 1,545,447,380	$ 12,463,285
B2 – Company Sales	56	$ 435,639,317	$ 7,779,274
C – Other	15	$ 350,672,980	$ 23,378,199
NA – Information Not Available	14	$ 246,704,061	$ 17,621,719
U – Unconditional Repayment	22	$ 19,156,989	$ 870,772
X – Contract Cancelled	11	$ 24,881,890	$ 2,261,990
Total	273	$ 2,641,108,284	$ 9,674,389

Table 5: Frequency of Contract Types

Contract Type	Aerospace and Defence	Enabling Technologies	Environmental Technologies	Number
A – Conditional Repayment	31	0	0	31
B1 – Product Sales	72	35	17	124
B2 – Company Sales	22	19	15	56
C – Other	8	1	6	15
NA – Information Not Available	2	5	7	14
U – Unconditional Repayment	22	0	0	22
X – Contract Cancelled	4	3	4	11
Total	161	63	49	273

For the purposes of the analysis in this study, we need to determine the actual and forecasted sales of TPC R&D related products. Some of the contract types permit these actual and forecasted sales to be calculated from the company actual and forecasted royalty payments. Table 6 considers the applicability of the contract types for this calculation, and the assumptions that have been made.

Table 6: Contract Type Sales Calculation Applicability

Contract Type	Applicability	Assumptions
A – Conditional Repayment	These repayment terms provide no information on sales.	It has been assumed that sales are in the same proportion to repayments as in the average of the Type B1 and B2 cases.
B1 – Product Sales	These repayment terms provide information on sales. Sales equal repayment divided by the royalty rate.	It has been assumed that the maximum amount will not be reached by the end of the repayment period, and therefore the repayment amount does not under-estimate sales.
B2 – Company Sales	These repayment terms provide information on sales. Sales equal repayment divided by the royalty rate.	It has been assumed that the majority of company sales are related to the TPC project. Also, it has been assumed that the maximum amount will not be reached by the end of the

Contract Type	Applicability	Assumptions
		repayment period, and therefore the repayment amount does not under-estimate sales.
C – Other	These repayment terms provide no information on sales.	It has been assumed that sales are in the same proportion to repayments as in the average of the Type B1 and B2 cases.
NA – Information Not Available	No information.	It has been assumed that sales are in the same proportion to repayments as in the average of the Type B1 and B2 cases.
U – Unconditional Repayment	These repayment terms provide no information on sales.	It has been assumed that sales are in the same proportion to repayments as in the average of the Type B1 and B2 cases.
X – Contract Cancelled	Repayment terms are no longer relevant.	It has been assumed that no further sales will result in these cases.

As can be seen in the table, only Type B1 and B2 contracts enable the calculation of sales from repayment information. Fortunately, these contract types represent the majority of cases – 66% of the number of contracts, and 74% of the value of contracts.

Type B1 and B2 contract types have associated royalty rates. Table 7 shows the average royalty rates for the three technology sectors for projects with those contract types.

Table 7: Royalty Rates for B1 and B2 Contract Types

Technology Area	Number	Average Royalty Rate
Aerospace and Defence	94	2.30%
Enabling Technologies	54	2.58%
Environmental Technologies	32	2.21%
Total	180	2.37%

In the case of Type U, NA, C, and A contracts, the average royalty rate for the corresponding sector has been used. It has been assumed that there will be no further sales from Type X contracts.

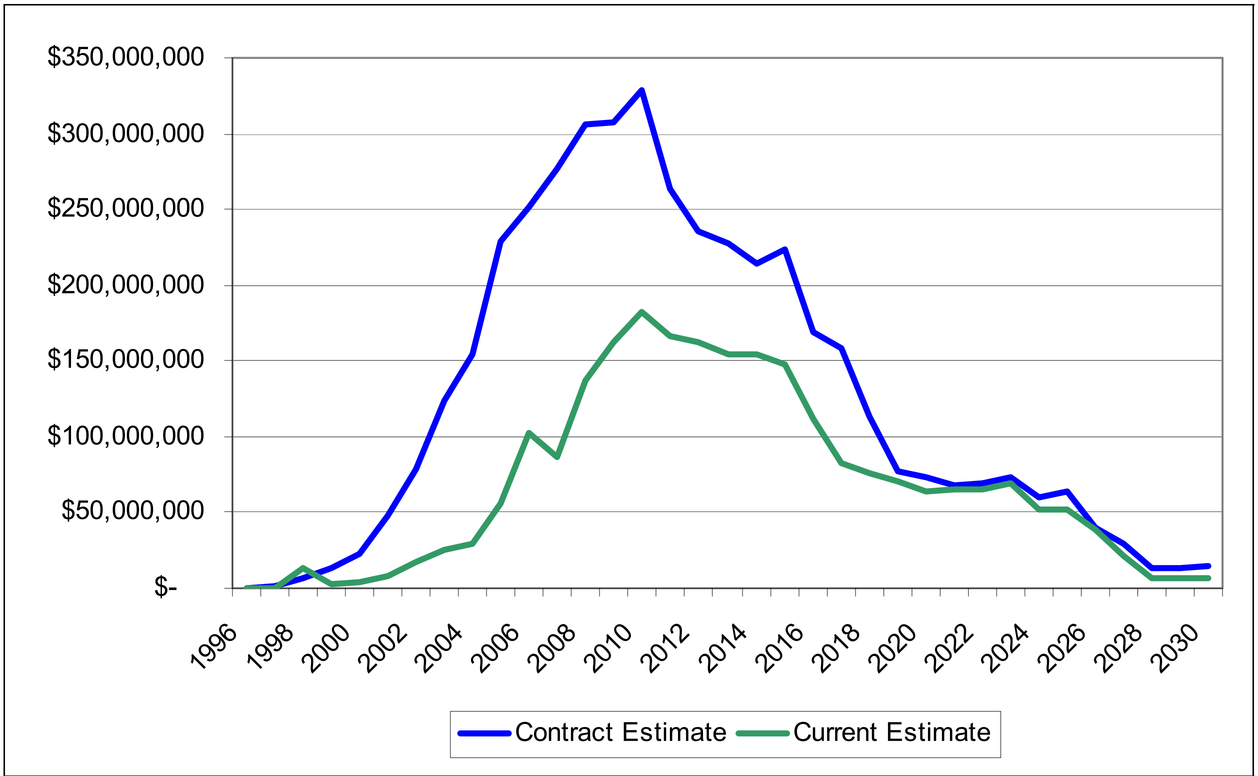
3.3.3 Repayment Estimates

At the contract stage, estimates are made of the expected repayments. Table 8 contains the aggregate of these estimates and Figure 4 shows the repayment profile. For a variety of reasons, repayments are typically less than originally forecasted. Every year, TPC adjusts their expectations of the repayment amounts based on project and company performance. Table 8 contains these estimates and Figure 4 also shows the current estimate of the repayment profile. At the time of contract, the aggregate of repayment estimates totalled about $4.3 billion, while the current repayment estimates total about $2.4 billion, or 55% of the original aggregated estimates. Figure 4 compares the aggregate of contract estimates and current total repayment profiles, while Figure 5 and Figure 6 show the original and current repayment profiles for each of the technology areas.

Table 8: Aggregate of Contract Estimates and Current Repayment Estimates

Technology Area	Aggregate of Contract Repayment Estimates	Current Repayment Estimate	Percentage
Aerospace and Defence	$ 2,384,578,011	$ 1,569,378,414	66%
Enabling Technologies	$ 1,109,059,854	$ 292,483,974	26%
Environmental Technologies	$ 856,058,907	$ 533,712,956	62%
Total	$ 4,349,696,772	$ 2,395,575,344	55%

Figure 4: Aggregate of Contract Estimates vs. Current Estimate Repayment Profile



As can be seen in Figure 4, repayments estimates have been both reduced and delayed, although estimates far in the future tend to remain constant.

Figure 5: Contract Repayment Profile

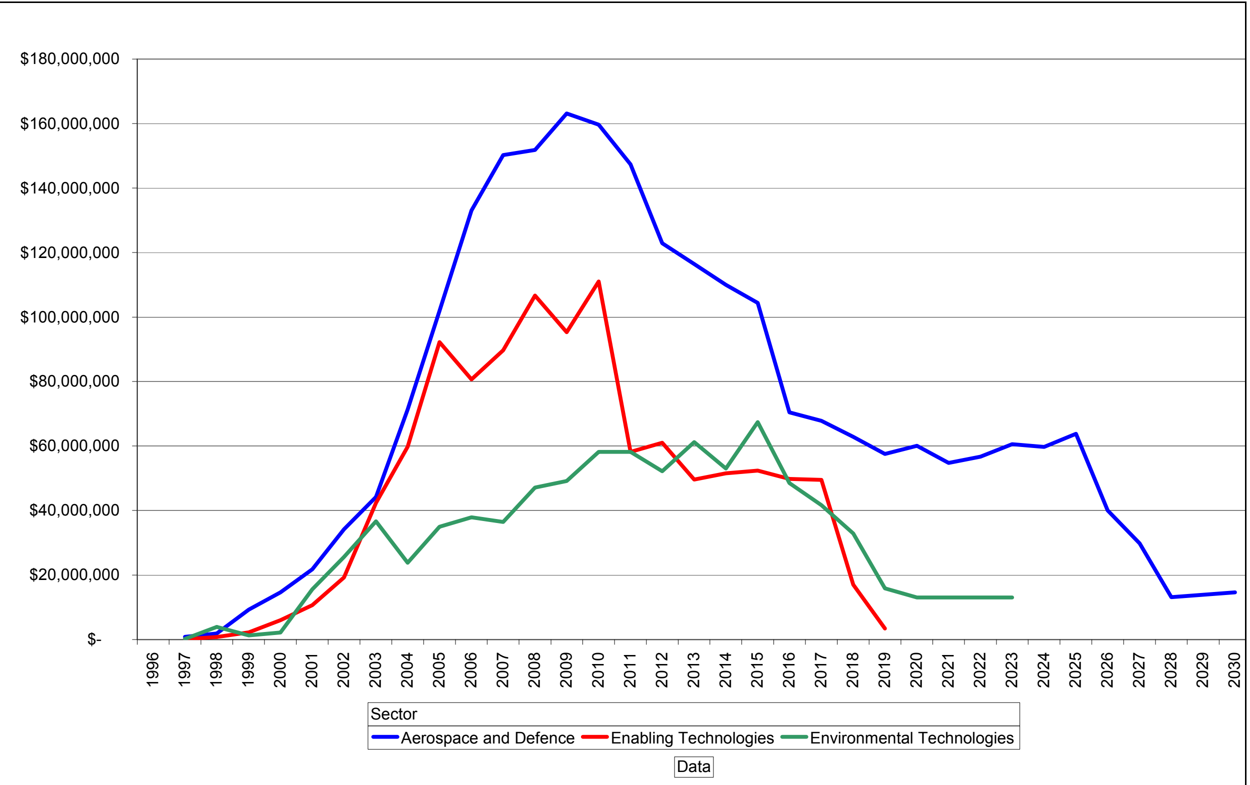
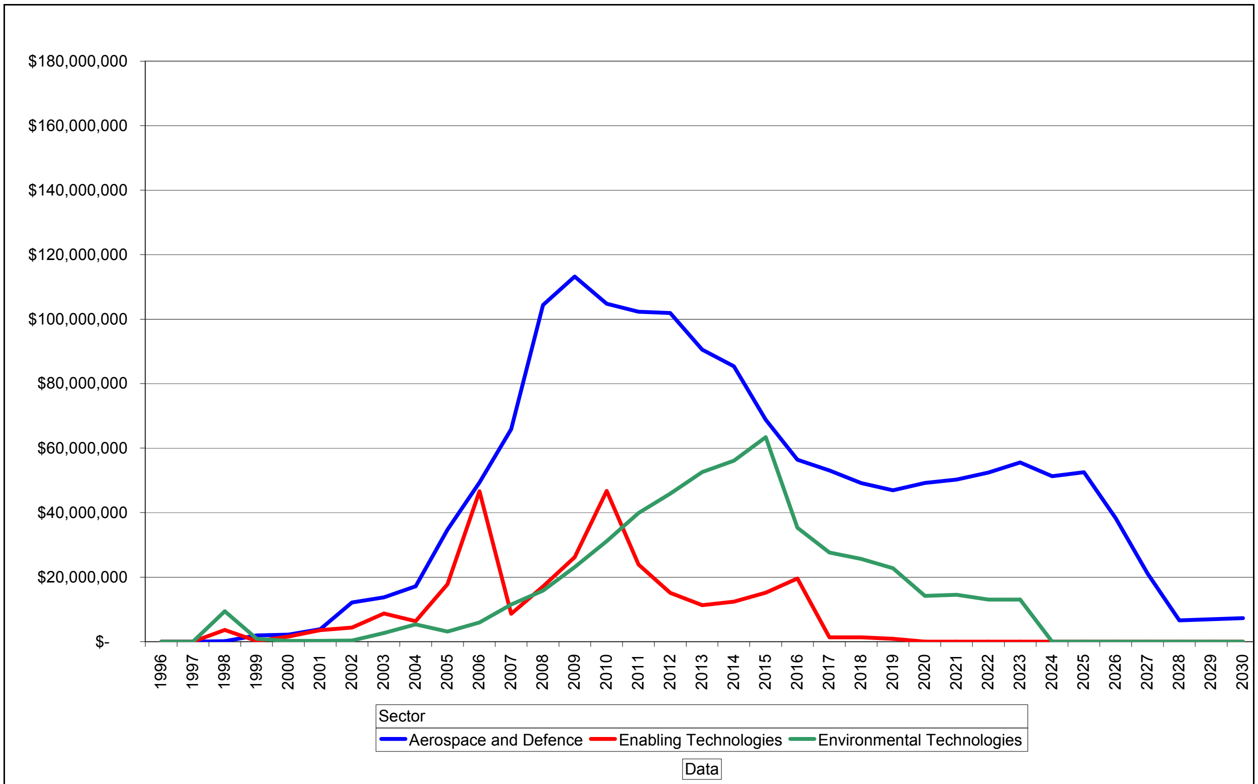


Figure 6: Current Repayment Profile



3.3.4 Sales Estimate

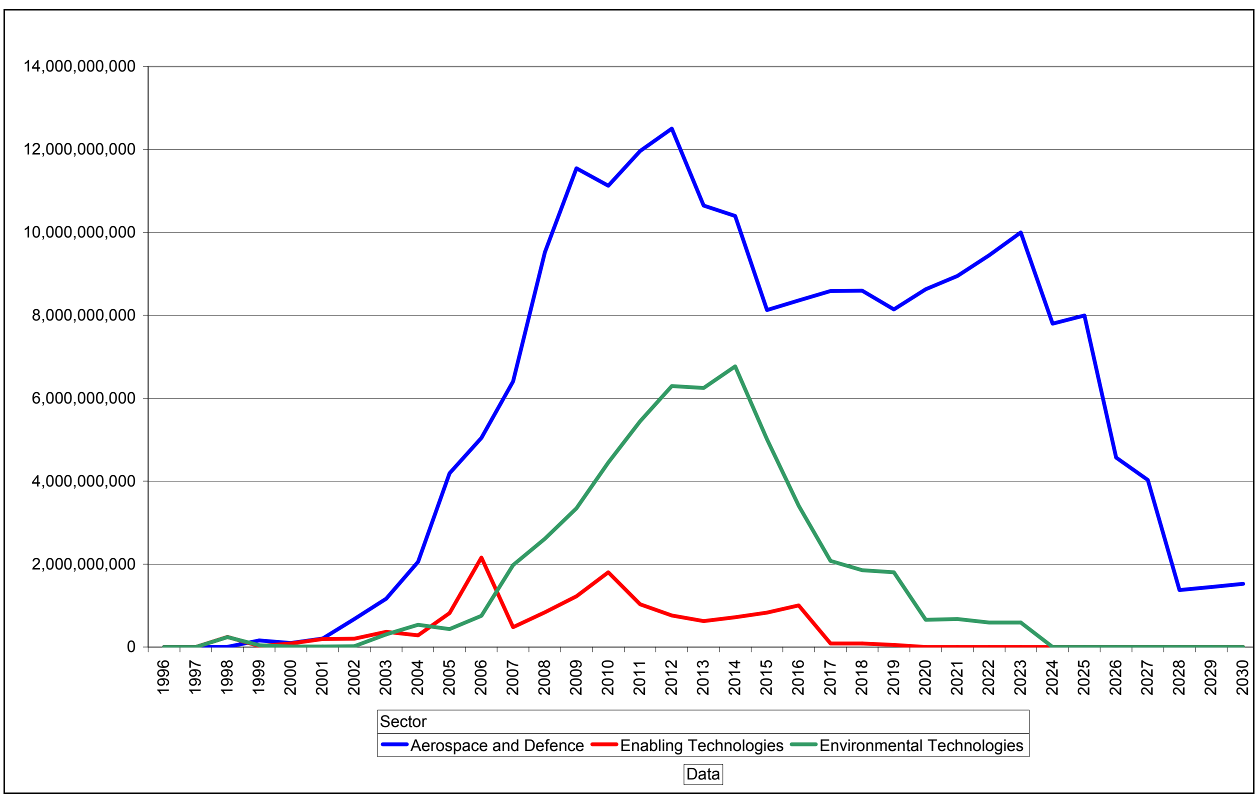
The indicator of interest is the sales that result from TPC R&D funded research. However, sales data is not available directly – the program instead tracks estimates of repayments. For contract types where repayment is tied to sales and the royalty rate is known, sales can be calculated based on the repayment stream (actual and forecasted). For the minority of other contract types, we have made the assumption that, on average, the terms of the contract will reflect the majority of contracts where royalties are tied to sales, and therefore we have used the average royalty rate for each technology area to calculate sales.

Table 9 compares the current repayment estimate with the resulting sales to calculate the implied average royalty rate. Figure 7 shows the sales profile for the three technology areas.

Table 9: Implied Royalty Rates

Contract Type	Current Repayment Estimate	Resulting Sales	Implied Royalty
Aerospace and Defence	$ 1,569,378,414	$ 205,230,421,334	2.3%
Enabling Technologies	$ 292,483,974	$ 13,876,328,319	2.6%
Environmental Technologies	$ 533,712,956	$ 56,303,474,945	1.8%
Total	$ 2,395,575,344	$ 275,410,224,597	2.3%

Figure 7: Sales Estimates



3.3.5 Non-Economic Benefits

Each of the projects was reviewed and rated according to its impact on six non-economic benefit types[3]: public health, sovereignty and security, environment, social, physical assets and advancement of knowledge. The original rating was at three levels: no impact, minor impact, and substantial impact. This was subsequently transformed, in aggregate, to a five-point scale (1 for little impact to 5 for substantial impact) for each of the technology areas, as shown in Table 10.

Table 10: Non-Economic Benefit Ratings

Non-Economic Benefit Types	Aerospace and Defence	Enabling Technologies	Environmental Technologies
Public Health	1.19	2.87	2.34
Sovereignty & Security	1.74	1.09	1.20
Environmental	1.46	4.88	1.27
Social	1.25	2.67	2.93
Physical Assets	1.72	1.70	1.51
Advancement of Knowledge	1.71	1.97	2.13

3.4 TPC IRAP Data

3.4.1 Program Expenditures

The analysis of the TPC IRAP program included 420 projects with a total authorized assistance of $156,736,778. The distribution of these projects among the three technology sectors is shown in Table 11. The majority of projects (55%) are in information and communications technology. Note that the full authorized assistance is not necessarily completely distributed to companies; however, in this analysis it has been assumed that it will be.

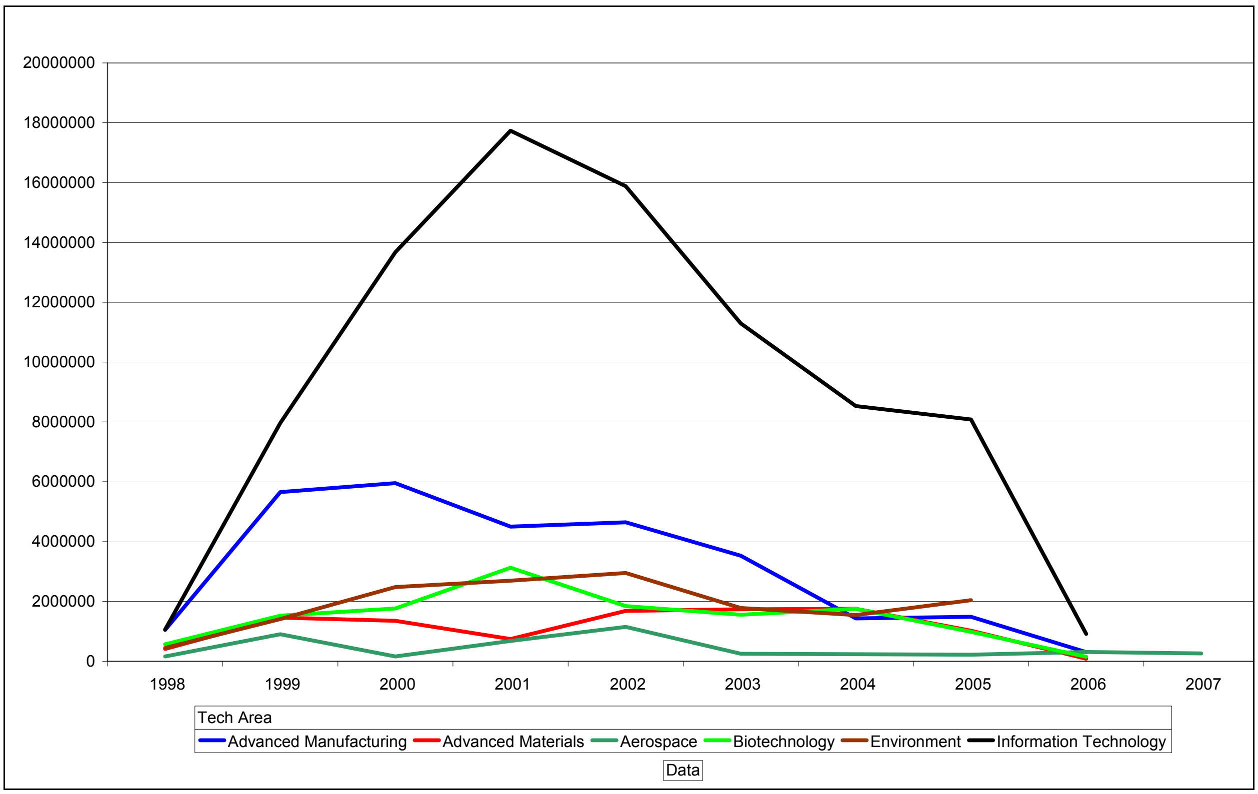
[3] TPC has in the past examined five benefit types: 1. Benefits specific to recipient firms, 2. Benefits specific to the industry and to the Canadian Innovation Network, 3. Environmental benefits, 4. Connectivity and access to the e-world, and 5. Benefits to Canadians. The first of these encompasses a number of infrastructure benefits that will ultimately result in spinoffs. The second also covers infrastructure benefits that will ultimately result in diffusion. The third is identical to one of our non-economic benefits, "environment". The fourth is one component of one of our non-economic benefits, "physical assets". The fifth is a catch-all for the other non-economic benefits that we consider explicitly.

Table 11: Authorized Assistance

Technology Area	Number of Projects	Authorized Assistance	Average Assistance
Advanced Manufacturing	78	$ 28,537,197	$ 365,862
Advanced Materials	23	$ 10,225,002	$ 444,565
Aerospace and Defence	11	$ 4,290,944	$ 390,086
Biotechnology	34	$ 13,240,466	$ 389,425
Environmental Technologies	44	$ 15,329,292	$ 348,393
Information Technology	230	$ 85,113,877	$ 370,060
Total	420	$ 156,736,778	$ 373,183

The spending profile for the TPC IRAP technology areas was available and is shown in Figure 8.

Figure 8: Authorized Assistance Disbursement



Information was also available on each company's contribution, which was assumed to be disbursed in the same profile as the program funding. The average company contribution multiplier (the amount the company contributed as a multiple of the program authorized assistance), the company contribution, and the total expenditures for the six technology areas are shown in Table 12.

Table 12: Company Contribution and Total Expenditures

Technology Area	Multiplier	Company Contribution	Total Expenditures
Advanced Manufacturing	2.67	$ 63,593,067	$ 92,130,264
Advanced Materials	2.24	$ 22,225,521	$ 32,450,523
Aerospace and Defence	2.10	$ 8,932,061	$ 13,223,005
Biotechnology	2.23	$ 29,227,608	$ 42,468,074
Environmental Technologies	3.50	$ 35,985,851	$ 51,315,143
Information Technology	2.55	$ 191,106,789	$ 276,220,666
Total	2.62	$ 351,070,897	$ 507,807,675

3.4.2 Repayment Terms

TPC IRAP contributions are repayable based on terms negotiated separately with each company. While there are variations among all of the contracts, in general they can be classified into four types:

- Gross Revenues above baseline amount
- Gross Revenues
- Fixed Payments upon success condition
- Other

Descriptions of each of these contract types follow.

RGR above baseline amount – RGR is Gross Revenue. The baseline sales amount is negotiated with the firm on an individual basis and is based on sales history. The amount above baseline is assumed to be the incremental sales due to the TPC investment. The percentage is usually higher for "above baseline" projects and ranges from 8%-12%. The fixed period usually begins at 2-4 years out from first the TPC contribution and does not extend past 10 years, even if no repayment has been made. Usually, total repayment is capped at 150% of the TPC contribution.

RGR: – Repayment is based on total gross revenue of the firm, and not just incremental sales attributable to TPC. However, these firms typically have only the TPC supported product, so the result is that total firm revenues are mostly attributable to TPC. Terms are typically 1%. The fixed period is the same as above. Usually, total repayment is capped at 150% of the TPC contribution.

Fixed Payments upon success condition: – Repayment is fixed once a success condition is met.

Other: – Negotiated separately with each firm. It sometimes involves a fixed payment tied to sales ranges.

The distribution, total value, and average value of the different contract types is shown in Table 13. As can be seen, the majority of contracts (90% in number and 91% in value) are of the RGR type. The frequency of contract types among the six technology sectors is shown in Table 14.

Table 13: Value of Contract Types

Contract Type	Number	Total Contribution	Average Contribution
FP upon success condition	5	$ 2,203,275	$ 440,655
Other	8	$ 3,042,037	$ 380,255
RGR above baseline	29	$ 9,362,830	$ 322,856
RGR	378	$ 142,128,637	$ 376,002
Total	420	$ 156,736,778	$ 373,183

Table 14: Frequency of Contract Types

Contract Type	FP upon success condition	Other	RGR above baseline	RGR	Total
Advanced Manufacturing	1	1	2	74	78
Advanced Materials	0	1	2	20	23
Aerospace	0	0	2	9	11
Biotechnology	1	2	4	27	34
Environment	1	2	6	35	44
Information Technology	2	2	13	213	230
Total	5	8	29	378	420

Contracts have associated royalty rates. Table 15 shows the average royalty rates, where known, by technology area.

Table 15: Royalty Rates

Technology Area	Number	Average Royalty Rate
Advanced Manufacturing	76	3.12%
Advanced Materials	23	3.20%
Aerospace	11	1.87%
Biotechnology	34	6.20%
Environment	43	4.09%
Information Technology	229	2.84%
Total	416	3.29%

3.4.3 Repayment Estimates

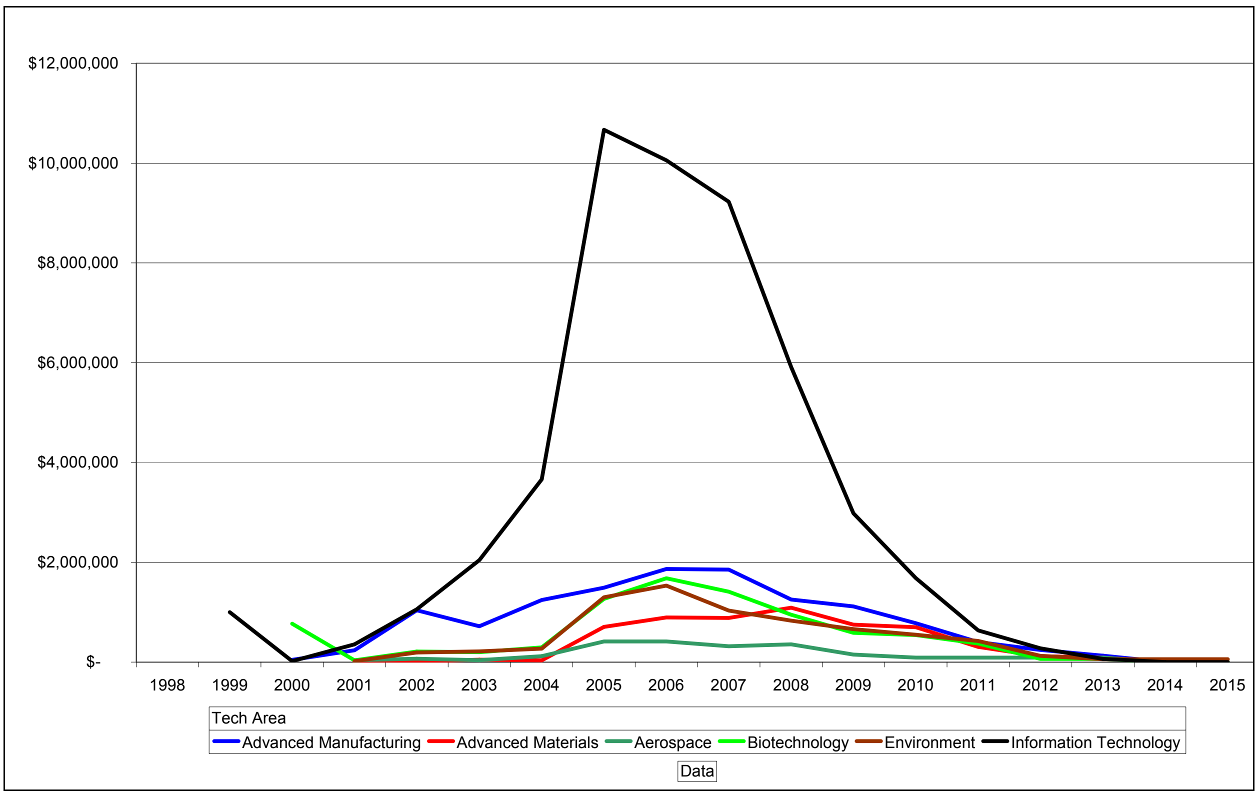
At the contract stage, estimates are made of the expected repayments. Table 16 contains these estimates. For a variety of reasons, repayments are typically less than expected. IRAP does not keep revised estimates of expected repayments. Therefore, the TPC IRAP contract estimates have been reduced by the same factor as has been estimated for the SME firms for the TPC R&D

projects. Since the majority (87%) of the TPC IRAP projects are Enabling Technologies, the factor for TPC R&D SME Enabling Technologies has been used (0.4) when estimating future repayments. Actual repayments have been used to date. The total of the repayments after applying this factor is $85.7 million, or 37% of the estimate of $228.9 million at the time of the contracts. Figure 9 shows this repayment profile for the six technology areas.

Table 16: Contract Repayment Estimates

Technology Area	Contract Repayment	Estimated Repayment	Ratio
Advanced Manufacturing	$ 37,514,323	$ 12,406,767	0.33
Advanced Materials	$ 14,698,750	$ 5,627,219	0.38
Aerospace	$ 5,373,815	$ 2,253,644	0.42
Biotechnology	$ 18,807,671	$ 8,437,811	0.45
Environment	$ 20,603,633	$ 7,322,320	0.36
Information Technology	$ 131,945,712	$ 49,637,807	0.38
Grand Total	$ 228,943,904	$ 85,685,569	0.37

Figure 9: Repayment Profile



3.4.4 Sales Estimate

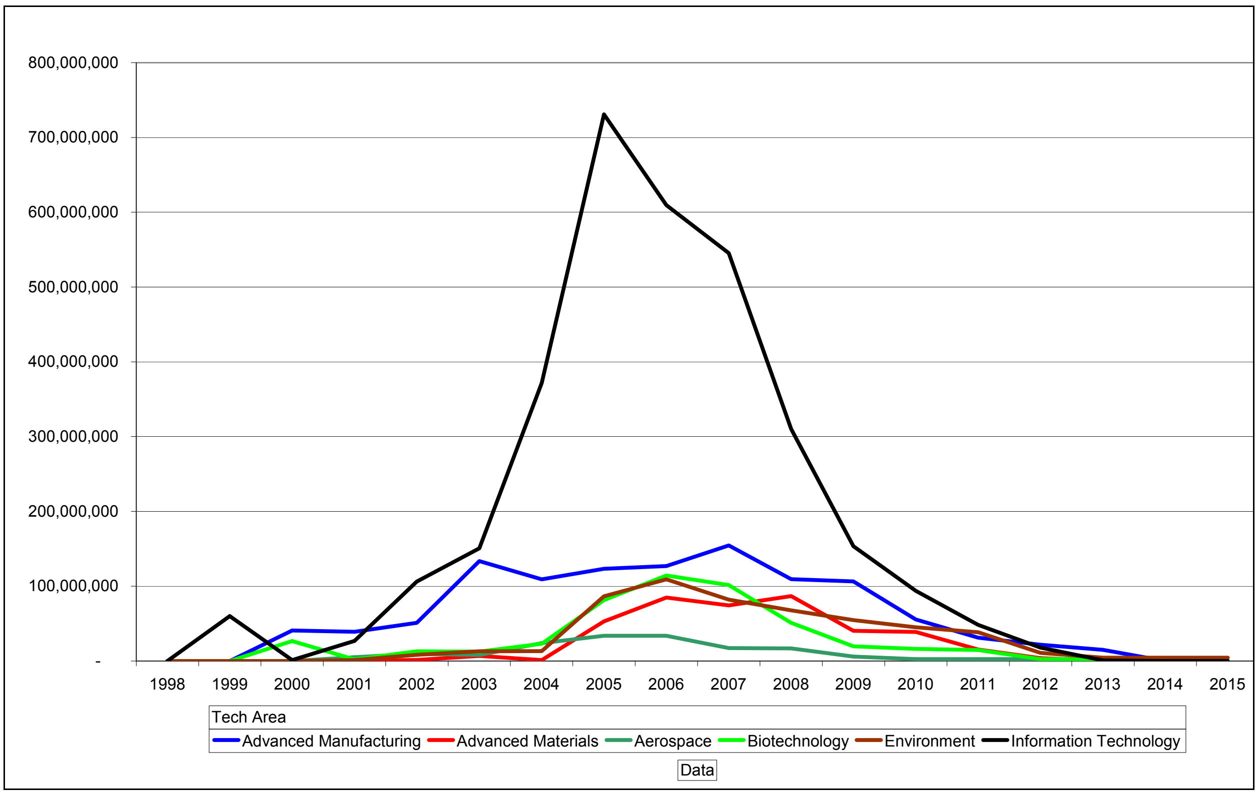
The indicator of interest is the sales that result from TPC funded research. At the contract stage, TPC IRAP makes estimates of future project related sales. These were used to calculate an implied royalty rate, which was then used in conjunction with the revised repayment estimates to determine the revised sales estimates.

Table 17 compares the revised repayment estimate with the resulting sales to calculate the implied average royalty rate. Figure 10 shows the resulting sales profile for the six technology areas.

Table 17: Implied Royalty Rate

Contract Type	Revised Repayment Estimate	Resulting Sales	Implied Royalty
Advanced Manufacturing	$ 12,406,767	$ 1,117,958,101	1.11%
Advanced Materials	$ 5,627,219	$ 407,608,553	1.38%
Aerospace	$ 2,253,644	$ 164,249,853	1.37%
Biotechnology	$ 8,437,811	$ 481,374,166	1.75%
Environment	$ 7,322,320	$ 543,201,045	1.35%
Information Technology	$ 49,637,807	$ 3,226,959,021	1.54%
Total	$ 85,685,569	$ 5,941,350,739	1.44%

Figure 10: Sales Estimates



3.4.5 Non-Economic Benefits

Based on the review of the TPC R&D projects, the TPC IRAP projects were given ratings of their impact for six non-economic benefit types: public health, sovereignty and security, environment, social, physical assets and advancement of knowledge, as shown in Table 18.

Table 18: Non-Economic Benefit Ratings

Non-Economic Benefit Types	Advanced Manufacturing	Advanced Materials	Aerospace	Biotechnology	Environment	Information Technology
Public Health	2.33	1.00	1.19	4.60	2.87	1.17
Sovereignty & Security	1.00	1.00	1.74	1.53	1.09	1.06
Environmental	1.67	2.33	1.46	1.42	4.88	1.06
Social	1.67	1.00	1.25	4.50	2.67	2.31
Physical Assets	1.00	2.33	1.72	2.05	1.70	1.18
Advancement of Knowledge	2.33	1.83	1.71	2.35	1.97	2.01

3.5 Other Parameters

3.5.1 Global Parameters

Many of the economic impacts of TPC accrue well into the future. In order to account for the preference that impacts occur sooner rather than later, a discount factor has been used to calculate the net present value (NPV) of impacts. The choice of a suitable discount factor is somewhat contentious. We have chosen a rate of 10%, as recommended by Treasury Board[4].

In order to calculate the distribution over time of impact, the TPC valuation models allows projects to be segregated into four stages of development, nominally termed research, development, engineering, and market. Each stage has a different lag time until returns begin to be realized. The lag times that have been used are as follows: research – 6.5 years, development – 4.5 years, engineering – 2.5 years, and market – 1 year.

4 See, for example, the Treasury Board Secretariat, Benefit Cost Analysis Guide, DRAFT July 1998; www.tbs-sct.gc.ca/fin/sigs/Revolving_Funds/bcag/BCA2_E.asp. On the other hand, the 2001 report "Research at DOE: Was it Worth it?" from the United States National Research Council suggests a discount rate of 0% and the United States Office of Management and Budget specifies 7%.

3.5.2 Technology Specific Parameters

The TPC projects have been assigned to a stage of development category based on the anticipated lag between contract end and the start of repayments. Table 19 shows the percentage breakdown of projects in each of the categories.

Table 19: Stage of Development Breakdown by Technology Area

	Stage of Development			
Technology Area	**Market**	**Engineering**	**Development**	**Research**
TPC R&D				
Aerospace and Defence	0.14	0.38	0.29	0.19
Enabling Technologies	0.21	0.40	0.32	0.07
Environmental Technologies	0.17	0.26	0.38	0.19
TPC IRAP				
Advanced Manufacturing	0.30	0.67	0.03	0.00
Advanced Materials	0.45	0.50	0.05	0.00
Aerospace	0.36	0.64	0.00	0.00
Biotechnology	0.24	0.67	0.09	0.00
Environment	0.28	0.65	0.08	0.00
Information Technology	0.43	0.54	0.04	0.00

The number of firms and size of firms participating in TPC projects, and in the total population of Canadian firms, are shown in Table 20 by technology area.

Table 20: Number and Size of Firms by Technology Area

Technology Area	**In TPC Projects**		**In Canada**	
	Number of Firms	**Size of Firms***	**Number of Firms**	**Size of Firms***
TPC R&D				
Aerospace and Defence	161	3.16	300	0.40
Enabling Technologies	63	1.09	3147	0.09
Environmental Technologies	49	1.13	7474	0.02
TPC IRAP				
Advanced Manufacturing	78	0.09	25592	0.11
Advanced Materials	23	0.13	2402	0.15
Aerospace	11	0.18	300	0.40
Biotechnology	34	0.07	417	0.09
Environment	44	0.01	7474	0.02
Information Technology	230	0.07	2232	0.09

* Firm size is expressed in units of $100,000,000 of sales.

The import content of technology area products, the proportion of products exported and the amount of domestic sales that is assumed to represent import substitution is shown in Table 21 by technology area[5].

Table 21: Import Content, Exports, and Import Substitution by Technology Area

Technology Area	Import Content*	Exports**	Import Substitution***
TPC R&D			
Aerospace and Defence	0.51	0.73	0.1
Enabling Technologies	0.55	0.31	0.1
Environmental Technologies	0.30	0.30	0.1
TPC IRAP			
Advanced Manufacturing	0.51	0.49	0.1
Advanced Materials	0.36	0.61	0.1
Aerospace	0.51	0.73	0.1
Biotechnology	0.23	0.07	0.1
Environment	0.30	0.30	0.1
Information Technology	0.75	0.40	0.1

* 'Import Content' is the portion of inputs to products that have been imported into Canada.
** 'Exports' is the portion of goods and services that have been exported out of Canada.
*** 'Import Substitution' is the portion of goods and services that have been sold domestically and that displace goods and services that otherwise would have been imported. Otherwise, domestic sales displace the domestic sales of other Canadian companies.

3.5.3 User Benefits

The expected return on investment (ROI) for all user industries has been assumed to be 20%[6].

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5 Data was derived from OECD Input Output Tables. See www.oecd.org/document/1/0,2340,en_2825_495684_34062721_1_1_1_1,00.html

6 See for example, Moor, MC; Arent, DJ, and Norland, D (2005) "R&D Advancement, Technology Diffusion, and Impact on Evaluation of Public R&D, p5.

4. TPC Valuation Model Results

The socio-economic model results presented in this Chapter are based on the model theory introduced in Chapter 2 and the model implementation described in Chapter 3. Quantitative estimates of economic impacts are reported in Sections 4.1 to 4.3, and estimates of non-economic impacts (public health, environment, sovereignty and security, social welfare, physical assets, and advancement of knowledge) are reported in Section 4.4. Finally, a short discussion of result validity is contained in Section 4.5.

4.1 Economic Impacts

4.1.1 Total Impacts

The total economic impact of Technology Partnerships Canada is summarized in Table 22. The results are broken out for the TPC R&D and the TPC IRAP programs in Table 23 and Table 24. The discounted values are for a base year of 2005 and a discount rate of 10%.

Table 22: Total Economic Impact Results

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$2,797,845,062		$3,741,166,880	$1,909,781,416
Company Expenditures	$8,644,407,620		$11,508,389,309	$5,852,158,379
Total Expenditures	$11,442,252,682		$15,249,556,189	$7,761,939,794
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$281,351,575,336	$84,405,472,601	$40,376,262,087	$14,300,588,608
Spinoff Sales	$72,550,148,095	$21,599,348,749	$11,811,043,559	$4,138,198,907
Diffusion Sales	$152,078,979,821	$4,223,230,959	$942,876,970	$352,850,660
Domestic User Value				$5,697,375,629
TOTAL	$517,422,955,934	$110,228,052,309	$68,379,738,804	**$32,250,953,598**

Table 23: TPC R&D Economic Impact Results

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$2,641,108,284		$3,523,551,701	$1,819,470,645
Company Expenditures	$8,293,336,724		$11,021,279,554	$5,649,522,409
Total Expenditures	$10,934,445,007		$14,544,831,256	$7,468,993,054
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$275,410,224,597	$82,623,067,379	$38,727,078,294	$13,974,370,532
Spinoff Sales	$68,985,374,440	$20,590,568,792	$11,159,345,077	$3,993,218,893
Diffusion Sales	$133,535,842,605	$3,890,006,929	$855,578,397	$328,932,886
Domestic User Value				$5,331,106,929
TOTAL	$488,865,886,649	$107,103,643,100	$65,286,833,023	**$31,096,622,294**

Table 24: TPC IRAP Economic Impact Results

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$ 156,736,778		$ 217,615,179	$ 90,310,771
Company Expenditures	$ 351,070,897		$ 487,109,755	$ 202,635,969
Total Expenditures	$ 507,807,675		$ 704,724,933	$ 292,946,741
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$ 5,941,350,739	$ 1,782,405,222	$ 1,649,183,793	$ 326,218,076
Spinoff Sales	$ 3,564,773,656	$ 1,008,779,957	$ 651,698,482	$ 144,980,014
Diffusion Sales	$ 18,543,137,216	$ 333,224,030	$ 87,298,573	$ 23,917,774
Domestic User Value				$ 366,268,700
TOTAL	$ 28,557,069,285	$ 3,124,409,209	$ 3,092,905,781	**$ 1,154,331,305**

Economic impacts come from five sources: project spending, direct sales, spinoffs and diffusion from project spending, and domestic technology use. These are described briefly below:

- **Project Expenditures** have an impact if it is assumed that the government spending, and the money it leverages from industry, is incremental to the economy. While this is rarely true, it is common to count program expenditures as an impact.
- **Direct Sales** is the net economic activity resulting from the sale of products resulting directly from TPC funded projects.
- **Spinoff Sales** is the net economic activity that Canadian companies participating in the TPC program achieve as a direct result of the knowledge and capabilities they acquire from their participation.

- **Diffusion Sales** is the net economic activity that Canadian companies not participating in the program achieve as a direct result of the knowledge and capabilities that diffuses through the Canadian economy from the program. Diffusion occurs through mechanisms such as published papers, movement of personnel, and reverse engineering.

- **Domestic User Value** is the net economic value to Canadian users of TPC funded technology. An argument can be made that users will continue to purchase the technology until the marginal cost of using the technology[7] is equal to its marginal value. In other words, the marginal net value is zero and there is no incremental value to the economy. However, there will still be consumer surplus benefits to the technology used before the margin and these have been considered to be equal to the return on investment (ROI) expected by the user industry on their technology investments (assumed to be 20%).

A number of factors can be taken into account when evaluating the magnitude of the economic impacts:

- **Sales** is the value of sales that will accrue to Canadian companies from each of the three sources described above.

- **Attributed Sales** is the value of sales adjusted for incrementality and attribution, i.e. the fact that some portion of the impact may have been achieved without TPC and the fact that TPC is not the only input to the achievement of sales and therefore should not be credited with the full value of the impacts.

- **Discounted Attributed Sales** adjusts the attributed sales to account for the preference for impacts that occur sooner rather than later. For example, spinoffs and diffusion impacts can occur many years after the base year.

- **Discounted Impact** adjusts the discounted attributed sales to account for leakage from the economy and displacement of domestic sales. Leakage occurs because some of the value of products sold requires imports of component materials, which is a loss to the Canadian economy. Domestic sales that simply displace sales that would have accrued to other (non-TPC) Canadian companies do not provide a net gain for the economy, and are not counted.

When comparing the economic impact of this program with others, it is important to be careful to compare like measures. **Total Sales is often the measure quoted for other programs in studies of this type, however discounted impact is a more conservative and reasonable measure, and is the focus of this analysis.**

When evaluating the economic impact of a program, it is common to quote ratios of impacts to program cost. Ratios are provided here for each of the impact levels. The ratio for Sales has

[7] The cost of using a technology may be significantly greater than the cost of purchasing the technology. There are significant organizational costs to learning how to use the technology and incorporating it into the operational process of the organization.

been calculated using the program expenditures in current dollars. The ratio for Discounted Impact has been calculated using the discounted program expenditures.

In summary, the combined TPC R&D and TPC IRAP program expenditures of $2.8 billion plus Company Expenditures of $8.6 billion are forecasted to result in $11.4 billion of total expenditures. This is expected to result in $281.2 billion of resulting direct sales. Further, this will develop Canadian experience and capabilities that will be worth $72.6 billion in future sales for TPC Funded Companies (spinoffs), and $152.1 billion in future sales for other Canadian companies (diffusion). Note that the majority of this value is from estimates of direct sales, which are the benefits that are the most certain and which do not depend on the TPC valuation model.

When attribution, discounting, leakage, and displacement are considered, the impacts are as follows. The discounted (to 2005) program cost of $3.7 billion is forecasted to result in $15.2 billion in Canadian company expenditures. These expenditures will have a net impact of $7.8 billion in the Canadian economy and produce direct, spinoff, and diffusion sales representing another $18.8 billion in net impact. Finally it is estimated that these TPC derived products will have an economic benefit worth $5.7 billion to Canadian users. Overall, the net impact on the Canadian economy is estimated to be $32.3 billion, which is 8.6 times the program expenditures.

All forecasts of the future are inherently uncertain. This uncertainty has been addressed by assigning probability distributions to some of the input parameters (see Chapter 3).

Figure 11 shows the distribution for Total Sales. The mean[8] is $518 billion with a 90% probability range between $448 billion and $597 billion.

Figure 11: Total Sales Probability Distribution

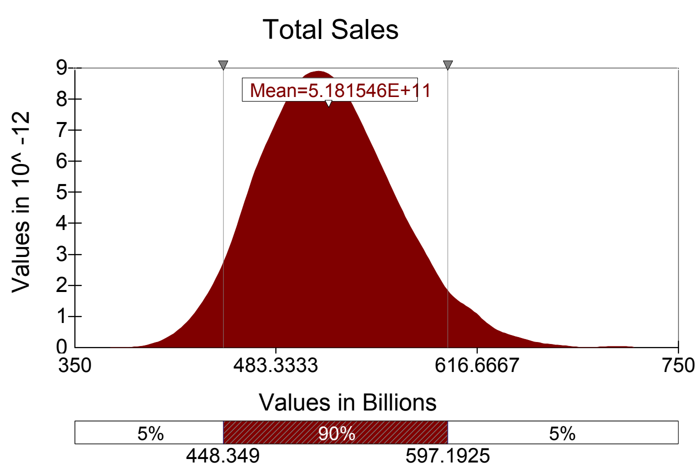


Figure 12 shows the distribution for the Total Discounted Impact. The mean is $32 billion with a 90% probability range between $30 billion and $35 billion.

8 The Monte Carlo simulation results and the results in Table 22 do not agree exactly due to the finite number of simulations (10,000) that were performed. The Monte Carlo results will converge to the results in Table 22 as the number of simulations approaches infinity.

Figure 12: Total Discounted Impact Probability Distribution

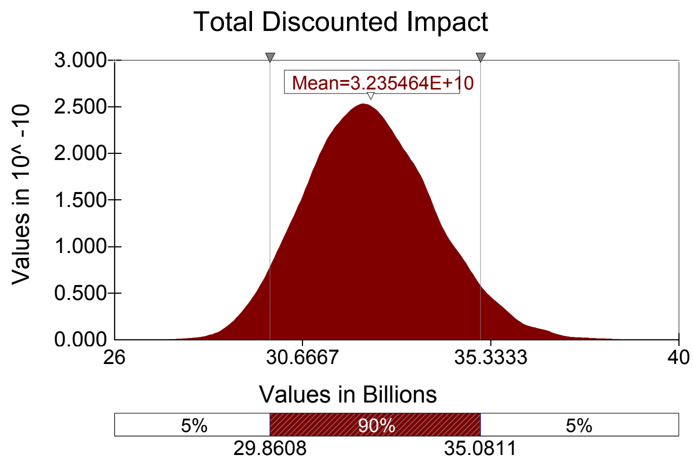


Figure 13 shows the distribution for the ratio of discounted impact to discounted program expenditures. The mean is 8.7 with a 90% confidence interval between 7.7 and 9.7.

Figure 13: Ratio of Discounted Impact to Discounted Program Expenditures Probability Distribution

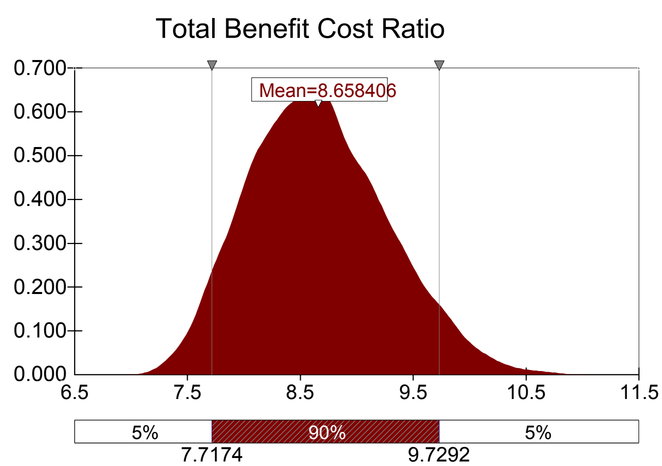
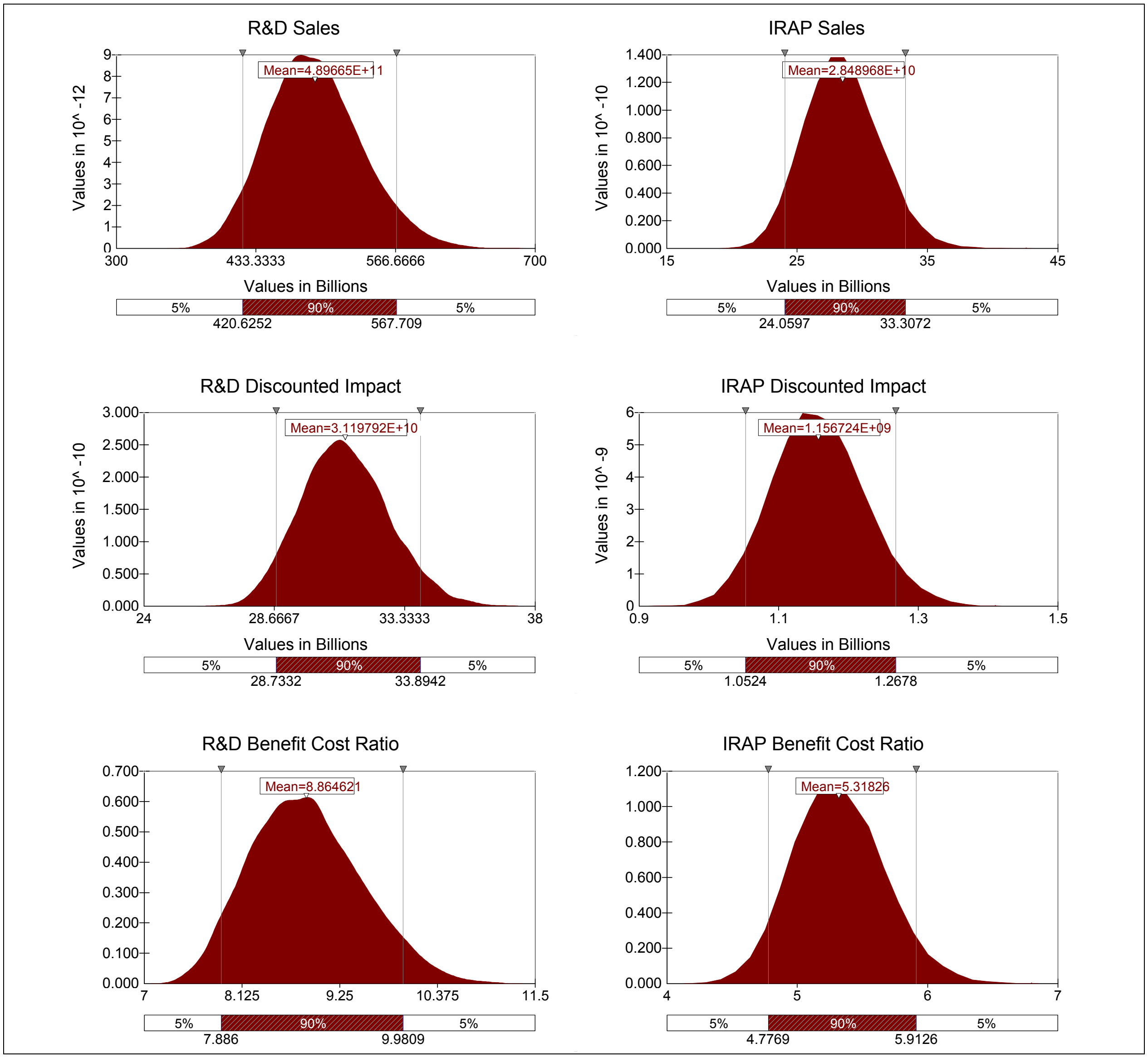


Figure 14 breaks down the total results into the TPC R&D and TPC IRAP components.

Figure 14: TPC R&D and TPC IRAP Sales, Discounted Impact, and Benefit Cost Ratio Probability Distributions



4.1.2 Impacts by Technology Area

Table 25 to Table 33 and Figure 15 to Figure 23 show the results by technology area.

Table 25: Aerospace & Defence R&D

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$1,577,873,748		$2,160,168,237	$1,058,482,436
Company Expenditures	$4,554,225,014		$6,093,483,533	$2,985,806,931
Total Expenditures	$6,132,098,762		$8,253,651,769	$4,044,289,367
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$205,230,421,334	$61,569,126,400	$26,980,034,425	$10,972,780,001
Spinoff Sales	$46,574,025,273	$14,903,688,087	$8,110,239,332	$3,298,434,337
Diffusion Sales	$113,281,983,112	$3,398,459,493	$747,695,785	$304,087,876
TOTAL	$371,218,528,480	$79,871,273,981	$44,091,621,312	$18,619,591,580

Figure 15: Aerospace & Defence R&D

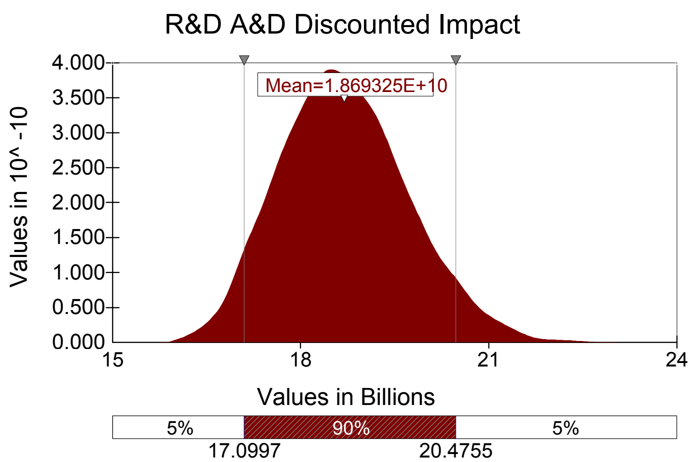


Table 26: Enabling Technologies R&D

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$588,868,270		$773,520,865	$348,084,389
Company Expenditures	$2,313,218,094		$3,142,966,949	$1,414,335,127
Total Expenditures	$2,902,086,364		$3,916,487,814	$1,762,419,516
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$13,876,328,319	$4,162,898,496	$3,011,327,243	$555,589,876
Spinoff Sales	$12,139,452,340	$2,913,468,562	$1,664,555,519	$307,110,493
Diffusion Sales	$11,606,834,910	$232,136,698	$56,147,866	$10,359,281
TOTAL	$40,524,701,933	$7,308,503,755	$8,648,518,442	$2,635,479,167

Figure 16: Enabling Technologies R&D

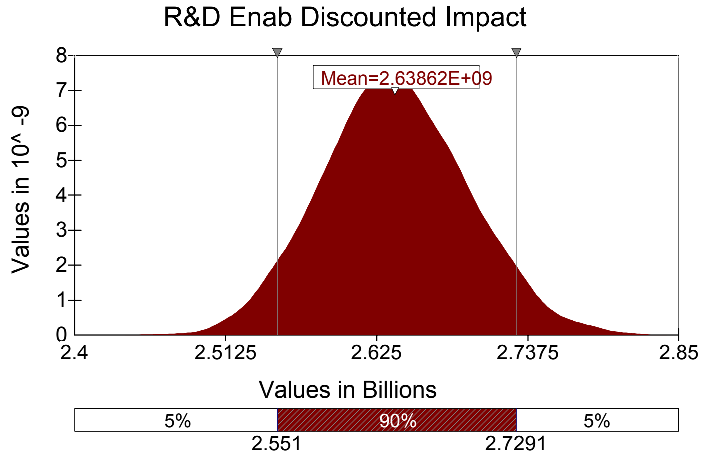


Table 27: Environmental Technologies R&D

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$474,366,266		$589,862,599	$412,903,819
Company Expenditures	$1,425,893,616		$1,784,829,073	$1,249,380,351
Total Expenditures	$1,900,259,882		$2,374,691,672	$1,662,284,171
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$56,303,474,945	$16,891,042,483	$8,735,716,625	$2,446,000,655
Spinoff Sales	$10,271,896,827	$2,773,412,143	$1,384,550,226	$387,674,063
Diffusion Sales	$8,647,024,583	$259,410,737	$51,734,746	$14,485,729
TOTAL	$77,122,656,236	$19,923,865,364	$12,546,693,270	$4,510,444,618

Figure 17: Environmental Technologies R&D

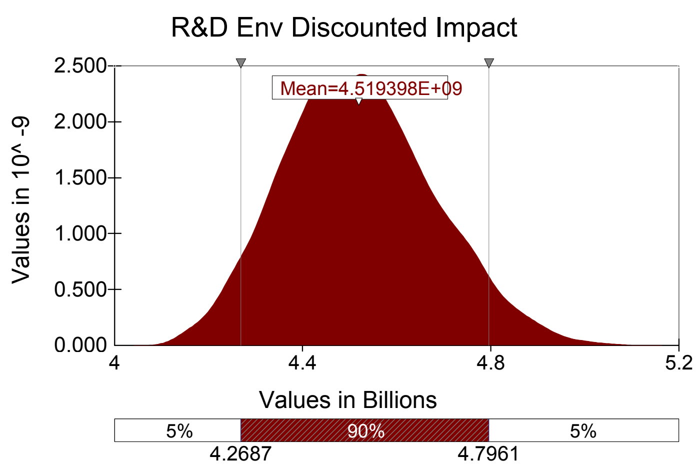


Table 28: Advanced Manufacturing IRAP

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$28,537,197		$41,738,806	$20,452,015
Company Expenditures	$63,593,067		$93,201,028	$45,668,504
Total Expenditures	$92,130,264		$134,939,834	$66,120,518
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$1,117,958,101	$335,387,430	$319,349,199	$92,323,854
Spinoff Sales	$810,475,254	$218,828,319	$147,778,050	$42,722,634
Diffusion Sales	$3,677,177,218	$110,315,317	$29,760,642	$8,603,802
TOTAL	$5,697,740,837	$664,531,065	$631,827,725	$209,770,808

Figure 18: Advanced Manufacturing IRAP

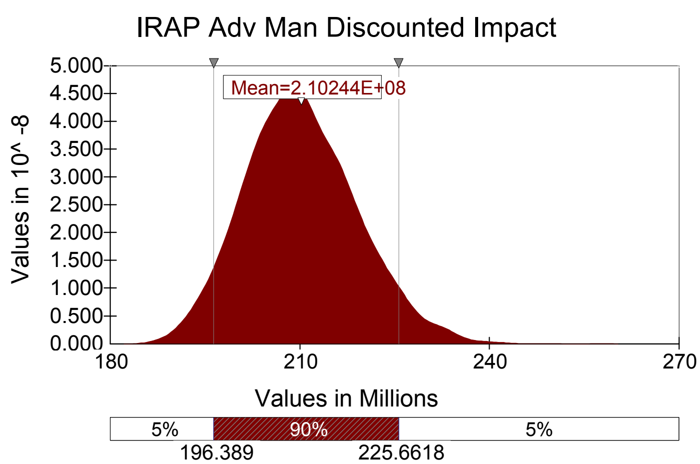


Table 29: Advanced Materials IRAP

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$10,225,002		$13,917,109	$8,906,950
Company Expenditures	$22,225,521		$29,929,787	$19,155,063
Total Expenditures	$32,450,523		$43,846,896	$28,062,013
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$407,608,553	$122,282,566	$99,684,564	$45,296,666
Spinoff Sales	$388,367,821	$120,394,024	$76,392,374	$34,712,695
Diffusion Sales	$1,827,508,993	$54,825,270	$14,727,443	$6,692,150
TOTAL	$2,655,935,890	$297,501,860	$234,651,277	$114,763,524

Figure 19: Advanced Materials IRAP

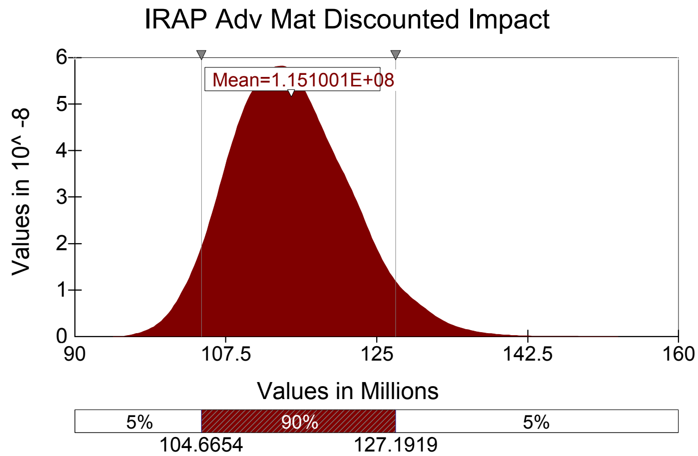


Table 30: Aerospace IRAP

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$4,290,944		$5,892,616	$2,887,382
Company Expenditures	$8,932,061		$11,967,594	$5,864,121
Total Expenditures	$13,223,005		$17,860,210	$8,751,503
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$164,249,853	$49,274,956	$47,093,907	$19,153,092
Spinoff Sales	$169,353,820	$54,193,222	$34,210,283	$13,913,322
Diffusion Sales	$1,085,785,546	$32,573,566	$8,313,424	$3,381,069
TOTAL	$1,432,612,224	$136,041,745	$107,477,823	$45,198,986

Figure 20: Aerospace IRAP

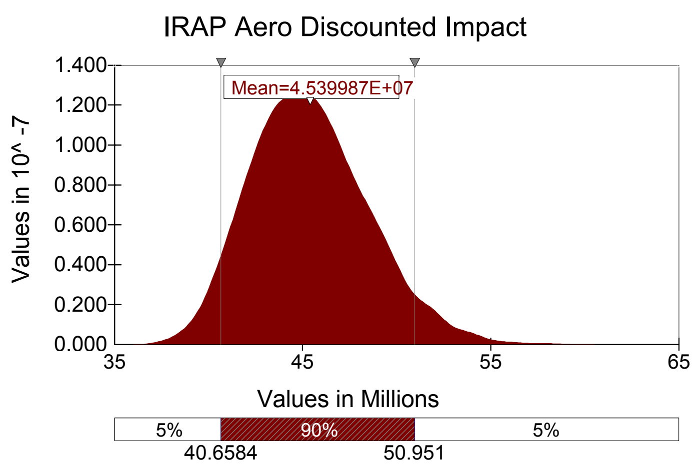


Table 31: Biotechnology IRAP

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$13,240,466		$18,467,765	$14,220,179
Company Expenditures	$29,227,608		$41,226,575	$31,744,463
Total Expenditures	$42,468,074		$59,694,340	$45,964,642
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$481,374,166	$144,412,250	$133,849,524	$17,520,903
Spinoff Sales	$384,399,509	$119,163,848	$75,794,651	$9,921,520
Diffusion Sales	$1,845,624,806	$55,368,744	$14,068,856	$1,841,613
TOTAL	$2,753,866,555	$318,944,842	$283,407,371	$75,248,678

Figure 21: Biotechnology IRAP

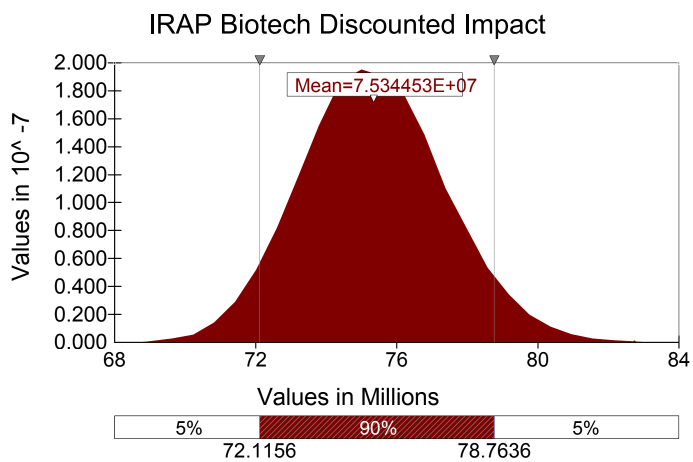


Table 32: Environment IRAP

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$15,329,292		$20,987,833	$14,691,483
Company Expenditures	$35,985,851		$50,016,946	$35,011,862
Total Expenditures	$51,315,143		$71,004,779	$49,703,345
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$543,201,045	$162,960,313	$134,017,656	$37,524,944
Spinoff Sales	$186,818,112	$41,099,985	$25,931,951	$7,260,946
Diffusion Sales	$3,607,410,972	$21,644,466	$5,455,574	$1,527,561
TOTAL	$4,388,745,272	$225,704,764	$236,409,961	$96,016,796

Figure 22: Environment IRAP

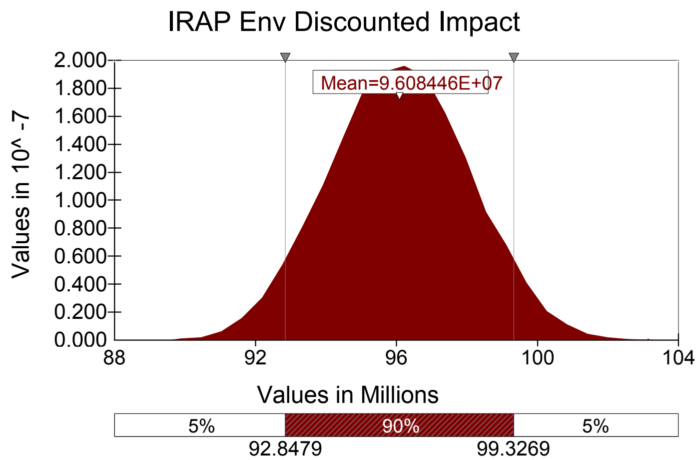
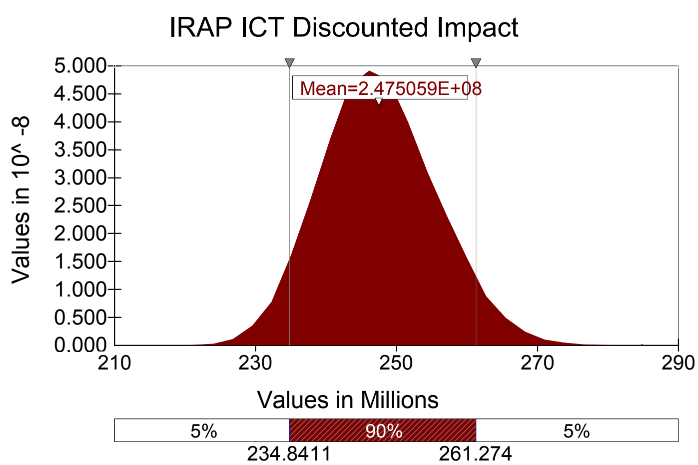


Table 33: ICT IRAP

Expenditures	Expenditures		Discounted Expenditures	Discounted Impact
Program Expenditures	$85,113,877		$116,611,050	$29,152,763
Company Expenditures	$191,106,789		$260,767,825	$65,191,956
Total Expenditures	$276,220,666		$377,378,875	$94,344,719
Impacts	**Sales**	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**
Direct Sales	$3,226,959,021	$968,087,706	$915,188,943	$114,398,618
Spinoff Sales	$1,625,359,141	$455,100,559	$291,591,173	$36,448,897
Diffusion Sales	$6,499,629,681	$58,496,667	$14,972,634	$1,871,579
TOTAL	$11,628,168,508	$1,481,684,933	$1,599,131,625	$247,063,812

Figure 23: ICT IRAP



4.2 Regional Impacts

Regional impacts have been calculated under the assumption that impacts will be proportional to regional program expenditures. Table 34 and Table 35 show the expected regional distribution of discounted impacts for the TPC R&D and TPC IRAP programs respectively.

Table 34: TPC R&D Discounted Impact Regional Distribution

		Aerospace & Defence	Enabling Technologies	Environmental Technologies
Total	1.00	$18,619,591,580	$2,635,479,167	$4,510,444,618
BC	0.12	$25,220,151	$13,797,694	$5,434,146
Prairies	0.03	$6,408,725	$3,506,150	$1,380,878
Ontario	0.42	$88,511,339	$48,423,674	$19,071,399
Quebec	0.39	$82,406,048	$45,083,530	$17,755,902
East	0.03	$7,224,545	$3,952,477	$1,556,661

Table 35: TPC IRAP Discounted Impact Regional Distribution

		Advanced Manufacturing	Advanced Materials	Aerospace	Biotech	Environment	ICT
Total	1.00	$ 209,770,808	$ 114,763,524	$ 45,198,986	$ 75,248,678	$ 96,016,796	$ 247,063,812
BC	0.19	$ 39,987,938	$ 21,877,004	$ 8,616,138	$ 14,344,415	$ 18,303,375	$ 47,096,984
Prairies	0.21	$ 43,710,834	$ 23,913,763	$ 9,418,305	$ 15,679,887	$ 20,007,428	$ 51,481,736
Ontario	0.31	$ 65,896,041	$ 36,051,069	$ 14,198,516	$ 23,638,132	$ 30,162,094	$ 77,611,024
Quebec	0.20	$ 41,737,219	$ 22,834,018	$ 8,993,053	$ 14,971,914	$ 19,104,060	$ 49,157,252
East	0.09	$ 18,438,775	$ 10,087,670	$ 3,972,974	$ 6,614,330	$ 8,439,840	$ 21,716,816

4.3 Employment Impacts

Employment impacts have been calculated under the assumption that employment will be proportional to sales. Table 36 and Table 37 show the expected regional distribution of employment impacts, in terms of total person-years, for the TPC R&D and TPC IRAP programs respectively.

Table 36: TPC R&D Person-Years Employment Regional Distribution

		Aerospace & Defence	Enabling Technologies	Environmental Technologies
Total	1.00	67,708	17,570	30,070
BC	0.12	8,140	2,112	3,615
Prairies	0.03	2,069	537	919
Ontario	0.42	28,569	7,413	12,688
Quebec	0.39	26,598	6,902	11,813
East	0.03	2,332	605	1,036

Table 37: TPC IRAP Person-Years Employment Regional Distribution

		Advanced Manufacturing	Advanced Materials	Aerospace	Biotech	Environment	ICT
Total	1.00	1,049	574	164	502	640	1,647
BC	0.19	200	109	31	96	122	314
Prairies	0.21	219	120	34	105	133	343
Ontario	0.31	329	180	52	158	201	517
Quebec	0.20	209	114	33	100	127	328
East	0.09	92	50	14	44	56	145

4.4 Non-Economic Impacts

The use of TPC technology brings impacts that include economic benefits, but also extend to other benefits that cannot be expressed in economic terms, such as public health, sovereignty and security, environment, social, physical assets and advancement of knowledge. Some of these impacts accrue to the users of the information; many also accrue to society in general.

Domestic impacts all accrue to Canada. Foreign impacts accrue to Canada only to the extent that Canadians benefit from impacts in other countries. For example, Canadians may benefit from the advancement of knowledge and contributions to the environment in other countries, but they probably do not benefit from contributions to economics, sovereignty and security, and public policy in other countries. We have only considered domestic non-economic impacts in this analysis.

The magnitude of the impacts depends on the degree of benefit in a particular instance, and the amount of use overall. Table 38 and Table 39 give a qualitative indication of the relative impact of TPC technology by impact type and application area. Interpretation of these numbers must be done with care:

- The numbers have no absolute meaning[9], however comparisons among the numbers do provide an indication of relative impact.

- Comparisons can be made among applications within an impact type (i.e. within rows). Comparisons among impact types within applications (i.e. within columns) are not valid; this is because the impact types are inherently different and cannot be compared directly.

Table 38: Non-Economic Benefits, TPC R&D

	Aerospace and Defence	Enabling Technologies	Environmental Technologies
Public Health	14.18	25.14	13.99
Sovereignty & Security	20.79	9.52	7.16
Environmental	17.46	42.71	7.56
Social	14.92	23.35	17.51
Physical Assets	20.54	14.85	9.00
Advancement of Knowledge	20.42	17.22	12.72

Aerospace and Defence ranks very highly in all cases. This is because of the amount spent in this sector, more than the degree of benefits for a particular user.

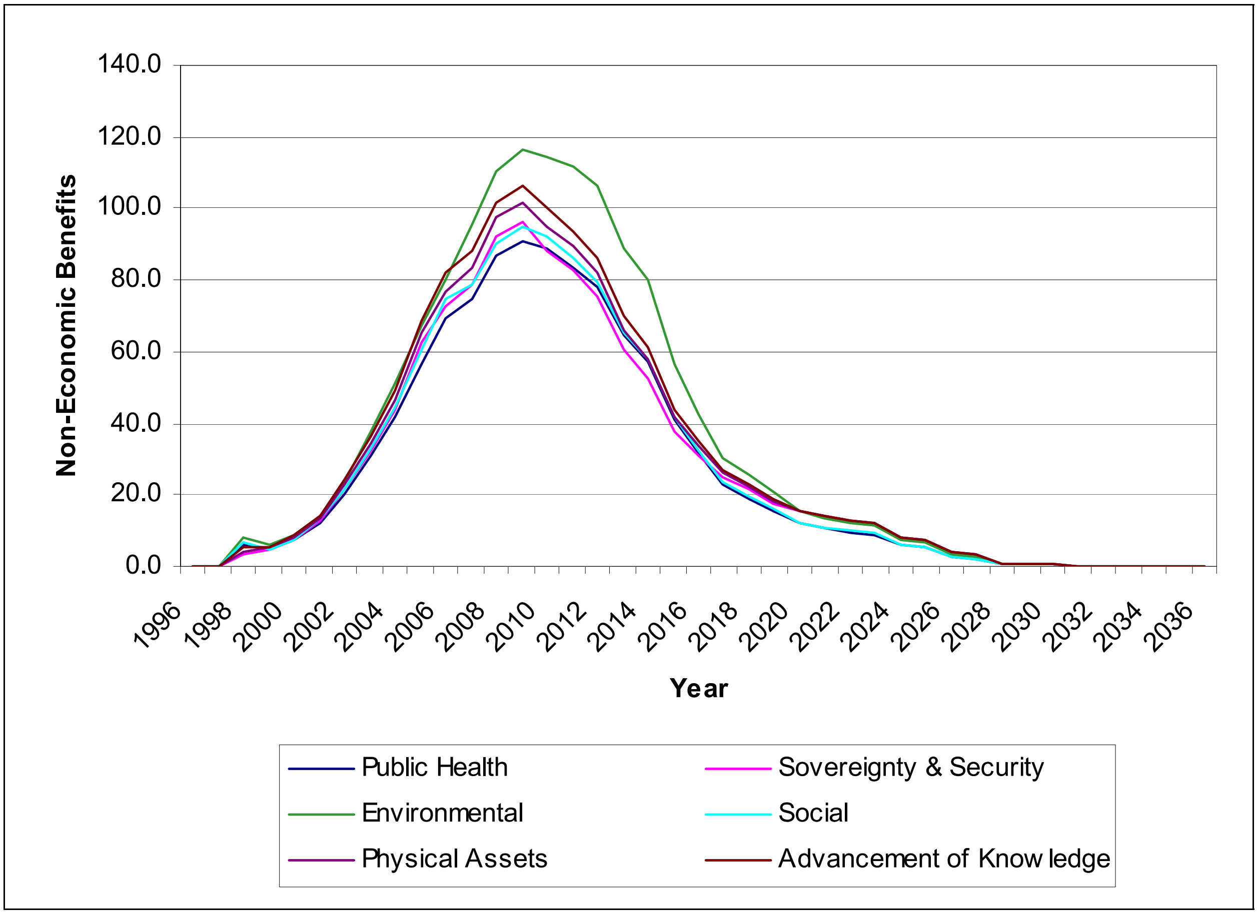
Table 39: Non-Economic Benefits, TPC IRAP

	Advanced Manufacturing	Advanced Materials	Aerospace	Biotechnology	Environment	Information Technology
Public Health	0.75	0.09	0.03	1.21	0.48	1.12
Sovereignty & Security	0.32	0.09	0.05	0.40	0.18	1.01
Environmental	0.54	0.21	0.04	0.37	0.81	1.01
Social	0.54	0.09	0.04	1.19	0.44	2.22
Physical Assets	0.32	0.21	0.05	0.54	0.28	1.13
Advancement of Knowledge	0.75	0.17	0.05	0.62	0.33	1.93

Figure 24 shows the time profile for the non-economic benefits.

[9] Numbers are the product of the value of sales (as a proxy for amount of use) and relative qualitative impact.

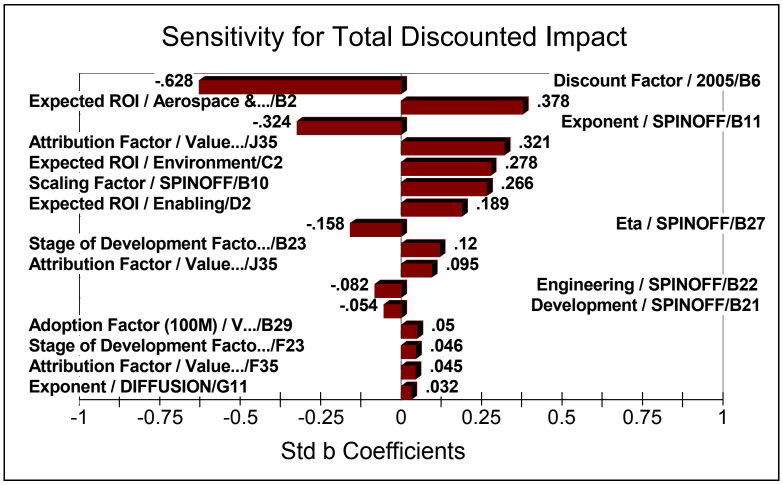
Figure 24: Time Profile of Non-Economic Benefits



4.5 *Sensitivity*

Figure 25 shows a tornado diagram for the major sources of sensitivity for the model input parameters that were assigned probability distributions. The two parameters that have the most impact are both discount rates: 1) the discount factor for the net present value calculations, and 2) the expected ROI of technology users. In the case of the discount factor, a higher value decreases impacts and is therefore more conservative (a triangular distribution with a peak of 10%, a minimum of 8%, and a maximum of 12% was used). In the case of the expected ROI, a higher value increases impacts and is therefore less conservative (a normal distribution with a mean value of 20% and a standard deviation of 5% was used for all technology areas).

Figure 25: Sensitivity for Total Discounted Impact



4.6 Validity

Having produced estimates on returns, it is important to ask whether these estimates are, in fact, reasonable. Do they, for example, under-state or over-state the impacts? This is, of course, an empirically difficult proposition given the inherent uncertainty associated with technological innovation.

One approach is to assess the validity of the estimates through comparisons with those from other technology impact studies. In the following sections, impacts have been compared with estimates available in the literature on socio-economic returns to R&D investments, and with the overall benefit/cost ratios in studies evaluating the US Advanced Technology Program (ATP), a program that is similar in objectives and design to Canada's TPC.

4.6.1 The Diffusion Literature

Diffusion of knowledge and skills results in TPC activities accruing to firms other than TPC Funded Companies. Among the earliest efforts to quantify diffusion was the work of Terleckyj (1974) who examined diffusion embodied in intermediate products including capital equipment. He estimated that the productivity improvements from R&D in downstream industries implied an excess return to industry R&D of 20% to 50%.[10] Similar results were found by Mansfield, et al (1977), who identified 17 specific innovations, and attempted to estimate the actual cost and overall social benefits of each. For these technologies, the median private rate of return was about 25% and the median social rate of return was about 50%.[11] These figures compare to an additional return of 30% for diffusion sales calculated in this study for TPC.

[10] This section is drawn from a summary of the literature on knowledge spillovers by A. Jaffe (1996) Economic Analysis Of Research Spillovers Implications For The Advanced Technology Program, Economic Assessment Office, Advanced Technology Program. http://www.atp.nist.gov/eao/gcr708.htm#II.B

[11] Ibid.

4.6.2 The Advanced Technology Program

The usefulness in comparing the HAL estimates to those from ATP studies stems from similarity of the program itself and the quality and quantity of quantitative evaluations of the ATP program itself. ATP began operations in 1990 with the goal of funding early-stage development of innovative technologies that show promise of significant commercial payoffs and widespread national benefits. Between 1990 and September 2004, ATP awarded $2.3 billion on a competitive basis, funding over 750 projects, with industry contributing a further $2.1 billion.

Table 40 summarizes the program statistics for ATP and TPC, along with economic impact figures from the literature and the HAL model respectively. Although extensive evaluations have been conducted on the ATP program, few carry out a full-scale quantitative valuation study as has been done here for TPC. Nonetheless, the studies do provide some indication of the type of returns technology programs can generate. One study of the ATP component-based software focused program, found the benefit cost ratio to be 10.5 with a net present value of the investment projected to be $840 million. This estimate, according to the authors, is deemed conservative due to the fact that benefits were calculated from just eight of the projects but included costs of all 24. Also, the authors note that the measures assumed very limited life spans for resulting products relative to their likely potential. In figures prepared by the ATP Economic Assessment Office, a total economic benefit of $17 billion was calculated from an analysis of 41 projects, though it is not clear from the study whether such a figure is fully attributable to ATP. Finally, in a third study, this one of a single project, ATP's HDTV joint venture project, a more conservative benefit / cost ratio of 4.2 was achieved, with an approximate NPV of net benefits of $US166 million. These results are in reasonable agreement with those of this study that found a benefit cost ratio of 8.6 for TPC.

Table 40: Comparison of TPC and ATP, selected indicators

	TPC R&D	TPC IRAP	ATP
Objectives	▪ Support for projects in technology areas that will produce economic, social and environmental benefits	▪ Support for SMEs with projects valued under $3 million	▪ Development of high-risk, enabling technologies
Supported sectors	▪ Aerospace & Defence 59% ▪ Enabling Tech. (IT, Biotech) 22% ▪ Environmental Tech. 18% ▪ H2 Early Adopters 1%	▪ Adv. Manufacturing 18% ▪ Advanced Materials 7% ▪ Aerospace 3% ▪ Biotechnology 8% ▪ Environment 10% ▪ ICT 54%	▪ Adv. Materials & Chemistry 21% ▪ Biotechnology 20% ▪ Electronics and Photonics 25% ▪ IT 23% ▪ Manufacturing 11%
Cost sharing of project costs	▪ 40%	▪ 38%	▪ Joint-ventures – 50% ▪ Large companies – 60% ▪ SMEs – indirect costs.
Economic impact	▪ Benefit cost 8.8	▪ Benefit cost 5.3	▪ Benefit cost of 10.5 (White et al. 2002[12]) for component-based software ▪ $17 Billion in net economic benefits from 41 projects to date (ATP 2004 Annual report[13]) ▪ Benefit cost of 4.2 (White et al. 2004) for ATP's HDTV Joint Venture project along with an estimated social rate of return of 28.6%[14]
Projects	▪ 278	▪ 420	▪ 768
Program Contributions	▪ $2,641 million	▪ $157 million	▪ $US 2,269 million
Industry Contributions	▪ $8,343 million	▪ $351 million	▪ $US 2,102 million

12 W. J White, M. Gallaher (2002) Benefits and Costs of ATP Investments In Component-Based Software, Economic Assessment Office Advanced Technology Program,National Institute of Standards and Technology Gaithersburg MD 20899-4710. http://www.atp.nist.gov/eao/gcr02-834/gcr02-834.pdf

13 Mearuring ATP Impact, 2004 Report on Economic Progress, ATP Economic Assessment Office, http://www.atp.nist.gov/eao/2004annual/2004annual.pdf

14 W. J. White and A. O'Connor, (2004) 'Economic Impact of the Advanced Technology Program's HDTV Joint Venture', ATP Economic Assessment Office, NIST GCR 03-859. http://www.atp.nist.gov/eao/gcr03-859/contents.htm

A. TPC Valuation Model Description

A.1 Introduction

A.1.1 Modelling Parameters

Inputs to the Model include:

- Expenditures: Total expenditures of the activity that generate spin-off benefits. This includes both public and private sector investment.
- Type of activity: Accounts for the nature of the activity funded. Speculative activity with a large research component will have larger spin-offs than a contract for a deliverable (e.g. hardware) which requires little or no new technology development.
- Incrementality and attribution: Incrementality refers to the difference in impacts and effects in Canada between what would have happened without the supported activity and what did (or will) happen with the activity. An attribution factor determines what portion of the total economic activity is justifiably attributable to the supported activity (i.e. accounts for the other contributing factors).
- Other model parameters: Includes import content, number, and size of firms in sector, and sponsorship.

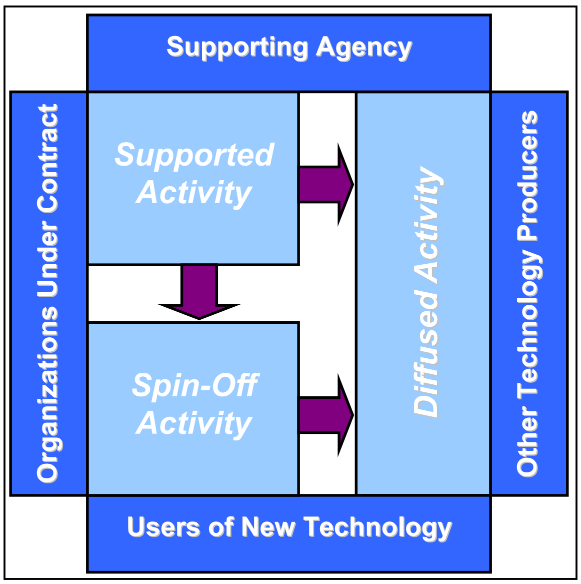
A.1.2 Categories of Benefits: Supported Activity, Spin-offs and Diffusion

Economic returns from technology come from the commercialization and application of the technology rather than from its development. Economic activity resulting from a million dollars worth of development of technology is essentially the same as from a million dollars worth of road building (or any other activity). The development of technology creates greater returns from investment because of its commercialization and application potential. When assessing the potential payoff from technology development, these downstream benefits must be identified and estimated. This assignment is concerned with the estimation of these downstream benefits (spin-off and diffusion) from the public support of R&D and the development of technology.

In the Model, we define public support of R&D and technology development as Supported Activity. The basic challenge of this study is the estimation of expected cumulative associated downstream benefits resulting from specific program supported activity.

The categories of Supported, Spin-Off and Diffused Technology impacts are illustrated in Figure 26. The direct output from the technology development program is Supported Activity, which consists of deliverables to the public sector and direct sales from products developed under contract.

Figure 26: Supported Activity, Spin-off Activity, and Diffused Activity



Supported Activity leads to Spin-Off Activity within the same firms or organizations under contract to the sponsoring agency. This Spin-Off Activity results from the expertise and capabilities attained through their involvement in the Supported Activity. Possession of a skilled and experienced labour force, production facilities, technological and project management expertise, and so on, will make a significant contribution to the competitiveness of the industrial team in other product markets, and in both Canadian and world markets.

Technology that is developed under contract will be diffused throughout the industrial sectors in Canada. Thus, Diffused Technology Activity results in products from technology-producing firms other than firms who have undertaken supported activity.

Benefits from the use and application of spinoff and diffused technologies in Canada, other than for the firms that produce and sell those technologies, are very difficult to estimate. The benefits that accrue are often in the form of improved product quality or lower cost production in the field of application. Such improvements improve the competitiveness of Canadian firms and result in economic development benefits. There are also qualititative benefits that need to be taken into account such as environmental, sovereignty and security, social, health, and advancement of knowledge benefits. It is recognized, however, that many such new technologies would likely be developed even without the technology development program within some timeframe and in some country. The only benefits that can legitimately be counted here are those resulting from the advanced timeliness of such developments for Canadian firms because of the development in Canada of the spinoff technologies.

A.2 Model Concepts

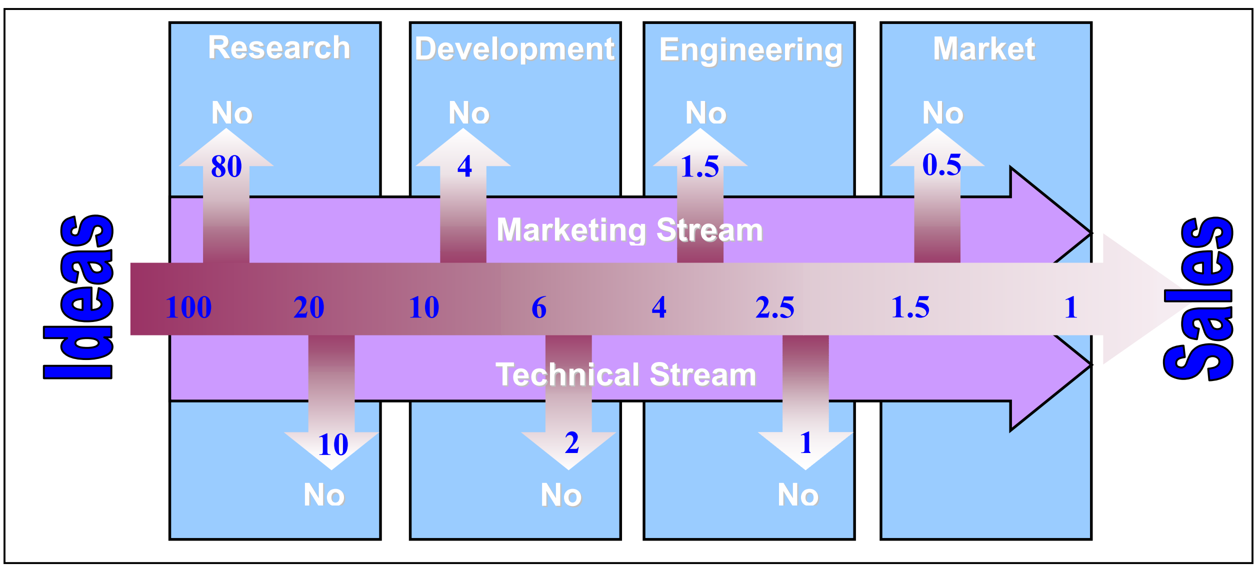
The Model estimates the sales of spin-offs and diffusion of technologies developed under public sector initiatives. The underlying concepts for this Model come from an understanding of the innovation adoption process (Section A.2.1) and incrementality and attribution (Section A.2.2). Section A.2.3 illustrates how supported activity leads to spin-offs and diffusion.

A.2.1 Innovation Adoption Process

From past work, HAL has developed a descriptive model of the innovation development process from basic research to commercialization. We apply this descriptive model to define the stage of development of activity associated with Spin-Offs and Diffused Technology. This stage of development is then used to define the probability of achieving commercial success for a Spin-Off or Diffused Technology Activity, and to determine "downstream" or future expected costs of commercialization. This model is also applied to define the delay and time response of expected activity commercial resulting from R&D activity.

The innovation development process can be characterized as comprising four stages of activity (Research, Development, Engineering, Market) with three major decision points (a Go/No Go decision after each of the first three stages). This four-stage process is illustrated in Figure 27.

Figure 27: Simplified Four-Stage Innovation Development Process Model



As shown, the typical R&D and innovation development process begins with many "ideas" only a few of which survive the inevitable assessments during investigation, research and development. The typical process is characterized by 20 "projects" at the output of the research stage for every project that is fully successful through market development to commercialization.

The typical number of projects at each stage for each successful project, can be interpreted in probabilistic terms to define probabilities of success. Using the average numbers of projects at each stage, the probability of a given idea reaching successful commercialization is one in a 100, or one percent. After successful completion of the research stage, the probability of commercial success is increased to one in 20, or five percent.

Assuming that a successful project would generate one million dollars of sales, the expected sales from any given project at any stage in the process would be the product of the cumulative probability and the sales of $1,000,000. From the (output of the) research stage, the expected sales would be 0.01 times $1,000,000, or $10,000, per project.

Costs of research, development, engineering and market development vary widely depending on the product, the innovation, the technology, the firm, the sector, etc. Surveys and analyses have been undertaken and aggregate average values exist in the literature[15]. For the high-technology sector, typical values for expenditures by stage of development (as a percentage of revenue or sales) are ten percent for R&D, ten percent for Engineering and 15 percent for marketing. These typical values have been calculated to include average allocations for G&A and profit--that is, the typical cost estimates for G&A and for profit have been allocated proportionally to engineering, marketing and costs of production.

These average cost estimates have been applied in the four-stage innovation development process model shown in Table 41. The appropriate probabilities of success from each stage, the probabilities of a project surviving the decision process, and the cumulative probabilities of success from each stage through all future stages to successful market development are also illustrated.

Table 41: Four-Stage Process Model with Probabilities and Costs

	Research		Development		Engineering		Market	
Total Cost of Stage	$50,000		$50,000		$100,000		$150,000	
	In	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**
Number of Projects	100	20	10	6	4	2.5	1.5	1
Cumulative Probability of Sales	0.01	0.05	0.1	0.167	0.25	0.4	0.667	1.0
Cost per Project	$500	$2,500	$5,000	$8,333	$25,000	$40,000	$100,000	$150,000
Sales / Project Cost	2,000	400	200	120	40	25	10	6.7

15 We have based our estimates on data presented in “Technology Venturing in Canada: A Guide to the Commercialization of the Results of Federally Funded Research in Your Community” prepared for the Ministry of State for Science and Technology, by Denzil Doyle, 1986.

Prob. x Sales **Project Cost**	20	20	20	20	10	10	6.7	6.7
Stage of Development Factor	2.9		3.3		4.0		6.7	

As illustrated in Table 41, the ten percent cost allocation for R&D has been divided equally between the research stage and the development stage. The average cost per project in each stage, and the ratio of sales to this average project cost, are shown in the table. This ratio of sales to the cost of the specific successful project at a given stage can be very large; i.e., the sales payoff for that one successful project can be as high as 2000 or 400 to one in the research stage. (The problem, of course, is to identify which project at these early stages will be successful.) These large ratios of sales to development costs are typical, and are sometimes quoted in a misleading way.

A more meaningful ratio is the expected sales (sales multiplied by the probability of successfully achieving the sales) divided by the project cost at each stage. These ratios are also shown in Table 41, and are the more typical 20 to one for the R&D stages, ten to one for the engineering stage, and 6.7 to one for market development.

A more useful ratio of sales per unit cost takes into account the costs of the "downstream" stages of development. This ratio is defined by apportioning expected sales between the current stage and all downstream stages in proportion to the expected costs of each stage. These apportioned expected sales are then divided by the current stage average project cost to yield a ratio of apportioned sales per unit project cost. Such a ratio recognizes that to achieve successful sales, there are future project costs to be incurred, and such future stages need to share the expected successful sales to justify their costs.

We define this ratio as the **Standard Spinoff Ratio**. It is essentially a "Spinoff" ratio - that is, a measure of the expected sales resulting from an R&D activity. The lower values at the earlier stages are consistent with the realization that government support is appropriate at these stages.

A.2.2 Incrementality and Attribution

Economic activity can be associated with supported activity in many ways. In this Model, we identify several factors that help determine what fraction of associated economic activity is justifiably attributable to the supported activity. Only the incremental and attributable activity is justifiably used to estimate the economic impacts of the supported activity. This interpretation of economic impact is stricter, and therefore tends to result in lower impact estimates, than that applied in many economic analyses. Comparisons with the results from other analyses, therefore, should include a comparison of the definitions of associated economic activity.

Incrementality refers to the difference in impacts and effects in Canada, and elsewhere if appropriate, between what would have happened without the supported activity and what did (or will) happen with the activity. If nothing changes as a result of this activity, impacts and effects are the same with and without, and the supported activity is said to have zero incrementality.

Even if the supported activity makes incremental differences in impacts, some fraction of the impacts may logically be attributable to other activity, funding sources, organizations or stimulants. To the extent these other sources can be identified, they should share in the allocation of impacts and effects associated with the supported activity.

Funding sources for activity associated with the supported activity other than from the funding source under review require particular attention. This additional funding has two effects: it increases the amount of activity, but the impacts of the activity must be allocated to their respective funding sources.

For Spin-Off Activity, incrementality is defined as the same as that for the associated Supported Activity. It is recognized, however, that there may be other factors contributing to the success of the Spin-Off Activity, and these factors are assessed as a separate attribution factor.

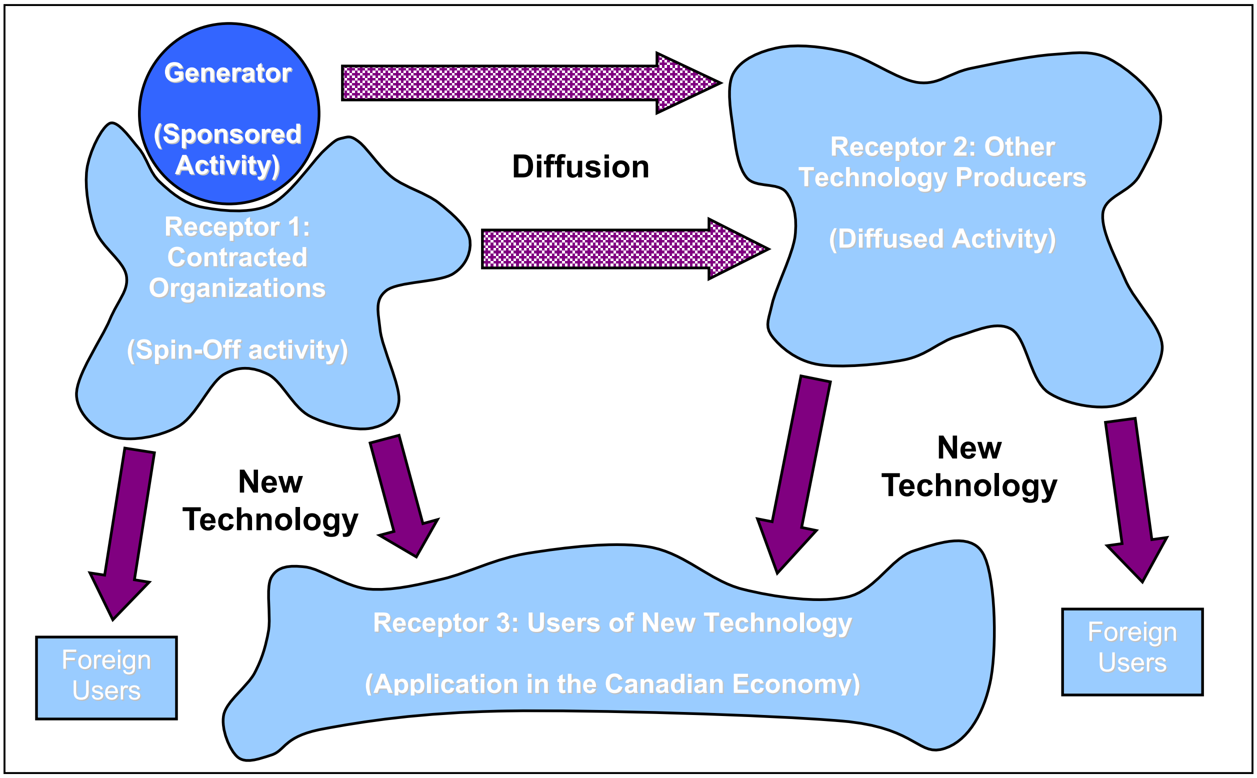
Diffused Technology Activity is stimulated by both Supported and Spin-Off Activity. The magnitude of the Diffused Technology Activity is related to the incremental and attributed Supported and Spin-Off Activity. In this way, the assessments of incrementality and attribution for the Supported and Spin-Off Activity are already automatically taken into account in the estimation of the size of Diffused Technology Activity. A further attribution to other sources for Diffused Technology Activity is assessed based on the expected nature of the activity, how it is linked to the supported activity, and what other influences there may be on the Diffused Technology Activity.

The assessments of incrementality and attribution are accounted for in the Model by means of multiplicative factors between zero and unity.

A.2.3 Generators and Receptors

An illustration of the process of how supported activity leads to spin-offs, and how these two activities lead to diffused technology, is given in Figure 28. In this figure, the initial Generator is identified as the Supported Activity that is closely linked to Receptor 1 where spin-offs are produced. Receptor 1 is the collection of firms (and other organizations, if appropriate) that are involved in the Supported Activity. By our definition, Spin-Off Activity takes place only in these organizations.

Figure 28: Generators and Receptors in Spin-Offs and Diffusion



Once Supported Activity and Spin-Off Activity is underway, the diffusion process transmits certain ideas, information, licences, etc. to a broader set of firms and organizations which are illustrated as Receptor 2 in the figure. These organizations are still **producers** of technology, but they are once removed from the organizations which are involved in the supported activity. This group (Receptor 2) receives stimuli from both the Supported Activity and the Spin-Off Activity.

The **linkage** between the (Supported Activity) Generator and Receptor 1 is very close--there is usually a contractual linkage. The linkages between these activities and Receptor 2 is much more tenuous than that between the (Supported Activity) Generator and Receptor 1.

There is a set of organizations called Receptor 3 which represents the Users of New Technology in the Canadian Economy. It is within these firms that the new technologies will be put to use to reduce costs of production, to improve product quality or to develop new products.

A.2.4 Factors Affecting Spin-Offs and Diffusion

Estimating spin-offs and the extent of technology diffusion is not straightforward. Identifying the direct linkage between supported activity and spin-offs is often problematical, even for known spin-offs over historical time periods.

Factors which characterize the relationship between supported activity and spin-offs or the adoption of innovations include:

- The capability of firms that undertake the supported activity to pursue spin-offs and innovations at the same time as performing the supported activity;
- The capability and desire of private business to investigate and evaluate new technologies;
- The number of firms or entrepreneurs that have access to a specific new technology;
- The degree of linkage between firms that have the interest and desire and the firms that have direct access to the new technologies (usually via the supported activity); and
- A long list of product and market development factors (time lags due to certification, registration, patenting, etc., competition from foreign sources, market conditions, business conditions, etc.).

These considerations are used to define the functional form of the Model, as discussed in Section A.3.

A.3 The Spinoff Component

A.3.1 Basic Form of the Model

A simple approach to calculating spin-off sales is to relate this value linearly to R&D or supported activity. In these applications, scalar parameters from less than five and up to 20 have been used and justified on the basis of specific examples.

In the Model, we have extended this simple linear model which links spin-offs to supported activity to account for some of the factors discussed in Section A.2. The Model is motivated by the observations that:

- A given amount of supported activity will likely lead to greater spin-off and/or technology diffusion activity if more firms (or more people) are involved; and
- For a given firm or set of firms undertaking a common supported activity, it is unlikely that doubling the expenditure on the supported activity will double the resulting spin-off and/or technology diffusion activity.

Consideration of a few hypothetical examples leads to the functional form for the Model outlined below. It seems reasonable to expect that doubling the level of the supported activity while at the same time doubling the number of firms involved in the supported activity would double the expected level of spin-off activity. This is consistent with the situation of having two separate programs sponsoring activity in two separate technology areas. For the Model to operationalize the two observations listed above and preserve the constant returns to scale characteristic illustrated in the example just cited, the following form is suggested:

$$Spinoffs = Constant \times (Level\ of\ Sponsored\ Activity)^{a} \times (Number\ of\ Firms)^{1-a}$$

With this form, a doubling of both the expenditure on supported activity and involving twice as many firms will double the expected spin-offs. The relative importance of the level of supported activity and the number of firms in determining spin-off sales can be adjusted by setting the exponent parameter a to different values between zero and one. Setting the parameter a equal to unity would, of course, let the model degenerate into a simple linear relationship between spin-offs and supported activity.

These observations were the motivation for the development of the model described below.

$$\begin{bmatrix} \textit{Response in} \\ \textit{Receptor} \\ \textit{(Sales)} \end{bmatrix} = M \begin{bmatrix} \textit{Standard} \\ \textit{Spinoff} \\ \textit{Ratio} \end{bmatrix} \times \begin{bmatrix} \textit{Generator} \\ \textit{Activity} \\ \textit{Stimulus} \end{bmatrix}^{a} \times \begin{bmatrix} \textit{Innovation} \\ \textit{Adoption} \\ \textit{Factor} \end{bmatrix}^{1-a}$$

Based on the form of a model suggested above, we have formulated a descriptive, quantitative model of the Spin-Off and Diffused Technology process as follows:

In this formulation, the terms are defined as follows:

- The **Response in the Receptor** refers to spin-offs, or to diffused technology, defined in terms of cumulative (over all future time) sales (in constant dollars). This response occurs in a group of firms which form the receptor associated with the driving force (stimulus).

- The **Factor M** represents a set of multiplicative factors to account for incrementality, attribution and a scaling factor.

- The **Standard Spin-Off Ratio** specifies the typical response to a stimulus (e.g., an R&D activity) in the innovation development process.

- The **Generator Activity Stimulus** refers to the driving force for the spin-off, or for the diffused technology, and is measured in terms of cumulative expenditure (in constant dollars). For spin-offs, the generator activity is the Speculative Portion (as defined in Section A.3.2) of the Supported Activity, and for diffused technology, the generator activity is the sum of the Supported Activity and the Spin-Off Activity.

- The **Innovation Adoption Factor** is an expansion of the "number of firms" factor introduced above.

These parameters and variables are described in more detail below.

A.3.2 Spinoff Sales

The Model recognizes two categories of Supported Activity: Speculative and Deliverable.

Speculative supported activity is the true technology development or R&D activity, activity that encompasses a certain degree of risk associated with R&D. Deliverable supported activity is procurement of technology by government for a specific purpose or application. Such activity generates spin-offs and diffusion but in a different manner than supported R&D activity.

Each category of supported activity will generate spin-offs, but under different circumstances and with different multipliers. Our approach to spin-offs based on the innovation development process applies to the speculative category of supported activity. For the deliverable category of supported activity, we apply a simple multiplier type of spin-off model. Such an approach adequately represents the assumed underlying processes linking spin-offs to this kind of supported activity, that is, spin-offs resulting from the increased capability resulting from learning new techniques due to participation in the technology development, and increased exposure and image associated with the specific deliverable.

The spin-off response is estimated separately for each of these categories. It is spin-offs from the Speculative category of Supported Activity that is usually more significant (in magnitude) and more complex to model. It is the Speculative category to which the above described models are applied.

Motivated by the considerations described above, and the model of the innovation development process, the Model Spin-Off component becomes:

$$\begin{bmatrix} \textit{Cumulative} \\ \textit{Spinoff} \\ \textit{Sales} \end{bmatrix} = K \begin{bmatrix} \textit{Incrementality} \\ \textit{\& Attribution} \\ \textit{Factors} \end{bmatrix} \times \begin{bmatrix} \textit{Standard} \\ \textit{Spinoff} \\ \textit{Ratio} \end{bmatrix} \times \begin{bmatrix} \textit{Total Spec.} \\ \textit{Sponsored} \\ \textit{Activity} \end{bmatrix}^{a} \times \begin{bmatrix} \textit{Innovation} \\ \textit{Adoption} \\ \textit{Factor} \end{bmatrix}^{1-a}$$

where K is a scaling constant, the Incrementality and Attribution Factors account for all aspects of incrementality and attribution for spin-offs related to the Supported Activity, the Standard Spin-Off Ratio is as defined above, the Total Speculative Supported Activity includes the amount of the supported funding from other than sources under review, and the Innovation Adoption Factor is as defined below.

A.3.3 Innovation Adoption Factor

The Innovation Adoption Factor is defined by:

$$\begin{bmatrix} \textit{Innovation} \\ \textit{Adoption} \\ \textit{Factor} \end{bmatrix} = \begin{bmatrix} \textit{Number} \\ \textit{of} \\ \textit{Firms} \end{bmatrix} \times \begin{bmatrix} \textit{Size} \\ \textit{of} \\ \textit{Firms} \end{bmatrix} \times \begin{bmatrix} \textit{Degree of} \\ \textit{Linkage to} \\ \textit{Activity} \end{bmatrix}$$

The product of the "number of firms" and the "size of firms" measures the aggregate size of the receptor for the Spin-Off or Diffused Technology Activity. The "size of firms" is measured in terms of average annual sales or revenue for the firms involved. These size factors account for the effect that innovations or opportunities that have been identified have a greater chance of progressing through all stages of development and marketing, and reaching the market place in a larger firm than in a smaller one. This effect is intended to take into account only the business and management risks involved; technical risks associated with the adoption of innovations and generating commercial sales is included separately as part of the Standard Spin-Off Ratio as described above. The incorporation of size in terms of sales in dollars has the desirable benefit that the equation is dimensionally correct; that is: $(\text{dollars})^a$ X $(\text{dollars})^{1-a}$ = dollars.

The "degree of linkage to activity" factor accounts for the separation between the driving or lead activity in the application to the situation of the adoption of diffused technology. In this situation, the Supported Activity together with the Spin-Off Activity, is the lead or driving activity for the diffusion of technology. In the situation of linking Spin-Off Activity to the Supported Activity, this linkage is very close because the Spin-Off Activity is assumed to take place within the same firms as the Supported Activity. For diffused technology, the firms adopting the new technology are only loosely linked with the leading activity in the Supported Activity firms.

The linkage factor is defined in relative terms with unity representing a perfect linkage between Sponsoring Activity and a spin-off receptor. This factor is an order of magnitude smaller when representing the linkage between the Spin-Off Activity and the Diffused Technology Activity.

A.3.4 Diffused Technology Sales

The calculation of cumulative diffused technology sales is the same as that for spin-off sales except that the driving force for Diffused Technology Activity includes both Supported Activity and Spin-Off Activity. Given the same form, however, the parameter values must be set to match the environment for diffused technology.

$$\begin{bmatrix} Cumulative \\ Diffusion \\ Sales \end{bmatrix} = K \begin{bmatrix} Incrementality \\ \&\ Attribution \\ Factors \end{bmatrix} \times \begin{bmatrix} Standard \\ Spinoff \\ Ratio \end{bmatrix} \times \begin{bmatrix} Sponsored \\ +\,Spinoff \\ Activity \end{bmatrix}^{a} \times \begin{bmatrix} Innovation \\ Adoption \\ Factor \end{bmatrix}^{1-a}$$

A.4 The Time Response Component

The Spin-offs component of the Model, as discussed in Section A.3, determines the total spin-off and diffused sales resulting from the total supported expenditures. It makes no distinction about when either the expenditures or sales occur. The distribution of benefits over time, however, is important since a benefit is preferred sooner to later. The Time Response component of the Model translates the stream of supported expenditures into a stream of spin-off and diffused sales so that later benefits can be appropriately discounted in value. This Section develops the formula for calculating the present value of the Supported Expenditures, Spin-off Sales, and Diffused Sales streams.

The essential feature of the Time Response component is the concept of a chain of stages of development activities that an innovation process passes through from the early stages of R&D to commercialization. The average time required to proceed from stage to stage, or from any stage to commercialization, has been studied and quantified using this model. As well, the technical risk for the successful development of innovations to commercialization has been defined using the model.

A.4.1 Distribution of the Supported Expenditures

The distribution of supported expenditures is an input to the Time Response component. The amounts are given in current dollars by year. The present value of this expenditure stream to the base year, PVBE, is calculated using the following formula:

$$PVB_E = \sum_Y \frac{E(Y)}{(1+i)^{(Y-B)}}$$

Where :
Y – Year (1)
B – Base Year
E(Y) – Sponsored Expenditures for year Y
i – Discount rate

Note that present valuing discounts expenditures which occur after the base year, but inflates expenditures which occur before the base year.

A.4.2 Distribution of Spin-off Sales

Spin-off sales are attributed to a particular year in the same proportion as the supported expenditures which occur in that year. For example, if 10% of supported expenditures are to be spent in 1999, then 10% of the spin-off sales are attributed to 1999. These sales are then distributed over time from that year forward.

When the sales will occur depends on the stage of development of the program. The Model considers four stages of development: Research, Development, Engineering, and Market. Typically, a supported program will have technologies in a number of these stages. The time response of each stage is modelled separately and the proportion of the program at each stage is used as an input.

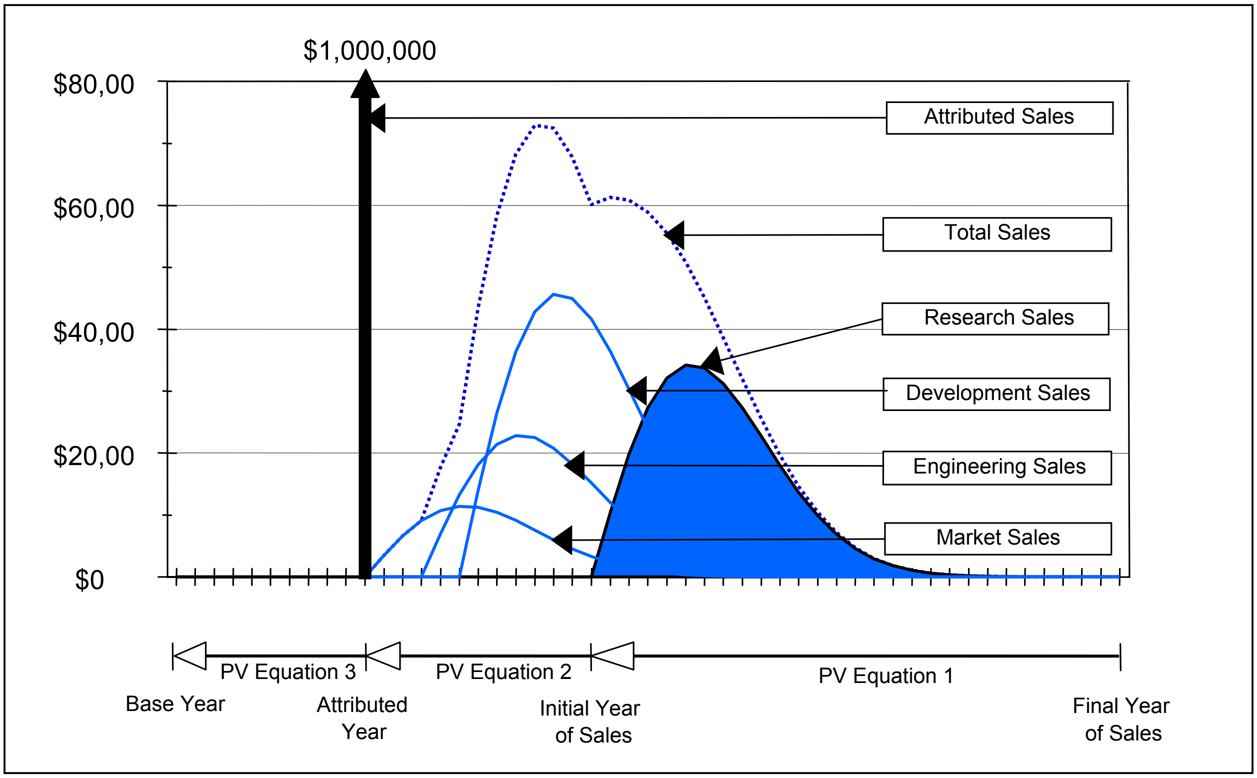
Sales can only occur once a technology is brought to market. Each stage of development will have a delay, during which there will be no sales, and then sales will occur over time. The delay is greatest at the research stage and least at the market stage. The delay for each stage is an input.

Once sales begin, they are assumed to increase quickly, reach a maximum, and then decline slowly. This behaviour is modelled using a Weibull distribution. The shape of the distribution is defined by two parameters that are inputs to the Time Response component. They are determined empirically and are the same for all stages of development.

The total distribution over time of spin-off sales attributed to a particular year's supported expenditures is calculated as the sum of these four delayed and scaled distributions, one for each stage of development.

The Time Response component of the Model is illustrated in Figure 29. In this example, the Base Year is considered to be year 0. Spin-off Sales of $1M are attributed to year 10.

Figure 29: Spinoff Sales Distribution



The portfolio of projects responsible for these sales is distributed among the stages of development as follows: Research 0.3, Development 0.4, Engineering 0.2, Market 0.1. Sales from projects in the Market Stage begin immediately. Sales from Engineering Stage projects are delayed three years, Development Stage projects are delayed five years and Research projects are delayed 12 years.

In each case, sales are distributed over time according to a Weibull distribution with parameters 2.0 and 7.5. The Total Sales over time are shown by the dotted line.

Using Research Sales as an example, the Weibull distribution is present valued to the Initial Year of sales using Equation 2 (described below). This amount is then present valued to the Attributed Year using Equation 3. The Attributed Year amount is present valued to the base year using Equation 4.

The following equation calculates PVI_S, the present value of a unit Weibull distribution to the initial year of the distribution:

$$PVI_S = \sum_{t=1}^{\infty} \frac{\varpi_{\beta\eta}(t)}{(1+i)^t}$$

$$\begin{aligned}
&Where: \\
&\varpi_{\beta\eta} - Weibull\ function \\
&\beta - Weibull\ shape\ parameter \\
&\eta - Weibull\ position\ parameter \\
&i - Discount\ rate \\
&t - Time\ period
\end{aligned} \tag{2}$$

The following equation calculates PVAS, the present value of the PVIS to the Attributed Year (the year of the supported expenditure), scaled according to the proportion of the program at each stage of development:

$$PVA_S = \left[\frac{P_R}{(1+i)^{T_R}} + \frac{P_D}{(1+i)^{T_D}} + \frac{P_E}{(1+i)^{T_E}} + \frac{P_M}{(1+i)^{T_M}} \right] PVI_S$$

$$\begin{aligned}
&Where: \\
&P_R - \mathrm{Re}search\ proportion \quad T_R - \mathrm{Re}search\ delay \\
&P_D - \mathrm{Re}search\ proportion \quad T_D - \mathrm{Re}search\ delay \\
&P_E - \mathrm{Re}search\ proportion \quad T_E - \mathrm{Re}search\ delay \\
&P_M - \mathrm{Re}search\ proportion \quad T_M - \mathrm{Re}search\ delay \\
&P_R + P_D + P_E + P_M = 1 \\
&i - Discount\ rate
\end{aligned} \tag{3}$$

The following equation calculates PVBS, the present value of the PVAS stream to the base year:

$$PVB_S = \sum_Y \frac{S(Y)\ PVA_S}{(1+i)^{(Y-B)}}$$

$$\begin{aligned}
&Where: \\
&Y - Year \\
&B - BaseYear \\
&i - Discount\ rate \\
&S(Y) \quad - Attributed\ Spinoff\ Sales\ for\ year\ Y \\
&\qquad S(Y) = \frac{S\ E(Y)}{\sum_Y E(Y)} \\
&\qquad Where: \\
&\qquad E(Y) - Sponsored\ Expenditures\ for\ year\ Y \\
&\qquad S\ \text{-}\ Total\ Spinoff\ Sales
\end{aligned} \tag{4}$$

A.4.3 Distribution of Diffused Sales

The distribution of diffused sales is calculated in a manner similar to the calculation of the spin-off sales. Like Spin-off Sales, Diffused Sales are attributed to a particular year in the same proportion as the supported expenditures which occur in that year. And like Spinoff Sales, Diffused Sales follow are assumed to follow a Weibull distribution, delayed and scaled according to the proportion of projects at each stage of development. The difference is that Diffused Sales are considered to be driven by Spinoff Sales, which themselves have a complex distribution over time, as described in the previous section.

The following equation calculates PVID, the present value of a unit Weibull distribution to the initial year of the distribution. It is analogous to PVIS for Spinoff Sales.

$$PVI_D = \sum_{t=1}^{\infty} \frac{\varpi_{\beta\eta}(t)}{(1+i)^t} \tag{5}$$

Where:
$\varpi_{\beta\eta}$ – *Weibull function*
β – *Weibull shape parameter*
η – *Weibull position parameter*
i – *Discount rate*
t – *Time period*

The following equation calculates PVAD, the present value of PVID for each stage of development to the year of the driving spinoff sales, scaled according to the proportion of the program at each stage of development. It is analogous to PVAD for Spinoff Sales except that the attributed year is the year of Spinoff Sales, rather than the year of Supported Expenditure.

$$PVA_D = \left[\frac{P_R}{(1+i)^{T_R}} + \frac{P_D}{(1+i)^{T_D}} + \frac{P_E}{(1+i)^{T_E}} + \frac{P_M}{(1+i)^{T_M}} \right] PVI_S \tag{6}$$

Where:
P_R – Research proportion T_R – Research delay
P_D – Research proportion T_D – Research delay
P_E – Research proportion T_E – Research delay
P_M – Research proportion T_M – Research delay
$P_R + P_D + P_E + P_M = 1$
i – *Discount rate*

The following equation calculates PVED, the present value of PVAD to the year of supported expenditure. This calculation is additional to those required by Spinoff Sales.

$$PVE_D = PVA_D \times PVA_S \tag{7}$$

Where:
PVA_S – *was calculated previously for Spinoff sales*

The following equation calculates PVBD, the present value of the PVAD stream to the base year:

$$PVB_D = \sum_Y \frac{D(Y)\ PVE_D}{(1+i)^{(Y-B)}}$$

$$\begin{aligned}
&Where:\\
&Y - Year\\
&B - Base\ Year\\
&i - Discount\ rate\\
&D(Y)\quad - Attributed\ Diffusion\ Sales\ for\ year\ Y\\
&\qquad D(Y) = \frac{D\ E(Y)}{\sum_Y E(Y)}\\
&\qquad Where:\\
&\qquad E(Y) - Sponsored\ Expenditures\ for\ year\ Y\\
&\qquad D\text{ - }Total\ Diffusion\ Sales
\end{aligned} \tag{8}$$

A.4.4 PV of Total Sales

The present value of the total sales to the base year is then calculated as follows:

$$PV = PVB_E + PVB_S + PVB_D \tag{9}$$

A.5 Analysis of Uncertainty

An important aspect of this analysis is the requirement to specify the degree of confidence in the results. It is our experience from reviewing many study reports that too seldom is the level of confidence or the range of results specified in the documentation.

The approach applied in this application not only specifies the level of confidence of the results, but incorporates the analysis of uncertainty of key factors. This approach comprises:

- Identification of the key factors which are uncertain;
- Quantification of this uncertainty using expert input; and
- Combination of these assessments of uncertainty within a rigorous framework of applied probability theory.

The analysis of uncertainty process involves four steps.

1. **Development of the structure and logic models**. This step establishes the approach, methodology and models, and ascertains which variables and assumptions must be subjected to detailed analysis in the Study.

2. **Estimation of initial parameter values and ranges.** In this step, estimates and ranges are developed for each variable and assumption identified in Step 1. These estimates are based

on the consulting team's statistical analysis of survey and other data, and subjective judgement drawn from experience in the field.

3. **Expert Review.** The purpose of expert review is to identify factors and issues that may have been overlooked in Step 2. The experts are best qualified to provide quantitative and qualitative information necessary to complete the analysis. Their experience, training, "street-wise" judgement and knowledge of relevant facts and issues provide a database and analytical process which would be impossible to model. Their opinions of the initial estimates and ranges enable the probabilities associated with expected outcomes to be assessed with a broad knowledge base.

4. **Simulation.** Once the experts have completed their work, the ranges for each assumption are transformed within the computer model into input probability distributions. And once final distributions are generated for all assumptions and variables, they are combined using probability theory to yield a probability distribution for each output variable of interest.

B. Detailed Model Results

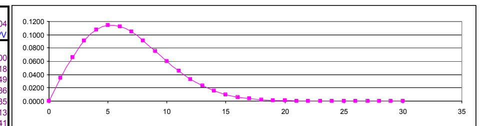
The following pages contain TPC Valuation Model parameters and results.

GLOBAL PARAMETERS

	Value	Best	Low	High		Value	Best	Low	High	
Base Year	2005									
Discount Factor	0.10	0.10	0.08	0.12						
Deliverable Multiplier	1.00	1.00	1.00	1.00						
	SPINOFF					DIFFUSION				
Scaling Factor	1.00	1.0	0.8	1.2		1.00	1.0	0.8	1.2	
Exponent	0.50	0.5	0.4	0.6		0.50	0.5	0.4	0.6	
Stage of Development Factor										
Research	2.90	2.9	2.4	3.4		2.90	2.9	2.4	3.4	
Development	3.30	3.3	2.8	3.8		3.30	3.3	2.8	3.8	
Engineering	4.00	4.0	3.5	4.5		4.00	4.0	3.5	4.5	
Market	6.73	6.7	6.2	7.3		6.73	6.7	6.2	7.3	
Stage of Development Delay					NPV					NPV
Research	6.50	6.5	5.0	8.0	0.30	6.50	6.5	5.0	8.0	0.30
Development	4.50	4.5	3.0	6.0	0.37	4.50	4.5	3.0	6.0	0.37
Engineering	2.50	2.5	1.0	4.0	0.44	2.50	2.5	1.0	4.0	0.44
Market	1.00	1.0	0.0	2.0	0.51	1.00	1.0	0.0	2.0	0.51
Time Response										
Beta	2.00	2.0	1.5	2.5		2.00	2.0	1.5	2.5	
Eta	7.50	7.5	6.0	9.0		7.50	7.5	6.0	9.0	

TIME RESPONSE

		SPINOFF		DIFFUSION	
	NPV		0.5604		0.5604
Year	Factor	Weibull	NPV	Weibull	NPV
0	1.0000	0.0000	0.0000	0.0000	0.0000
1	0.9105	0.0349	0.0318	0.0349	0.0318
2	0.8290	0.0662	0.0549	0.0662	0.0549
3	0.7547	0.0909	0.0686	0.0909	0.0686
4	0.6872	0.1070	0.0735	0.1070	0.0735
5	0.6256	0.1140	0.0713	0.1140	0.0713
6	0.5696	0.1125	0.0641	0.1125	0.0641
7	0.5186	0.1042	0.0540	0.1042	0.0540
8	0.4722	0.0912	0.0431	0.0912	0.0431
9	0.4299	0.0758	0.0326	0.0758	0.0326
10	0.3914	0.0601	0.0235	0.0601	0.0235
11	0.3564	0.0455	0.0162	0.0455	0.0162
12	0.3245	0.0330	0.0107	0.0330	0.0107
13	0.2954	0.0229	0.0068	0.0229	0.0068
14	0.2690	0.0153	0.0041	0.0153	0.0041
15	0.2449	0.0098	0.0024	0.0098	0.0024
16	0.2230	0.0060	0.0013	0.0060	0.0013
17	0.2030	0.0035	0.0007	0.0035	0.0007
18	0.1848	0.0020	0.0004	0.0020	0.0004
19	0.1683	0.0011	0.0002	0.0011	0.0002
20	0.1532	0.0006	0.0001	0.0006	0.0001
21	0.1395	0.0003	0.0000	0.0003	0.0000
22	0.1270	0.0001	0.0000	0.0001	0.0000
23	0.1156	0.0001	0.0000	0.0001	0.0000
24	0.1053	0.0000	0.0000	0.0000	0.0000
25	0.0959	0.0000	0.0000	0.0000	0.0000
26	0.0873	0.0000	0.0000	0.0000	0.0000
27	0.0795	0.0000	0.0000	0.0000	0.0000
28	0.0724	0.0000	0.0000	0.0000	0.0000
29	0.0659	0.0000	0.0000	0.0000	0.0000
30	0.0600	0.0000	0.0000	0.0000	0.0000
		0.9970	0.5604	0.9970	0.5604



Aerospace & Defence R&D

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	$1,577,873,748		$2,160,168,237	$1,058,482,436	11.80
Company Expenditures	$4,554,225,014		$6,093,483,533	$2,985,806,931	
Total Expenditures	$6,132,098,762		$8,253,651,769	$4,044,289,367	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	$205,230,421,334	$61,569,126,400	$26,980,034,425	$10,972,780,001	
Spinoff Sales	$46,574,025,273	$14,903,688,087	$8,110,239,332	$3,298,434,337	
Diffusion Sales	$113,281,983,112	$3,398,459,493	$747,695,785	$304,087,876	
TOTAL	$371,218,528,480	$79,871,273,981	$44,091,621,312	$18,619,591,580	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.19				0.19						
Development		0.29				0.29						
Engineering		0.38				0.38						
Market		0.14				0.14						
Total		1.00				1.00						
Stage of Development Factor	3.97	3.97	3.57	4.37	3.97	3.97	1.985	5.956				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		161				300						
Size of Firms (100M$)		3.16				0.40						
Linkage		0.900				0.54						
Adoption Factor (100M)	457.88	457.88	412.10	503.67	64.40	64.40	32.200	96.600				
Attribution Parameters			1	1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.32				0.03				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.32	0.32	0.32	0.32	0.03	0.03	0.015	0.045	0.30	0.30	0.27	0.33
NPV Factor	0.40				0.40							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.51	0.36	0.3	0.4
Direct Sales				
Exports	0.73	0.76	0.70	0.90
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.36	0.3	0.4
Spinoff	0.00			
Exports	0.73	0.76	0.7	0.9
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.36	0.3	0.4
Diffusion	0.00			
Exports	0.73	0.76	0.70	0.90
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.36	0.3	0.4
		1.00		

Factor:

Year	Expenditures Program	Company	Sales Direct	Attributed Sales Direct	Spin-off	Diffusion	PV Expenditures Program	Company	PV Attributed Sales Direct	Spinoff	Diffusion	
TOTAL	1,577,873,748	4,554,225,014	205,230,421,334	61,569,126,400	14,903,688,087	3,398,459,493	2,160,168,237	6,093,483,533	26,980,034,425	8,110,239,332	747,695,785	
1996	60,728	171,850	0	0	565,265	128,896	141,252	399,720	0	531,572	49,006	1,121,551
1997	70,524,104	170,793,196	0	0	586,506,824	133,740,029	149,351,948	361,696,144	0	502,168,307	46,295,690	1,059,512,089
1998	111,026,833	277,560,971	5,068,114	1,520,434	944,438,707	215,358,552	214,075,567	535,177,131	2,931,614	736,233,957	67,874,572	1,553,361,227
1999	120,354,778	299,243,784	154,372,986	46,311,896	1,019,808,444	232,544,969	211,284,833	525,327,485	81,301,310	723,813,211	66,729,484	1,527,155,013
2000	121,296,176	286,021,064	97,297,493	29,189,248	989,959,447	225,738,560	193,873,268	457,160,647	46,654,520	639,721,788	58,976,963	1,349,732,666
2001	216,268,374	607,626,320	200,443,111	60,132,933	2,002,425,272	456,609,205	314,723,862	884,246,265	87,508,259	1,178,137,260	108,614,336	2,485,721,724
2002	249,475,439	730,729,507	672,822,037	201,846,611	2,382,327,706	543,237,631	330,544,769	968,186,755	267,438,517	1,276,165,239	117,651,691	2,692,548,454
2003	213,118,480	676,220,104	1,163,794,967	349,138,490	2,161,482,613	492,878,747	257,092,518	815,748,730	421,178,368	1,054,199,951	97,188,360	2,224,229,559
2004	240,153,562	750,716,622	2,053,008,522	615,902,557	2,408,248,908	549,148,393	263,768,662	824,537,090	676,466,308	1,069,395,748	98,589,285	2,256,290,784
2005	136,520,235	426,277,308	4,189,974,573	1,256,992,372	1,367,844,741	311,907,020	136,520,235	426,277,308	1,256,992,372	553,018,579	50,983,657	1,166,799,779
2006	81,823,923	271,468,466	5,042,992,165	1,512,897,649	858,655,377	195,797,544	74,498,261	247,164,005	1,377,448,543	316,073,181	29,139,286	666,874,733
2007	17,151,950	57,175,100	6,407,238,947	1,922,171,684	180,647,313	41,192,661	14,218,218	47,395,663	1,593,396,456	60,543,301	5,581,583	127,738,764
2008	99,166	220,724	9,521,772,122	2,856,531,637	777,471	177,285	74,844	166,589	2,155,939,382	237,238	21,871	500,543
2009	0	0	11,547,108,091	3,464,132,427	0	0	0	0	2,380,443,232	0	0	0
2010	0	0	11,125,678,556	3,337,703,567	0	0	0	0	2,088,223,322	0	0	0
2011	0	0	11,960,018,923	3,588,005,677	0	0	0	0	2,043,845,844	0	0	0
2012	0	0	12,501,812,202	3,750,543,661	0	0	0	0	1,945,158,862	0	0	0
2013	0	0	10,645,735,378	3,193,720,613	0	0	0	0	1,508,077,317	0	0	0
2014	0	0	10,392,268,330	3,117,680,499	0	0	0	0	1,340,368,240	0	0	
2015	0	0	8,127,010,849	2,438,103,255	0	0	0	0	954,356,096	0	0	
2016	0	0	8,356,231,785	2,506,869,535	0	0	0	0	893,420,527	0	0	
2017	0	0	8,583,274,852	2,574,982,455	0	0	0	0	835,534,340	0	0	
2018	0	0	8,592,855,008	2,577,856,502	0	0	0	0	761,578,375	0	0	
2019	0	0	8,142,220,535	2,442,666,161	0	0	0	0	657,030,934	0	0	
2020	0	0	8,626,199,639	2,587,859,892	0	0	0	0	633,765,066	0	0	
2021	0	0	8,945,041,811	2,683,512,543	0	0	0	0	598,352,352	0	0	
2022	0	0	9,446,417,701	2,833,925,310	0	0	0	0	575,317,532	0	0	
2023	0	0	9,995,446,418	2,998,633,925	0	0	0	0	554,253,564	0	0	
2024	0	0	7,800,001,944	2,340,000,583	0	0	0	0	393,791,961	0	0	
2025	0	0	7,994,793,122	2,398,437,937	0	0	0	0	367,489,725	0	0	
2026	0	0	4,565,346,581	1,369,603,974	0	0	0	0	191,063,425	0	0	
2027	0	0	4,026,230,512	1,207,869,154	0	0	0	0	153,415,160	0	0	
2028	0	0	1,374,452,098	412,335,629	0	0	0	0	47,683,166	0	0	
2029	0	0	1,448,549,363	434,564,809	0	0	0	0	45,754,584	0	0	
2030	0	0	1,524,942,601	457,482,780	0	0	0	0	43,855,155	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Enabling Technologies R&D

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	$588,868,270		$773,520,865	$348,084,389	4.48
Company Expenditures	$2,313,218,094		$3,142,966,949	$1,414,335,127	
Total Expenditures	$2,902,086,364		$3,916,487,814	$1,762,419,516	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	$13,876,328,319	$4,162,898,496	$3,011,327,243	$555,589,876	
Spinoff Sales	$12,139,452,340	$2,913,468,562	$1,664,555,519	$307,110,493	
Diffusion Sales	$11,606,834,910	$232,136,698	$56,147,866	$10,359,281	
TOTAL	$40,524,701,933	$7,308,503,755	$8,648,518,442	$2,635,479,167	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.07				0.07						
Development		0.32				0.32						
Engineering		0.40				0.40						
Market		0.21				0.21						
Total		1.00				1.00						
Stage of Development Factor	4.27	4.27	3.85	4.70	4.27	4.27	2.137	6.410				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		63				3147						
Size of Firms (100M$)		1.09				0.09						
Linkage		0.90				0.02						
Adoption Factor (100M)	61.80	61.80	55.62	67.98	5.67	5.67	2.835	8.505				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.24				0.02				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.24	0.24	0.22	0.26	0.02	0.02	0.010	0.030	0.30	0.30	0.27	0.33
NPV Factor	0.42				0.42							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.55	0.36	0.30	0.4
Direct Sales				
Exports	0.31	0.51	0.40	0.60
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.55	0.36	0.30	0.40
Spinoff	0.00			
Exports	0.31	0.51	0.40	0.60
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.55	0.36	0.30	0.40
Diffusion	0.00			
Exports	0.31	0.51	0.40	0.60
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.55	0.36	0.30	0.40
		1.00		

Factor:

Year	Expenditures Program	Expenditures Company	Sales Direct	Attributed Sales Direct	Attributed Sales Spin-off	Attributed Sales Diffusion	PV Expenditures Program	PV Expenditures Company	PV Attributed Sales Direct	PV Attributed Sales Spinoff	PV Attributed Sales Diffusion	
TOTAL	588,868,270	2,313,218,094	13,876,328,319	4,162,898,496	2,913,468,562	232,136,698	773,520,865	3,142,966,949	3,011,327,243	1,664,555,519	56,147,866	
1996	19,613	45,967	0	0	65,837	5,246	45,619	106,919	0	64,830	2,187	219,554
1997	9,839,091	39,342,379	767,733	230,320	49,374,364	3,934,006	20,836,670	83,317,060	487,759	44,266,617	1,493,177	149,913,524
1998	22,805,528	84,045,871	242,677,080	72,803,124	107,270,478	8,547,000	43,972,309	162,052,424	140,374,804	87,563,047	2,953,628	296,541,408
1999	35,111,839	211,766,096	22,934,000	6,880,200	247,846,209	19,747,665	61,639,422	371,758,936	12,078,307	184,199,636	6,213,320	623,811,315
2000	69,265,765	343,171,530	85,782,006	25,734,602	414,054,905	32,990,690	110,710,664	548,506,871	41,132,800	280,175,565	9,450,727	948,843,827
2001	78,348,985	389,553,758	189,655,080	56,896,524	469,737,893	37,427,349	114,017,111	566,896,865	82,798,485	289,396,820	9,761,773	980,072,569
2002	89,705,496	334,364,346	199,598,784	59,879,635	425,733,075	33,921,173	118,856,119	443,019,104	79,338,071	238,803,884	8,055,201	808,734,307
2003	93,839,398	290,799,405	366,031,248	109,809,375	386,147,385	30,767,100	113,201,854	350,801,823	132,467,014	197,207,273	6,652,087	667,863,038
2004	80,127,518	239,306,950	278,560,826	83,568,248	320,687,313	25,551,432	88,006,724	262,838,800	91,785,792	149,113,665	5,029,820	504,989,008
2005	48,754,293	164,211,747	816,782,819	245,034,846	213,801,308	17,035,066	48,754,293	164,211,747	245,034,846	90,513,188	3,053,141	306,532,368
2006	37,466,063	131,129,129	2,154,225,329	646,267,599	169,256,435	13,485,860	34,111,742	119,389,191	588,407,525	65,239,786	2,200,632	220,941,352
2007	21,127,898	74,799,404	479,200,677	143,760,203	96,303,536	7,673,186	17,514,106	62,005,442	119,170,936	33,796,786	1,140,015	114,456,349
2008	2,456,783	10,681,511	836,434,155	250,930,247	13,189,824	1,050,927	1,854,233	8,061,767	189,387,155	4,214,422	142,159	14,272,580
2009	0	0	1,220,801,152	366,240,346	0	0	0	0	251,668,887	0	0	0
2010	0	0	1,799,195,147	539,758,544	0	0	0	0	337,698,168	0	0	0
2011	0	0	1,029,381,054	308,814,316	0	0	0	0	175,910,774	0	0	0
2012	0	0	760,324,215	228,097,265	0	0	0	0	118,298,960	0	0	0
2013	0	0	624,286,971	187,286,091	0	0	0	0	88,436,636	0	0	0
2014	0	0	715,949,342	214,784,803	0	0	0	0	92,341,318	0	0	
2015	0	0	826,643,389	247,993,017	0	0	0	0	97,072,856	0	0	
2016	0	0	1,002,072,464	300,621,739	0	0	0	0	107,138,257	0	0	
2017	0	0	86,797,101	26,039,130	0	0	0	0	8,449,218	0	0	
2018	0	0	87,521,739	26,256,522	0	0	0	0	7,756,987	0	0	
2019	0	0	50,706,004	15,211,801	0	0	0	0	4,091,686	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Environmental Technologies R&D

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	$474,366,266		$589,862,599	$412,903,819	9.51
Company Expenditures	$1,425,893,616		$1,784,829,073	$1,249,380,351	
Total Expenditures	$1,900,259,882		$2,374,691,672	$1,662,284,171	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	$56,303,474,945	$16,891,042,483	$8,735,716,625	$2,446,000,655	
Spinoff Sales	$10,271,896,827	$2,773,412,143	$1,384,550,226	$387,674,063	
Diffusion Sales	$8,647,024,583	$259,410,737	$51,734,746	$14,485,729	
TOTAL	$77,122,656,236	$19,923,865,364	$12,546,693,270	$4,510,444,618	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.19				0.19						
Development		0.38				0.38						
Engineering		0.26				0.26						
Market		0.17				0.17						
Total		1.00				1.00						
Stage of Development Factor	3.99	3.99	3.59	4.39	3.99	3.99	1.995	5.985				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		49				7474						
Size of Firms (100M$)		1.13				0.02						
Linkage		0.90				0.01						
Adoption Factor (100M)	49.83	49.83	44.85	54.82	0.98	0.98	0.490	1.470				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.27				0.03				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.27	0.27	0.24	0.30	0.03	0.03	0.015	0.045	0.30	0.30	0.27	0.33
NPV Factor	0.40				0.40							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.30	0.13	0.1	0.2
Direct Sales				
Exports	0.30	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.30	0.13	0.1	0.2
Spinoff	0.00			
Exports	0.30	0.45	0.4	0.5
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.30	0.13	0.1	0.2
Diffusion	0.00			
Exports	0.30	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.30	0.13	0.1	0.2
		0.50		

Factor:

	Expenditures		Sales	Attributed Sales			PV Expenditures		PV Attributed Sales			
Year	Program	Company	Direct	Direct	Spin-off	Diffusion	Program	Company	Direct	Spinoff	Diffusion	
TOTAL	474,366,266	1,425,893,616	56,303,474,945	16,891,042,483	2,773,412,143	259,410,737	589,862,599	1,784,829,073	8,735,716,625	1,384,550,226	51,734,746	
1996	981,984	7,241,483	0	0	12,002,076	1,122,613	2,284,082	16,843,604	0	11,152,286	416,713	30,696,686
1997	10,048,234	46,981,601	0	0	83,234,529	7,785,331	21,279,580	99,494,970	0	70,416,902	2,631,180	193,822,632
1998	25,717,385	90,571,284	236,133,315	70,839,994	169,722,262	15,874,949	49,586,785	174,634,351	136,589,611	130,730,835	4,884,855	359,836,825
1999	34,889,490	94,867,727	41,239,455	12,371,837	189,379,488	17,713,585	61,249,086	166,541,887	21,718,967	132,812,208	4,962,627	365,565,807
2000	36,836,355	95,208,040	11,092,408	3,327,722	192,717,602	18,025,815	58,877,244	152,175,398	5,318,852	123,053,020	4,597,967	338,703,629
2001	36,379,083	102,700,995	10,446,397	3,133,919	202,986,118	18,986,280	52,940,544	149,455,296	4,560,626	118,005,722	4,409,371	324,810,934
2002	49,856,132	149,112,682	18,955,066	5,686,520	290,393,188	27,161,888	66,057,339	197,568,214	7,534,406	153,705,352	5,743,314	423,074,220
2003	59,995,241	177,924,899	301,847,262	90,554,179	347,242,296	32,479,262	72,374,425	214,637,231	109,238,776	167,340,484	6,252,801	460,604,941
2004	71,727,699	210,257,823	538,141,754	161,442,526	411,555,324	38,494,773	78,780,923	230,933,176	177,317,708	180,577,012	6,747,394	497,038,504
2005	51,448,161	150,815,924	454,570,992	136,371,298	295,202,607	27,611,737	51,448,161	150,815,924	136,371,298	117,928,904	4,406,501	324,599,490
2006	32,570,937	96,652,521	769,653,536	230,896,061	188,600,469	17,640,720	29,654,874	87,999,260	210,224,031	68,597,561	2,563,199	188,814,894
2007	20,553,200	62,379,375	1,996,670,296	599,001,089	121,039,344	11,321,399	17,037,706	51,709,780	496,545,766	40,082,823	1,497,724	110,328,034
2008	13,959,759	44,283,308	2,628,428,362	788,528,509	85,005,230	7,950,953	10,535,992	33,422,395	595,134,198	25,629,683	957,672	70,545,741
2009	9,202,536	30,750,983	3,365,223,159	1,009,566,948	58,311,801	5,454,187	6,323,695	21,131,112	693,742,765	16,007,366	598,127	44,060,299
2010	6,715,263	22,346,318	4,471,312,878	1,341,393,863	42,415,115	3,967,292	4,201,383	13,980,901	839,238,684	10,601,075	396,117	29,179,475
2011	5,995,073	19,471,996	5,466,585,964	1,639,975,789	37,168,956	3,476,593	3,414,990	11,091,888	934,184,057	8,458,151	316,045	23,281,075
2012	6,011,497	19,525,344	6,312,065,980	1,893,619,794	37,270,789	3,486,118	3,117,766	10,126,504	982,095,306	7,721,995	288,538	21,254,803
2013	1,478,237	4,801,314	6,267,656,245	1,880,296,874	9,164,948	857,242	698,025	2,267,184	887,877,622	1,728,848	64,600	4,758,656
2014	0	0	6,768,907,933	2,030,672,380	0	0	0	0	873,036,465	0	0	
2015	0	0	5,005,075,349	1,501,522,605	0	0	0	0	587,746,745	0	0	
2016	0	0	3,408,912,178	1,022,673,653	0	0	0	0	364,469,559	0	0	
2017	0	0	2,072,759,561	621,827,868	0	0	0	0	201,771,681	0	0	
2018	0	0	1,852,251,264	555,675,379	0	0	0	0	164,163,658	0	0	
2019	0	0	1,799,466,909	539,840,073	0	0	0	0	145,206,755	0	0	
2020	0	0	652,616,893	195,785,068	0	0	0	0	47,947,625	0	0	
2021	0	0	671,561,337	201,468,401	0	0	0	0	44,922,127	0	0	
2022	0	0	590,950,226	177,285,068	0	0	0	0	35,990,789	0	0	
2023	0	0	590,950,226	177,285,068	0	0	0	0	32,768,548	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Advanced Manufacturing IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	28,537,197		41,738,806	20,452,015	7.35
Company Expenditures	63,593,067		93,201,028	45,668,504	
Total Expenditures	92,130,264		134,939,834	66,120,518	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	1,117,958,101	335,387,430	319,349,199	92,323,854	
Spinoff Sales	810,475,254	218,828,319	147,778,050	42,722,634	
Diffusion Sales	3,677,177,218	110,315,317	29,760,642	8,603,802	
TOTAL	5,697,740,837	664,531,065	631,827,725	209,770,808	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.00				0.19						
Development		0.03				0.38						
Engineering		0.67				0.26						
Market		0.30				0.17						
Total		1.00				1.00						
Stage of Development Factor	4.80	4.80	4.32	5.28	3.99	3.99	1.995	5.985				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		78				25592						
Size of Firms (100M$)		0.09				0.11						
Linkage		0.90				0.00						
Adoption Factor (100M)	6.32	6.32	5.69	6.95	8.58	8.58	4.290	12.870				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.27				0.03				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.27	0.27	0.24	0.30	0.03	0.03	0.015	0.045	0.30	0.30	0.27	0.33
NPV Factor	0.46				0.40							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.51	0.13	0.1	0.2
Direct Sales				
Exports	0.49	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.13	0.1	0.2
Spinoff	0.00			
Exports	0.49	0.45	0.4	0.5
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.13	0.1	0.2
Diffusion	0.00			
Exports	0.49	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.13	0.1	0.2
		0.50		

Factor:

Year	Expenditures Program	Company	Sales Direct	Attributed Sales Direct	Spin-off	Diffusion	PV Expenditures Program	Company	PV Attributed Sales Direct	Spinoff	Diffusion	
TOTAL	28,537,197	63,593,067	1,117,958,101	335,387,430	218,828,319	110,315,317	41,738,806	93,201,028	319,349,199	147,778,050	29,760,642	
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	1,046,113	2,561,297	0	0	8,568,340	4,319,455	2,017,055	4,938,546	0	7,617,359	1,534,040	16,107,000
1999	5,650,742	12,835,660	0	0	43,909,005	22,135,324	9,919,972	22,533,216	0	35,540,795	7,157,469	75,151,453
2000	5,953,288	13,467,522	40,738,396	12,221,519	46,128,418	23,254,170	9,515,415	21,525,762	19,534,217	33,994,443	6,846,054	71,881,673
2001	4,500,477	9,331,365	39,036,767	11,711,030	32,853,467	16,562,028	6,549,305	13,579,438	17,042,439	22,043,798	4,439,344	46,611,885
2002	4,644,738	10,164,788	51,053,913	15,316,174	35,175,670	17,732,692	6,154,088	13,467,929	20,293,305	21,488,862	4,327,587	45,438,466
2003	3,523,773	7,941,914	133,574,999	40,072,500	27,233,364	13,728,832	4,250,855	9,580,618	48,340,903	15,147,403	3,050,497	32,029,372
2004	1,433,428	3,453,782	109,337,798	32,801,340	11,608,129	5,851,868	1,574,382	3,793,404	36,026,805	5,878,479	1,183,852	12,430,117
2005	1,484,138	3,226,610	123,381,592	37,014,478	11,188,994	5,640,574	1,484,138	3,226,610	37,014,478	5,158,930	1,038,944	10,908,621
2006	300,500	610,129	126,896,675	38,069,003	2,162,931	1,090,373	273,596	555,504	34,660,700	907,982	182,856	1,919,938
2007	0	0	154,567,353	46,370,206	0	0	0	0	38,438,877	0	0	0
2008	0	0	109,491,105	32,847,332	0	0	0	0	24,791,203	0	0	0
2009	0	0	106,410,439	31,923,132	0	0	0	0	21,936,576	0	0	0
2010	0	0	55,664,506	16,699,352	0	0	0	0	10,447,895	0	0	0
2011	0	0	31,267,450	9,380,235	0	0	0	0	5,343,290	0	0	0
2012	0	0	21,727,107	6,518,132	0	0	0	0	3,380,524	0	0	0
2013	0	0	14,810,000	4,443,000	0	0	0	0	2,097,988	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	
2015	0	0	0	0	0	0	0	0	0	0	0	
2016	0	0	0	0	0	0	0	0	0	0	0	
2017	0	0	0	0	0	0	0	0	0	0	0	
2018	0	0	0	0	0	0	0	0	0	0	0	
2019	0	0	0	0	0	0	0	0	0	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Advanced Materials IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	10,225,002		13,917,109	8,906,950	11.22
Company Expenditures	22,225,521		29,929,787	19,155,063	
Total Expenditures	32,450,523		43,846,896	28,062,013	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	407,608,553	122,282,566	99,684,564	45,296,666	
Spinoff Sales	388,367,821	120,394,024	76,392,374	34,712,695	
Diffusion Sales	1,827,508,993	54,825,270	14,727,443	6,692,150	
TOTAL	2,655,935,890	297,501,860	234,651,277	114,763,524	

	SPINOFF				DIFFUSION				DIRECT			
	Value	Best	Low	High	Value	Best	Low	High	Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.00				0.07						
Development		0.05				0.32						
Engineering		0.50				0.40						
Market		0.45				0.21						
Total		1.00				1.00						
Stage of Development Factor	5.20	5.20	4.68	5.71	4.27	4.27	2.137	6.410				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		23				2402						
Size of Firms (100M$)		0.13				0.15						
Linkage		0.90				0.01						
Adoption Factor (100M)	2.69	2.69	2.42	2.96	3.45	3.45	1.725	5.175				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.31				0.03				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.31	0.31	0.28	0.34	0.03	0.03	0.015	0.045	0.30	0.30	0.27	0.33
NPV Factor	0.47				0.42							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.36	0.36	0.30	0.4
Direct Sales				
Exports	0.61	0.51	0.40	0.60
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.36	0.36	0.30	0.40
Spinoff	0.00			
Exports	0.61	0.51	0.40	0.60
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.36	0.36	0.30	0.40
Diffusion	0.00			
Exports	0.61	0.51	0.40	0.60
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.36	0.36	0.30	0.40
		1.00		

Factor:

	Expenditures		Sales	Attributed Sales			PV Expenditures		PV Attributed Sales			
Year	Program	Company	Direct	Direct	Spin-off	Diffusion	Program	Company	Direct	Spinoff	Diffusion	
TOTAL	10,225,002	22,225,521	407,608,553	122,282,566	120,394,024	54,825,270	13,917,109	29,929,787	99,684,564	76,392,374	14,727,443	
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	406,831	826,451	0	0	4,575,577	2,083,635	784,429	1,593,516	0	4,142,981	798,712	7,319,638
1999	1,454,699	2,931,444	0	0	16,272,941	7,410,404	2,553,749	5,146,199	0	13,415,256	2,586,285	23,701,489
2000	1,351,175	2,770,272	0	0	15,290,896	6,963,199	2,159,645	4,427,853	0	11,477,087	2,212,631	20,277,217
2001	745,197	1,570,001	181,875	54,563	8,589,570	3,911,536	1,084,446	2,284,739	79,402	5,869,972	1,131,653	10,370,810
2002	1,678,704	3,495,367	1,584,524	475,357	19,196,216	8,741,611	2,224,214	4,631,219	629,829	11,943,897	2,302,626	21,101,955
2003	1,733,394	3,726,688	6,722,893	2,016,868	20,257,338	9,224,827	2,091,056	4,495,638	2,433,021	11,475,685	2,212,361	20,274,739
2004	1,751,586	4,684,476	1,398,600	419,580	23,878,302	10,873,749	1,923,825	5,145,116	460,839	12,315,882	2,374,340	21,759,164
2005	1,017,749	2,049,749	53,011,388	15,903,416	11,380,664	5,182,549	1,017,749	2,049,749	15,903,416	5,344,358	1,030,322	9,442,178
2006	85,666	171,072	84,974,221	25,492,266	952,520	433,760	77,996	155,756	23,209,954	407,256	78,514	719,523
2007	0	0	74,324,575	22,297,373	0	0	0	0	18,483,549	0	0	0
2008	0	0	86,583,215	25,974,965	0	0	0	0	19,604,351	0	0	0
2009	0	0	40,229,082	12,068,725	0	0	0	0	8,293,249	0	0	0
2010	0	0	38,789,082	11,636,725	0	0	0	0	7,280,479	0	0	0
2011	0	0	15,291,349	4,587,405	0	0	0	0	2,613,136	0	0	0
2012	0	0	3,830,122	1,149,037	0	0	0	0	595,929	0	0	0
2013	0	0	687,627	206,288	0	0	0	0	97,409	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	
2015	0	0	0	0	0	0	0	0	0	0	0	
2016	0	0	0	0	0	0	0	0	0	0	0	
2017	0	0	0	0	0	0	0	0	0	0	0	
2018	0	0	0	0	0	0	0	0	0	0	0	
2019	0	0	0	0	0	0	0	0	0	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Aerospace IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	4,290,944		5,892,616	2,887,382	10.53
Company Expenditures	8,932,061		11,967,594	5,864,121	
Total Expenditures	13,223,005		17,860,210	8,751,503	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	164,249,853	49,274,956	47,093,907	19,153,092	
Spinoff Sales	169,353,820	54,193,222	34,210,283	13,913,322	
Diffusion Sales	1,085,785,546	32,573,566	8,313,424	3,381,069	
TOTAL	1,432,612,224	136,041,745	107,477,823	45,198,986	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.00				0.19						
Development		0.00				0.29						
Engineering		0.64				0.38						
Market		0.36				0.14						
Total		1.00				1.00						
Stage of Development Factor	4.98	4.98	4.49	5.48	3.97	3.97	1.985	5.956				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		11				300						
Size of Firms (100M$)		0.18				0.40						
Linkage		0.900				0.04						
Adoption Factor (100M)	1.78	1.78	1.60	1.96	4.40	4.40	2.200	6.600				
Attribution Parameters			1	1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.32				0.03				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.32	0.32	0.32	0.32	0.03	0.03	0.015	0.045	0.30	0.30	0.27	0.33
NPV Factor	0.47				0.40							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.51	0.36	0.3	0.4
Direct Sales				
Exports	0.73	0.76	0.70	0.90
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.36	0.3	0.4
Spinoff	0.00			
Exports	0.73	0.76	0.7	0.9
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.36	0.3	0.4
Diffusion	0.00			
Exports	0.73	0.76	0.70	0.90
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.51	0.36	0.3	0.4
		1.00		

Factor:

Year	Expenditures Program	Company	Sales Direct	Attributed Sales Direct	Spin-off	Diffusion	PV Expenditures Program	Company	PV Attributed Sales Direct	Spinoff	Diffusion	
TOTAL	4,290,944	8,932,061	164,249,853	49,274,956	54,193,222	32,573,566	5,892,616	11,967,594	47,093,907	34,210,283	8,313,424	107,477,823
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	157,371	282,366	0	0	1,802,222	1,083,250	303,434	544,443	0	1,624,062	394,662	2,866,601
1999	899,563	1,440,833	0	0	9,591,890	5,765,335	1,579,198	2,529,407	0	7,869,814	1,912,440	13,890,858
2000	154,702	312,010	0	0	1,912,773	1,149,698	247,267	498,699	0	1,428,860	347,226	2,522,053
2001	680,874	1,423,903	4,970,812	1,491,244	8,626,229	5,184,911	990,840	2,072,131	2,170,127	5,866,957	1,425,726	10,355,654
2002	1,145,110	2,499,987	9,510,705	2,853,212	14,939,083	8,979,337	1,517,224	3,312,381	3,780,389	9,250,851	2,248,045	16,328,501
2003	245,192	680,433	8,053,879	2,416,164	3,793,586	2,280,186	295,784	820,831	2,914,705	2,138,817	519,753	3,775,185
2004	229,088	569,255	23,979,576	7,193,873	3,271,934	1,966,640	251,615	625,232	7,901,270	1,679,554	408,148	2,964,549
2005	214,028	473,437	33,671,851	10,101,555	2,817,511	1,693,503	214,028	473,437	10,101,555	1,316,803	319,996	2,324,265
2006	304,885	674,416	33,671,851	10,101,555	4,013,573	2,412,412	277,589	614,036	9,197,167	1,707,860	415,026	3,014,511
2007	260,131	575,419	17,328,090	5,198,427	3,424,421	2,058,295	215,637	476,997	4,309,269	1,326,704	322,402	2,341,740
2008	0	0	16,883,090	5,064,927	0	0	0	0	3,822,704	0	0	0
2009	0	0	5,780,000	1,734,000	0	0	0	0	1,191,550	0	0	0
2010	0	0	2,600,000	780,000	0	0	0	0	488,004	0	0	0
2011	0	0	2,600,000	780,000	0	0	0	0	444,314	0	0	0
2012	0	0	2,600,000	780,000	0	0	0	0	404,534	0	0	0
2013	0	0	2,600,000	780,000	0	0	0	0	368,317	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	
2015	0	0	0	0	0	0	0	0	0	0	0	
2016	0	0	0	0	0	0	0	0	0	0	0	
2017	0	0	0	0	0	0	0	0	0	0	0	
2018	0	0	0	0	0	0	0	0	0	0	0	
2019	0	0	0	0	0	0	0	0	0	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Biotechnology IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	13,240,466		18,467,765	14,220,179	5.68
Company Expenditures	29,227,608		41,226,575	31,744,463	
Total Expenditures	42,468,074		59,694,340	45,964,642	
	Sales	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**	
Direct Sales	481,374,166	144,412,250	133,849,524	17,520,903	
Spinoff Sales	384,399,509	119,163,848	75,794,651	9,921,520	
Diffusion Sales	1,845,624,806	55,368,744	14,068,856	1,841,613	
TOTAL	2,753,866,555	318,944,842	283,407,371	75,248,678	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.00				0.19						
Development		0.09				0.38						
Engineering		0.67				0.26						
Market		0.24				0.17						
Total		1.00				1.00						
Stage of Development Factor	4.59	4.59	4.13	5.05	3.99	3.99	1.995	5.985				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		34				417						
Size of Firms (100M$)		0.07				0.09						
Linkage		0.90				0.08						
Adoption Factor (100M)	2.14	2.14	1.93	2.36	3.06	3.06	1.530	4.590				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.31				0.03				0.30		
Other Contributions		1.00				1.00				1.00		
Attribution Factor	0.31	0.31	0.28	0.34	0.03	0.03	0.015	0.045	0.30	0.30	0.27	0.33
NPV Factor	0.45				0.40							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.23	0.13	0.1	0.2
Direct Sales				
Exports	0.07	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.23	0.13	0.1	0.2
Spinoff	0.00			
Exports	0.07	0.45	0.4	0.5
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.23	0.13	0.1	0.2
Diffusion	0.00			
Exports	0.07	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.23	0.13	0.1	0.2
		0.50		
	Factor:	2.00		

	Expenditures		Sales	Attributed Sales			PV Expenditures		PV Attributed Sales			
Year	Program	Company	Direct	Direct	Spin-off	Diffusion	Program	Company	Direct	Spinoff	Diffusion	
TOTAL	13,240,466	29,227,608	481,374,166	144,412,250	119,163,848	55,368,744	18,467,765	41,226,575	133,849,524	75,794,651	14,068,856	
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	565,341	1,623,101	0	0	6,140,688	2,853,233	1,090,058	3,129,570	0	5,357,715	994,489	10,571,832
1999	1,517,617	3,913,394	0	0	15,239,217	7,080,808	2,664,202	6,870,029	0	12,105,733	2,247,043	23,887,007
2000	1,762,261	3,750,004	26,815,460	8,044,638	15,467,212	7,186,745	2,816,703	5,993,804	12,858,116	11,186,811	2,076,474	22,073,793
2001	3,126,283	6,672,923	2,163,224	648,967	27,496,210	12,775,944	4,549,513	9,710,750	944,407	18,106,435	3,360,881	35,727,579
2002	1,842,656	3,839,888	12,826,955	3,848,087	15,945,009	7,408,750	2,441,444	5,087,695	5,098,558	9,559,842	1,774,479	18,863,460
2003	1,550,297	3,217,686	12,534,944	3,760,483	13,378,784	6,216,369	1,870,179	3,881,611	4,536,407	7,303,119	1,355,591	14,410,500
2004	1,753,619	3,783,673	22,983,770	6,895,131	15,537,436	7,219,374	1,926,058	4,155,734	7,573,152	7,722,128	1,433,366	15,237,286
2005	979,592	2,096,800	81,498,382	24,449,515	8,632,243	4,010,918	979,592	2,096,800	24,449,515	3,906,134	725,049	7,707,575
2006	142,800	330,138	114,268,717	34,280,615	1,327,048	616,604	130,015	300,581	31,211,486	546,734	101,484	1,078,814
2007	0	0	101,611,762	30,483,528	0	0	0	0	25,269,515	0	0	0
2008	0	0	51,004,457	15,301,337	0	0	0	0	11,548,535	0	0	0
2009	0	0	19,674,216	5,902,265	0	0	0	0	4,055,851	0	0	0
2010	0	0	16,074,216	4,822,265	0	0	0	0	3,017,034	0	0	0
2011	0	0	14,669,982	4,400,995	0	0	0	0	2,506,951	0	0	0
2012	0	0	2,624,040	787,212	0	0	0	0	408,275	0	0	0
2013	0	0	2,624,040	787,212	0	0	0	0	371,722	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	
2015	0	0	0	0	0	0	0	0	0	0	0	
2016	0	0	0	0	0	0	0	0	0	0	0	
2017	0	0	0	0	0	0	0	0	0	0	0	
2018	0	0	0	0	0	0	0	0	0	0	0	
2019	0	0	0	0	0	0	0	0	0	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Environment IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	15,329,292		20,987,833	14,691,483	6.26
Company Expenditures	35,985,851		50,016,946	35,011,862	
Total Expenditures	51,315,143		71,004,779	49,703,345	
	Sales	**Attributed Sales**	**Discounted Attributed Sales**	**Discounted Impact**	
Direct Sales	543,201,045	162,960,313	134,017,656	37,524,944	
Spinoff Sales	186,818,112	41,099,985	25,931,951	7,260,946	
Diffusion Sales	3,607,410,972	21,644,466	5,455,574	1,527,561	
TOTAL	4,388,745,272	225,704,764	236,409,961	96,016,796	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.00				0.19						
Development		0.08				0.38						
Engineering		0.65				0.26						
Market		0.28				0.17						
Total		1.00				1.00						
Stage of Development Factor	4.70	4.70	4.23	5.17	3.99	3.99	1.995	5.985				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		44				7474						
Size of Firms (100M$)		0.01				0.02						
Linkage		1.00				0.10						
Adoption Factor (100M)	0.44	0.44	0.40	0.48	14.95	14.95	7.474	22.422				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.22				0.02				0.30		
Other Contributions		1.00				0.30				1.00		
Attribution Factor	0.22	0.22	0.20	0.24	0.01	0.01	0.003	0.009	0.30	0.30	0.27	0.33
NPV Factor	0.46				0.40							

	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.30	0.13	0.1	0.2
Direct Sales				
Exports	0.30	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.30	0.13	0.1	0.2
Spinoff	0.00			
Exports	0.30	0.45	0.4	0.5
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.30	0.13	0.1	0.2
Diffusion	0.00			
Exports	0.30	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.30	0.13	0.1	0.2

Factor:

Year	Expenditures Program	Expenditures Company	Sales Direct	Attributed Sales Direct	Attributed Sales Spin-off	Attributed Sales Diffusion	PV Expenditures Program	PV Expenditures Company	PV Attributed Sales Direct	PV Attributed Sales Spinoff	PV Attributed Sales Diffusion	
TOTAL	15,329,292	35,985,851	543,201,045	162,960,313	41,099,985	21,644,466	20,987,833	50,016,946	134,017,656	25,931,951	5,455,574	
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	442,021	1,484,746	0	0	1,543,212	812,701	852,280	2,862,803	0	1,356,801	285,444	5,357,329
1999	1,410,029	3,728,859	0	0	4,115,904	2,167,557	2,475,330	6,546,074	0	3,294,745	693,150	13,009,298
2000	2,476,458	6,378,392	0	0	7,092,141	3,734,931	3,958,237	10,194,879	0	5,168,918	1,087,439	20,409,473
2001	2,692,001	5,602,623	1,346,551	403,965	6,643,437	3,498,630	3,917,526	8,153,200	587,869	4,408,400	927,441	17,406,567
2002	2,946,708	7,067,082	8,114,674	2,434,402	8,020,374	4,223,766	3,904,268	9,363,596	3,225,484	4,845,612	1,019,422	19,132,897
2003	1,775,423	4,119,884	12,900,581	3,870,174	4,721,745	2,486,611	2,141,757	4,969,965	4,668,731	2,597,302	546,421	10,255,445
2004	1,543,559	3,276,271	13,237,836	3,971,351	3,860,360	2,032,980	1,695,342	3,598,437	4,361,867	1,933,363	406,742	7,633,885
2005	2,043,093	4,327,992	86,386,696	25,916,009	5,102,811	2,687,291	2,043,093	4,327,992	25,916,009	2,326,811	489,515	9,187,411
2006	0	0	109,229,279	32,768,784	0	0	0	0	29,835,008	0	0	0
2007	0	0	82,110,590	24,633,177	0	0	0	0	20,419,829	0	0	0
2008	0	0	67,577,670	20,273,301	0	0	0	0	15,301,076	0	0	0
2009	0	0	54,769,399	16,430,820	0	0	0	0	11,290,744	0	0	0
2010	0	0	44,969,114	13,490,734	0	0	0	0	8,440,434	0	0	0
2011	0	0	38,383,230	11,514,969	0	0	0	0	6,559,304	0	0	0
2012	0	0	10,828,092	3,248,428	0	0	0	0	1,684,744	0	0	0
2013	0	0	4,449,111	1,334,733	0	0	0	0	630,262	0	0	0
2014	0	0	4,449,111	1,334,733	0	0	0	0	573,835	0	0	
2015	0	0	4,449,111	1,334,733	0	0	0	0	522,460	0	0	
2016	0	0	0	0	0	0	0	0	0	0	0	
2017	0	0	0	0	0	0	0	0	0	0	0	
2018	0	0	0	0	0	0	0	0	0	0	0	
2019	0	0	0	0	0	0	0	0	0	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

ICT IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	85,113,877		116,611,050	29,152,763	2.90
Company Expenditures	191,106,789		260,767,825	65,191,956	
Total Expenditures	276,220,666		377,378,875	94,344,719	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	3,226,959,021	968,087,706	915,188,943	114,398,618	
Spinoff Sales	1,625,359,141	455,100,559	291,591,173	36,448,897	
Diffusion Sales	6,499,629,681	58,496,667	14,972,634	1,871,579	
TOTAL	11,628,168,508	1,481,684,933	1,599,131,625	247,063,812	

	SPINOFF Value	Best	Low	High	DIFFUSION Value	Best	Low	High	DIRECT Value	Best	Low	High
Stage of Development			0.9	1.1			0.5	1.5				
Research		0.00				0.19						
Development		0.04				0.38						
Engineering		0.54				0.26						
Market		0.43				0.17						
Total		1.00				1.00						
Stage of Development Factor	5.14	5.14	4.62	5.65	3.99	3.99	1.995	5.985				
Adoption Parameters			0.9	1.1			0.5	1.5				
Number of Firms		230				2232						
Size of Firms (100M$)		0.07				0.09						
Linkage		0.90				0.10						
Adoption Factor (100M)	14.49	14.49	13.04	15.94	20.70	20.70	10.350	31.050				
Attribution Parameters			0.9	1.1			0.5	1.5			0.9	1.1
Incrementality		1.00				1.00				1.00		
Sponsorship		0.28				0.03				0.30		
Other Contributions		1.00				0.30				1.00		
Attribution Factor	0.28	0.28	0.25	0.31	0.01	0.01	0.005	0.014	0.30	0.30	0.27	0.33
NPV Factor	0.47				0.40							

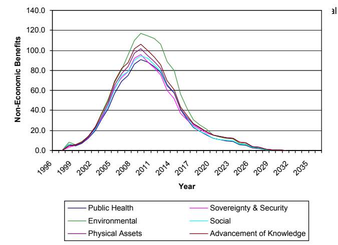
	Value	Best	Low	High
Deliverable Portion	0.00	0.00	0.0	0.0
Expenditures				
Import Content	0.75	0.13	0.1	0.2
Direct Sales				
Exports	0.40	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.75	0.13	0.1	0.2
Spinoff	0.00			
Exports	0.40	0.45	0.4	0.5
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.75	0.13	0.1	0.2
Diffusion	0.00			
Exports	0.40	0.45	0.40	0.50
Import Substitution	0.10	0.10	0.05	0.15
Import Content	0.75	0.13	0.1	0.2
		0.50		
	Factor:	2.00		

	Expenditures		Sales	Attributed Sales			PV Expenditures		PV Attributed Sales			
Year	Program	Company	Direct	Direct	Spin-off	Diffusion	Program	Company	Direct	Spinoff	Diffusion	
TOTAL	85,113,877	191,106,789	3,226,959,021	968,087,706	455,100,559	58,496,667	116,611,050	260,767,825	915,188,943	291,591,173	14,972,634	
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	1,058,075	2,353,939	0	0	5,621,627	722,580	2,040,119	4,538,730	0	5,083,311	261,018	11,923,179
1999	7,961,558	17,323,326	60,000,000	18,000,000	41,659,320	5,354,710	13,976,649	30,411,389	31,599,302	34,297,522	1,761,110	80,446,672
2000	13,671,827	30,083,337	1,312,805	393,841	72,090,911	9,266,255	21,852,310	48,083,584	629,495	54,037,708	2,774,730	126,748,332
2001	17,731,054	39,553,690	26,875,088	8,062,526	94,382,217	12,131,484	25,803,060	57,560,381	11,732,966	64,412,836	3,307,473	151,083,749
2002	15,877,473	34,392,861	106,292,913	31,887,874	82,825,292	10,646,007	21,037,003	45,569,137	42,250,131	51,464,890	2,642,621	120,713,651
2003	11,294,544	26,629,657	150,739,553	45,221,866	62,483,831	8,031,403	13,625,016	32,124,317	54,552,770	35,349,360	1,815,120	82,913,814
2004	8,530,847	19,472,422	371,747,338	111,524,201	46,138,125	5,930,396	9,369,714	21,387,210	122,490,748	23,765,102	1,220,291	55,742,318
2005	8,080,184	19,013,619	730,820,824	219,246,247	44,639,691	5,737,794	8,080,184	19,013,619	219,246,247	20,934,701	1,074,956	49,103,460
2006	908,315	2,283,937	609,409,829	182,822,949	5,259,547	676,040	826,994	2,079,457	166,454,885	2,245,742	115,314	5,267,507
2007	0	0	545,243,329	163,572,999	0	0	0	0	135,594,879	0	0	0
2008	0	0	310,183,354	93,055,006	0	0	0	0	70,232,358	0	0	0
2009	0	0	153,478,544	46,043,563	0	0	0	0	31,639,694	0	0	0
2010	0	0	93,831,477	28,149,443	0	0	0	0	17,611,607	0	0	0
2011	0	0	48,281,845	14,484,554	0	0	0	0	8,250,877	0	0	0
2012	0	0	17,801,364	5,340,409	0	0	0	0	2,769,717	0	0	0
2013	0	0	940,756	282,227	0	0	0	0	133,268	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	
2015	0	0	0	0	0	0	0	0	0	0	0	
2016	0	0	0	0	0	0	0	0	0	0	0	
2017	0	0	0	0	0	0	0	0	0	0	0	
2018	0	0	0	0	0	0	0	0	0	0	0	
2019	0	0	0	0	0	0	0	0	0	0	0	
2020	0	0	0	0	0	0	0	0	0	0	0	
2021	0	0	0	0	0	0	0	0	0	0	0	
2022	0	0	0	0	0	0	0	0	0	0	0	
2023	0	0	0	0	0	0	0	0	0	0	0	
2024	0	0	0	0	0	0	0	0	0	0	0	
2025	0	0	0	0	0	0	0	0	0	0	0	
2026	0	0	0	0	0	0	0	0	0	0	0	
2027	0	0	0	0	0	0	0	0	0	0	0	
2028	0	0	0	0	0	0	0	0	0	0	0	
2029	0	0	0	0	0	0	0	0	0	0	0	
2030	0	0	0	0	0	0	0	0	0	0	0	
2031	0	0	0	0	0	0	0	0	0	0	0	
2032	0	0	0	0	0	0	0	0	0	0	0	
2033	0	0	0	0	0	0	0	0	0	0	0	
2034	0	0	0	0	0	0	0	0	0	0	0	
2035	0	0	0	0	0	0	0	0	0	0	0	
2036	0	0	0	0	0	0	0	0	0	0	0	

Data Use	Aerospace & Defence	Environment	Enabling	Manufacturing	Materials	Aerospace	Biotech	Environment	ICT	User Value
Expected ROI	20%	20%	20%	20%	20%	20%	20%	20%	20%	
Discounted Attributed Domes	$11,904,737,754	$8,782,685,289	$5,967,477,725	$322,232,140	$91,513,998	$29,019,012	$263,568,855	$165,486,972	$959,478,975	$5,697,375,629
									TPC R&D	$5,331,106,929
									TPC IRAP	$366,268,700

Relative Impact									
Public Health	1.19	2.87	2.34	2.33	1.00	1.19	4.60	2.87	1.17
Sovereignty & Security	1.74	1.09	1.20	1.00	1.00	1.74	1.53	1.09	1.06
Environmental	1.46	4.88	1.27	1.67	2.33	1.46	1.42	4.88	1.06
Social	1.25	2.67	2.93	1.67	1.00	1.25	4.50	2.67	2.31
Physical Assets	1.72	1.70	1.51	1.00	2.33	1.72	2.05	1.70	1.18
Advancement of Knowledge	1.71	1.97	2.13	2.33	1.83	1.71	2.35	1.97	2.01

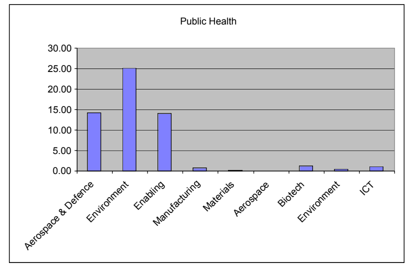
Impact										Total
Public Health	14.14	25.22	13.99	0.75	0.09	0.03	1.21	0.48	1.12	57.0
Sovereignty & Security	20.74	9.55	7.16	0.32	0.09	0.05	0.40	0.18	1.01	39.5
Environmental	17.42	42.84	7.56	0.54	0.21	0.04	0.37	0.81	1.01	70.8
Social	14.88	23.42	17.51	0.54	0.09	0.04	1.19	0.44	2.22	60.3
Physical Assets	20.49	14.90	9.00	0.32	0.21	0.05	0.54	0.28	1.13	46.9
Advancement of Knowledge	20.37	17.28	12.72	0.75	0.17	0.05	0.62	0.33	1.93	54.2

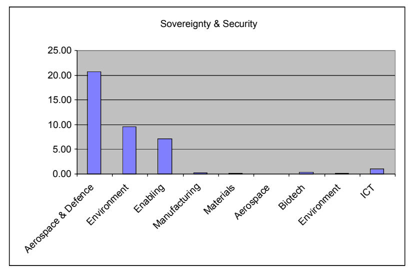


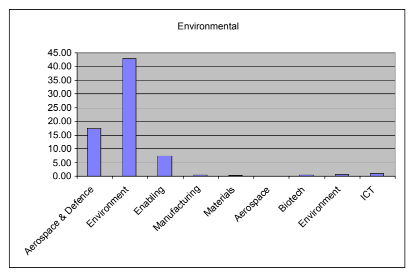
Public Health										Total
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
1997	0.001	0.027	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.0
1998	0.566	3.667	2.037	0.000	0.000	0.000	0.000	0.000	0.000	6.3
1999	2.911	1.259	0.453	0.000	0.000	0.000	0.000	0.000	0.036	4.7
2000	4.233	1.585	1.346	0.017	0.000	0.000	0.017	0.000	0.005	7.2
2001	6.937	2.461	2.801	0.020	0.000	0.000	0.005	0.001	0.025	12.3
2002	12.299	3.496	3.944	0.026	0.000	0.000	0.013	0.003	0.072	19.9
2003	17.853	7.099	6.005	0.052	0.001	0.000	0.016	0.005	0.101	31.1
2004	24.922	9.896	6.706	0.047	0.001	0.000	0.023	0.006	0.192	41.8
2005	36.460	9.955	9.906	0.050	0.002	0.001	0.046	0.017	0.313	56.7
2006	40.649	12.717	15.410	0.050	0.003	0.001	0.056	0.019	0.262	69.2
2007	45.044	20.502	9.151	0.052	0.003	0.000	0.049	0.015	0.231	75.0
2008	53.005	23.160	10.037	0.041	0.003	0.000	0.031	0.012	0.155	86.4
2009	54.996	25.443	10.446	0.036	0.002	0.000	0.021	0.010	0.106	91.1
2010	48.790	28.592	10.920	0.024	0.002	0.000	0.017	0.008	0.082	88.4
2011	45.536	30.236	7.772	0.018	0.001	0.000	0.015	0.006	0.061	83.6
2012	41.285	30.561	6.030	0.013	0.001	0.000	0.010	0.003	0.045	77.9
2013	32.293	27.259	4.707	0.010	0.001	0.000	0.008	0.002	0.033	64.3
2014	27.355	25.981	3.945	0.006	0.000	0.000	0.005	0.002	0.024	57.3
2015	19.693	17.951	3.316	0.004	0.000	0.000	0.004	0.001	0.017	41.0
2016	17.041	11.590	2.894	0.003	0.000	0.000	0.003	0.001	0.012	31.5
2017	14.838	6.876	1.079	0.002	0.000	0.000	0.002	0.000	0.008	22.8
2018	12.770	5.438	0.749	0.001	0.000	0.000	0.001	0.000	0.005	19.0
2019	10.569	4.580	0.469	0.001	0.000	0.000	0.001	0.000	0.003	15.6
2020	9.750	1.842	0.257	0.000	0.000	0.000	0.000	0.000	0.002	11.9
2021	8.931	1.558	0.155	0.000	0.000	0.000	0.000	0.000	0.001	10.6
2022	8.406	1.187	0.090	0.000	0.000	0.000	0.000	0.000	0.001	9.7
2023	7.988	1.005	0.051	0.000	0.000	0.000	0.000	0.000	0.000	9.0
2024	5.650	0.111	0.028	0.000	0.000	0.000	0.000	0.000	0.000	5.8
2025	5.239	0.068	0.015	0.000	0.000	0.000	0.000	0.000	0.000	5.3
2026	2.723	0.040	0.007	0.000	0.000	0.000	0.000	0.000	0.000	2.8
2027	2.180	0.023	0.004	0.000	0.000	0.000	0.000	0.000	0.000	2.2
2028	0.679	0.013	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.7
2029	0.649	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.7
2030	0.621	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6
2031	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2032	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	622.862	316.191	120.739	0.000	0.000	0.000	0.000	0.000	0.000	1059.8

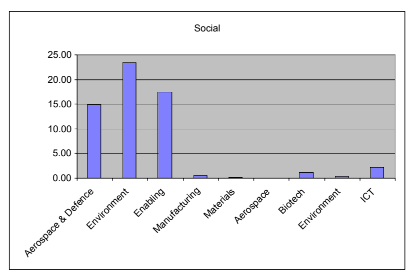
Sovereignty & Security										Total
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
1997	0.001	0.010	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.0
1998	0.830	1.388	1.043	0.000	0.000	0.000	0.000	0.000	0.000	3.3
1999	4.269	0.477	0.232	0.000	0.000	0.000	0.000	0.000	0.032	5.0
2000	6.207	0.600	0.689	0.007	0.000	0.000	0.006	0.000	0.004	7.5
2001	10.172	0.931	1.434	0.008	0.000	0.000	0.002	0.000	0.023	12.6
2002	18.034	1.323	2.019	0.011	0.000	0.000	0.004	0.001	0.065	21.5
2003	26.178	2.687	3.074	0.022	0.001	0.000	0.005	0.002	0.092	32.1
2004	36.543	3.745	3.433	0.020	0.001	0.000	0.008	0.002	0.174	43.9
2005	53.462	3.768	5.071	0.022	0.002	0.001	0.015	0.006	0.283	62.6
2006	59.605	4.813	7.889	0.021	0.003	0.001	0.018	0.007	0.237	72.6
2007	66.049	7.760	4.685	0.022	0.003	0.001	0.016	0.006	0.208	78.7
2008	77.723	8.766	5.138	0.017	0.003	0.000	0.010	0.005	0.140	91.8
2009	80.643	9.630	5.348	0.015	0.002	0.000	0.007	0.004	0.096	95.7
2010	71.542	10.822	5.590	0.010	0.002	0.000	0.006	0.003	0.074	88.0
2011	66.771	11.444	3.979	0.008	0.001	0.000	0.005	0.002	0.055	82.3
2012	60.538	11.567	3.087	0.006	0.001	0.000	0.003	0.001	0.041	75.2
2013	47.353	10.317	2.410	0.004	0.001	0.000	0.003	0.001	0.030	60.1
2014	40.111	9.833	2.019	0.002	0.000	0.000	0.002	0.001	0.022	52.0
2015	28.876	6.794	1.697	0.002	0.000	0.000	0.001	0.000	0.016	37.4
2016	24.988	4.387	1.482	0.001	0.000	0.000	0.001	0.000	0.011	30.9
2017	21.757	2.603	0.553	0.001	0.000	0.000	0.001	0.000	0.007	24.9
2018	18.725	2.058	0.383	0.000	0.000	0.000	0.000	0.000	0.005	21.2
2019	15.498	1.733	0.240	0.000	0.000	0.000	0.000	0.000	0.003	17.5
2020	14.297	0.697	0.131	0.000	0.000	0.000	0.000	0.000	0.002	15.1
2021	13.096	0.590	0.079	0.000	0.000	0.000	0.000	0.000	0.001	13.8
2022	12.326	0.449	0.046	0.000	0.000	0.000	0.000	0.000	0.001	12.8
2023	11.714	0.380	0.026	0.000	0.000	0.000	0.000	0.000	0.000	12.1
2024	8.284	0.042	0.014	0.000	0.000	0.000	0.000	0.000	0.000	8.3
2025	7.682	0.026	0.008	0.000	0.000	0.000	0.000	0.000	0.000	7.7
2026	3.993	0.015	0.004	0.000	0.000	0.000	0.000	0.000	0.000	4.0
2027	3.196	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	3.2
2028	0.996	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.0
2029	0.952	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.0
2030	0.911	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.9
2031	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	913.321	119.673	61.812	0.203	0.021	0.005	0.114	0.042	1.620	1096.8

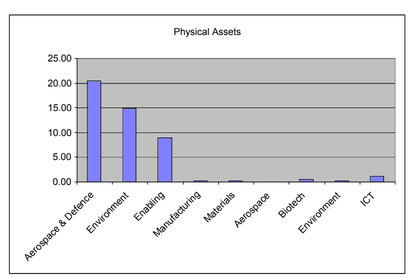
Environmental										Total
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
1997	0.001	0.046	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.1
1998	0.697	6.229	1.101	0.000	0.000	0.000	0.000	0.000	0.000	8.0
1999	3.585	2.138	0.245	0.000	0.000	0.000	0.000	0.000	0.032	6.0
2000	5.213	2.691	0.727	0.012	0.000	0.000	0.005	0.001	0.004	8.7
2001	8.543	4.179	1.514	0.014	0.001	0.000	0.002	0.002	0.023	14.3
2002	15.145	5.938	2.132	0.019	0.001	0.000	0.004	0.006	0.065	23.3
2003	21.986	12.058	3.246	0.037	0.002	0.000	0.005	0.008	0.092	37.4
2004	30.690	16.808	3.625	0.034	0.002	0.001	0.007	0.010	0.174	51.3
2005	44.900	16.908	5.355	0.036	0.006	0.001	0.014	0.028	0.283	67.5
2006	50.059	21.600	8.329	0.036	0.008	0.001	0.017	0.032	0.237	80.3
2007	55.471	34.822	4.946	0.037	0.007	0.000	0.015	0.025	0.208	95.5
2008	65.275	39.336	5.425	0.029	0.007	0.000	0.010	0.020	0.140	110.2
2009	67.727	43.214	5.646	0.026	0.004	0.000	0.006	0.017	0.096	116.7
2010	60.084	48.563	5.902	0.018	0.004	0.000	0.005	0.013	0.074	114.7
2011	56.077	51.355	4.201	0.013	0.003	0.000	0.004	0.011	0.055	111.7
2012	50.842	51.907	3.260	0.009	0.002	0.000	0.003	0.006	0.041	106.1
2013	39.769	46.299	2.544	0.007	0.001	0.000	0.002	0.004	0.030	88.7
2014	33.687	44.127	2.132	0.004	0.001	0.000	0.002	0.003	0.022	80.0
2015	24.251	30.489	1.792	0.003	0.001	0.000	0.001	0.002	0.016	56.6
2016	20.986	19.685	1.564	0.002	0.000	0.000	0.001	0.001	0.011	42.3
2017	18.273	11.679	0.583	0.001	0.000	0.000	0.001	0.001	0.007	30.5
2018	15.726	9.236	0.405	0.001	0.000	0.000	0.000	0.001	0.005	25.4
2019	13.016	7.779	0.254	0.000	0.000	0.000	0.000	0.000	0.003	21.1
2020	12.007	3.128	0.139	0.000	0.000	0.000	0.000	0.000	0.002	15.3
2021	10.998	2.646	0.084	0.000	0.000	0.000	0.000	0.000	0.001	13.7
2022	10.352	2.015	0.049	0.000	0.000	0.000	0.000	0.000	0.001	12.4
2023	9.838	1.707	0.028	0.000	0.000	0.000	0.000	0.000	0.000	11.6
2024	6.957	0.189	0.015	0.000	0.000	0.000	0.000	0.000	0.000	7.2
2025	6.452	0.115	0.008	0.000	0.000	0.000	0.000	0.000	0.000	6.6
2026	3.353	0.068	0.004	0.000	0.000	0.000	0.000	0.000	0.000	3.4
2027	2.684	0.039	0.002	0.000	0.000	0.000	0.000	0.000	0.000	2.7
2028	0.836	0.022	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.9
2029	0.800	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8
2030	0.765	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8
2031	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
2032	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0

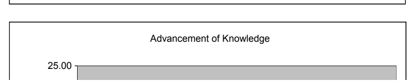


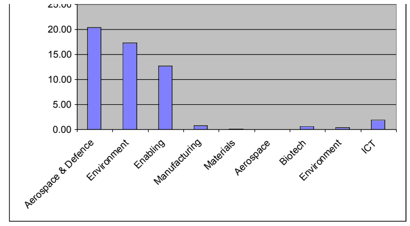












	2033	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
		767.043	537.040	65.263	0.339	0.050	0.005	0.106	0.191	1.620	1371.656
Social											**Total**
	1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	1997	0.001	0.025	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	1998	0.595	3.406	2.550	0.000	0.000	0.000	0.000	0.000	0.000	6.6
	1999	3.063	1.169	0.567	0.000	0.000	0.000	0.000	0.000	0.071	4.9
	2000	4.454	1.472	1.685	0.012	0.000	0.000	0.017	0.000	0.009	7.6
	2001	7.299	2.285	3.507	0.014	0.000	0.000	0.005	0.001	0.050	13.2
	2002	12.940	3.246	4.937	0.019	0.000	0.000	0.013	0.003	0.143	21.3
	2003	18.785	6.593	7.517	0.037	0.001	0.000	0.016	0.005	0.200	33.2
	2004	26.222	9.190	8.394	0.034	0.001	0.000	0.022	0.005	0.380	44.2
	2005	38.363	9.244	12.400	0.036	0.002	0.001	0.045	0.015	0.618	60.7
	2006	42.771	11.809	19.288	0.036	0.003	0.001	0.054	0.018	0.518	74.5
	2007	47.395	19.039	11.454	0.037	0.003	0.000	0.048	0.014	0.456	78.4
	2008	55.771	21.507	12.563	0.029	0.003	0.000	0.031	0.011	0.307	90.2
	2009	57.866	23.627	13.075	0.026	0.002	0.000	0.020	0.009	0.210	94.8
	2010	51.336	26.551	13.668	0.018	0.002	0.000	0.017	0.007	0.162	91.8
	2011	47.912	28.078	9.729	0.013	0.001	0.000	0.014	0.006	0.121	85.9
	2012	43.440	28.379	7.548	0.009	0.001	0.000	0.010	0.003	0.089	79.5
	2013	33.979	25.314	5.892	0.007	0.001	0.000	0.007	0.002	0.065	65.3
	2014	28.782	24.126	4.938	0.004	0.000	0.000	0.005	0.002	0.048	57.9
	2015	20.720	16.670	4.150	0.003	0.000	0.000	0.004	0.001	0.034	41.6
	2016	17.930	10.763	3.622	0.002	0.000	0.000	0.003	0.001	0.024	32.3
	2017	15.612	6.386	1.351	0.001	0.000	0.000	0.002	0.000	0.016	23.4
	2018	13.436	5.050	0.937	0.001	0.000	0.000	0.001	0.000	0.010	19.4
	2019	11.121	4.253	0.588	0.000	0.000	0.000	0.001	0.000	0.006	16.0
	2020	10.259	1.710	0.321	0.000	0.000	0.000	0.000	0.000	0.004	12.3
	2021	9.397	1.447	0.194	0.000	0.000	0.000	0.000	0.000	0.002	11.0
	2022	8.845	1.102	0.113	0.000	0.000	0.000	0.000	0.000	0.001	10.1
	2023	8.405	0.933	0.064	0.000	0.000	0.000	0.000	0.000	0.001	9.4
	2024	5.944	0.103	0.035	0.000	0.000	0.000	0.000	0.000	0.000	6.1
	2025	5.512	0.063	0.018	0.000	0.000	0.000	0.000	0.000	0.000	5.6
	2026	2.865	0.037	0.009	0.000	0.000	0.000	0.000	0.000	0.000	2.9
	2027	2.294	0.021	0.005	0.000	0.000	0.000	0.000	0.000	0.000	2.3
	2028	0.715	0.012	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.7
	2029	0.683	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.7
	2030	0.654	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.7
	2031	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2032	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
		655.368	293.622	151.130	0.339	0.021	0.004	0.336	0.104	3.546	1104.470
Physical Assets											**Total**
	1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	1997	0.001	0.016	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	1998	0.820	2.166	1.310	0.000	0.000	0.000	0.000	0.000	0.000	4.3
	1999	4.217	0.744	0.291	0.000	0.000	0.000	0.000	0.000	0.036	5.3
	2000	6.132	0.936	0.866	0.007	0.000	0.000	0.008	0.000	0.005	8.0
	2001	10.049	1.453	1.802	0.008	0.001	0.000	0.002	0.001	0.025	13.3
	2002	17.816	2.064	2.537	0.011	0.001	0.000	0.006	0.002	0.073	22.5
	2003	25.863	4.192	3.863	0.022	0.002	0.000	0.007	0.003	0.102	34.1
	2004	36.103	5.844	4.314	0.020	0.002	0.001	0.010	0.003	0.193	46.5
	2005	52.818	5.879	6.373	0.022	0.006	0.001	0.020	0.010	0.314	65.4
	2006	58.887	7.510	9.914	0.021	0.008	0.001	0.025	0.011	0.263	76.6
	2007	65.253	12.107	5.887	0.022	0.007	0.001	0.022	0.009	0.231	83.5
	2008	76.786	13.676	6.457	0.017	0.007	0.000	0.014	0.007	0.156	97.1
	2009	79.671	15.025	6.720	0.015	0.004	0.000	0.009	0.006	0.107	101.6
	2010	70.679	16.885	7.025	0.010	0.004	0.000	0.008	0.005	0.082	94.7
	2011	65.966	17.855	5.000	0.008	0.003	0.000	0.006	0.004	0.062	88.9
	2012	59.808	18.047	3.880	0.006	0.002	0.000	0.004	0.002	0.045	81.8
	2013	46.782	16.098	3.028	0.004	0.001	0.000	0.003	0.001	0.033	66.0
	2014	39.627	15.342	2.538	0.002	0.001	0.000	0.002	0.001	0.024	57.5
	2015	28.528	10.601	2.133	0.002	0.001	0.000	0.002	0.001	0.017	41.3
	2016	24.686	6.844	1.862	0.001	0.000	0.000	0.001	0.000	0.012	33.4
	2017	21.495	4.061	0.694	0.001	0.000	0.000	0.001	0.000	0.008	26.3
	2018	18.499	3.211	0.482	0.000	0.000	0.000	0.000	0.000	0.005	22.2
	2019	15.311	2.705	0.302	0.000	0.000	0.000	0.000	0.000	0.003	18.3
	2020	14.125	1.088	0.165	0.000	0.000	0.000	0.000	0.000	0.002	15.4
	2021	12.938	0.920	0.100	0.000	0.000	0.000	0.000	0.000	0.001	14.0
	2022	12.178	0.701	0.058	0.000	0.000	0.000	0.000	0.000	0.001	12.9
	2023	11.572	0.593	0.033	0.000	0.000	0.000	0.000	0.000	0.000	12.2
	2024	8.184	0.066	0.018	0.000	0.000	0.000	0.000	0.000	0.000	8.3
	2025	7.589	0.040	0.009	0.000	0.000	0.000	0.000	0.000	0.000	7.6
	2026	3.945	0.024	0.005	0.000	0.000	0.000	0.000	0.000	0.000	4.0
	2027	3.158	0.014	0.002	0.000	0.000	0.000	0.000	0.000	0.000	3.2
	2028	0.984	0.008	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.0
	2029	0.941	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.9
	2030	0.900	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.9
	2031	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2032	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
		902.311	186.720	77.677	0.203	0.050	0.005	0.153	0.066	1.802	1168.988
Advancement of Knowledge											**Total**
	1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	1997	0.001	0.019	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	1998	0.815	2.512	1.852	0.000	0.000	0.000	0.000	0.000	0.000	5.2
	1999	4.193	0.862	0.412	0.000	0.000	0.000	0.000	0.000	0.062	5.5
	2000	6.096	1.085	1.223	0.017	0.000	0.000	0.009	0.000	0.008	8.4
	2001	9.991	1.685	2.547	0.020	0.001	0.000	0.003	0.001	0.044	14.3
	2002	17.713	2.394	3.586	0.026	0.001	0.000	0.007	0.002	0.125	23.9
	2003	25.712	4.862	5.459	0.052	0.002	0.000	0.008	0.003	0.174	36.3
	2004	35.893	6.778	6.096	0.047	0.002	0.001	0.012	0.004	0.331	49.2
	2005	52.511	6.818	9.006	0.050	0.004	0.001	0.023	0.011	0.538	69.0
	2006	58.545	8.710	14.009	0.050	0.006	0.001	0.028	0.013	0.451	81.8
	2007	64.874	14.042	8.319	0.052	0.005	0.000	0.025	0.010	0.396	87.7
	2008	76.340	15.862	9.125	0.041	0.005	0.000	0.016	0.008	0.267	101.7
	2009	79.208	17.426	9.497	0.036	0.003	0.000	0.011	0.007	0.182	106.4
	2010	70.269	19.582	9.928	0.024	0.003	0.000	0.009	0.005	0.141	100.0
	2011	65.582	20.708	7.066	0.018	0.002	0.000	0.007	0.004	0.106	93.5
	2012	59.461	20.931	5.482	0.013	0.001	0.000	0.005	0.002	0.078	86.0
	2013	46.510	18.670	4.279	0.010	0.001	0.000	0.004	0.002	0.056	69.5
	2014	39.397	17.794	3.586	0.006	0.001	0.000	0.003	0.001	0.042	60.8
	2015	28.362	12.294	3.014	0.004	0.001	0.000	0.002	0.001	0.030	43.7
	2016	24.543	7.938	2.631	0.003	0.000	0.000	0.001	0.001	0.021	35.1
	2017	21.370	4.710	0.981	0.002	0.000	0.000	0.001	0.000	0.014	27.1
	2018	18.392	3.724	0.681	0.001	0.000	0.000	0.001	0.000	0.009	22.8
	2019	15.222	3.137	0.427	0.001	0.000	0.000	0.000	0.000	0.005	18.8
	2020	14.043	1.261	0.233	0.000	0.000	0.000	0.000	0.000	0.003	15.5
	2021	12.863	1.067	0.141	0.000	0.000	0.000	0.000	0.000	0.002	14.1
	2022	12.107	0.813	0.082	0.000	0.000	0.000	0.000	0.000	0.001	13.0
	2023	11.505	0.688	0.046	0.000	0.000	0.000	0.000	0.000	0.001	12.2
	2024	8.137	0.076	0.025	0.000	0.000	0.000	0.000	0.000	0.000	8.2
	2025	7.545	0.046	0.013	0.000	0.000	0.000	0.000	0.000	0.000	7.6
	2026	3.922	0.027	0.007	0.000	0.000	0.000	0.000	0.000	0.000	4.0
	2027	3.139	0.016	0.003	0.000	0.000	0.000	0.000	0.000	0.000	3.2
	2028	0.978	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.0
	2029	0.935	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.9
	2030	0.895	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.9
	2031	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2032	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	2036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
		897.068	216.556	109.768	0.474	0.039	0.005	0.175	0.077	3.086	1227.249

Regional Impacts

IRAP	Discounted Impact Distribution	Advanced Manufacturing	Advanced Materials	Aerospace	Biotech	Environment	ICT
Canada	1.00	$209,770,808	$114,763,524	$45,198,986	$75,248,678	$96,016,796	$247,063,812
BC	0.19	$39,987,938	$21,877,004	$8,616,138	$14,344,415	$18,303,375	$47,096,984
Praries	0.21	$43,710,834	$23,913,763	$9,418,305	$15,679,887	$20,007,428	$51,481,736
Ontario	0.31	$65,896,041	$36,051,069	$14,198,516	$23,638,132	$30,162,094	$77,611,024
Quebec	0.20	$41,737,219	$22,834,018	$8,993,053	$14,971,914	$19,104,060	$49,157,252
East	0.09	$18,438,775	$10,087,670	$3,972,974	$6,614,330	$8,439,840	$21,716,816

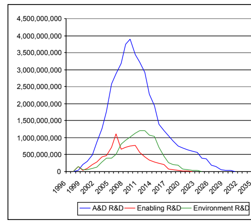
R&D	Discounted Impact Distribution	A&D	Enabling	Environment		
Canada	1.00	$18,619,591,580	$2,635,479,167	$4,510,444,618		
BC	0.12	$25,220,151	$13,797,694	$5,434,146	BC	0.12
Praries	0.03	$6,408,725	$3,506,150	$1,380,878	Prairies	0.03
Ontario	0.42	$88,511,339	$48,423,674	$19,071,399	Ontario	0.42
Quebec	0.39	$82,406,048	$45,083,530	$17,755,902	Quebec	0.39
East	0.03	$7,224,545	$3,952,477	$1,556,661	Atlantic	0.03
						1

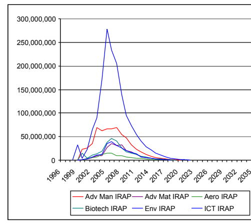
Regional Employment

IRAP	Discounted Impact	200000	200000	275000	150000	150000	150000
	Distribution	Advanced Manufacturing	Advanced Materials	Aerospace	Biotech	Environment	ICT
Canada	1.00	1,049	574	164	502	640	1,647
BC	0.19	200	109	31	96	122	314
Praries	0.21	219	120	34	105	133	343
Ontario	0.31	329	180	52	158	201	517
Quebec	0.20	209	114	33	100	127	328
East	0.09	92	50	14	44	56	145

R&D	Discounted Impact	275000	150000	150000
	Distribution	A&D	Enabling	Environment
Canada	1.00	67,708	17,570	30,070
BC	0.12	8,140	2,112	3,615
Praries	0.03	2,069	537	919
Ontario	0.42	28,569	7,413	12,688
Quebec	0.39	26,598	6,902	11,813
East	0.03	2,332	605	1,036

		A&D R&D	1,121,551	##########	##########	##########	##########	##########	##########	##########	##########	##########	666,874,733	127,738,764	500,543	0	0	0	0	0	Other	Direct	Total
		Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
0	0.0000	1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0.0349	1997	39,175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39,175	0	39,175
2	0.0662	1998	74,280	37,007,743	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37,082,023	2,931,614	40,013,637
3	0.0909	1999	101,944	70,171,412	54,257,420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	124,530,776	81,301,310	205,832,086
4	0.1070	2000	120,020	96,304,709	102,879,007	53,342,062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	252,645,798	46,654,520	299,300,318
5	0.1140	2001	127,843	113,381,115	141,193,293	101,143,371	47,144,869	0	0	0	0	0	0	0	0	0	0	0	0	0	402,990,491	87,508,259	490,498,751
6	0.1125	2002	126,162	120,771,266	166,229,182	138,811,270	89,392,701	86,823,879	0	0	0	0	0	0	0	0	0	0	0	0	602,154,461	267,438,517	869,592,978
7	0.1042	2003	116,817	119,183,509	177,063,956	163,424,788	122,684,406	164,629,178	94,048,139	0	0	0	0	0	0	0	0	0	0	0	841,150,793	421,178,368	1,262,329,161
8	0.0912	2004	102,255	110,355,168	174,736,129	174,076,772	144,438,366	225,940,515	178,327,298	77,690,208	0	0	0	0	0	0	0	0	0	0	##########	676,466,308	1,762,133,020
9	0.0758	2005	85,032	96,599,029	161,792,811	171,788,217	153,852,820	266,003,478	244,740,100	147,310,570	78,810,076	0	0	0	0	0	0	0	0	0	##########	1,256,992,372	2,577,974,507
10	0.0601	2006	67,398	80,328,904	141,624,799	159,063,261	151,830,146	283,341,515	288,136,539	202,172,096	149,433,983	40,755,199	0	0	0	0	0	0	0	0	##########	1,377,448,543	2,874,202,382
11	0.0455	2007	51,039	63,669,920	117,771,006	139,235,496	140,583,554	279,616,476	306,917,202	238,020,529	205,086,312	77,277,069	23,293,296	0	0	0	0	0	0	0	##########	1,593,396,456	3,184,918,356
12	0.0330	2008	36,993	48,215,912	93,347,104	115,784,133	123,059,346	258,904,303	302,882,219	253,534,644	241,451,483	106,056,660	44,167,067	4,461,793	0	0	0	0	0	0	##########	2,155,939,382	3,747,841,038
13	0.0229	2009	25,695	34,946,264	70,689,829	91,772,278	102,332,523	226,631,020	280,446,670	250,201,471	257,189,227	124,862,247	60,615,804	8,460,130	17,483	0	0	0	0	0	##########	2,380,443,232	3,888,633,874
14	0.0153	2010	17,123	24,274,098	51,235,066	69,497,245	81,110,326	188,459,673	245,488,059	231,668,170	253,808,008	133,000,735	71,363,981	11,610,858	33,151	0	0	0	0	0	##########	2,088,223,322	3,449,789,816
15	0.0098	2011	10,956	16,175,824	35,588,496	50,370,697	61,423,170	149,376,025	204,140,631	202,789,962	235,007,558	131,252,199	76,015,467	13,669,654	45,497	0	0	0	0	0	##########	2,043,845,844	3,219,711,980
16	0.0060	2012	6,735	10,349,675	23,715,537	34,988,095	44,518,713	113,119,370	161,804,992	168,634,152	205,713,084	121,529,888	75,016,106	14,560,638	53,564	0	0	0	0	0	974,010,550	1,945,158,862	2,919,169,411
17	0.0035	2013	3,980	6,362,253	15,173,762	23,315,441	30,923,236	81,987,444	122,531,569	133,662,013	171,064,934	106,380,783	69,459,399	14,369,212	57,056	0	0	0	0	0	775,291,083	1,508,077,317	2,283,368,400
18	0.0020	2014	2,262	3,759,705	9,327,762	14,917,771	20,606,691	56,949,470	88,809,284	101,219,474	135,588,688	88,463,122	60,801,054	13,304,834	56,306	0	0	0	0	0	593,806,423	1,340,368,240	1,934,174,663
19	0.0011	2015	1,237	2,136,730	5,512,141	9,170,397	13,184,649	37,950,108	61,688,002	73,362,555	102,678,505	70,117,226	50,560,363	11,646,342	52,135	0	0	0	0	0	438,060,391	954,356,096	1,392,416,488
20	0.0006	2016	651	1,168,319	3,132,681	5,419,148	8,104,995	24,281,377	41,107,781	50,958,518	74,420,042	53,098,323	40,074,919	9,684,755	45,636	0	0	0	0	0	311,497,145	893,420,527	1,204,917,672
21	0.0003	2017	330	614,790	1,712,884	3,079,831	4,789,560	14,926,484	26,301,731	33,957,845	51,693,061	38,484,972	30,347,906	7,676,285	37,950	0	0	0	0	0	213,623,629	835,534,340	1,049,157,969
22	0.0001	2018	161	311,433	901,350	1,683,987	2,722,021	8,820,645	16,168,456	21,727,032	34,447,331	26,732,127	21,995,767	5,813,092	30,079	0	0	0	0	0	141,353,481	761,578,375	902,931,856
23	0.0001	2019	76	151,905	456,594	886,144	1,488,344	5,012,983	9,554,575	13,356,252	22,040,217	17,813,811	15,279,525	4,213,253	22,779	0	0	0	0	0	90,275,460	657,030,934	747,306,393
24	0.0000	2020	34	71,358	222,710	448,891	783,193	2,740,994	5,430,093	7,892,734	13,548,777	11,397,698	10,181,336	2,926,577	16,510	0	0	0	0	0	55,660,905	633,765,066	689,425,970
25	0.0000	2021	15	32,289	104,619	218,953	396,740	1,442,360	2,969,061	4,485,629	8,006,504	7,006,504	6,514,260	1,950,218	11,468	0	0	0	0	0	33,138,618	598,352,352	631,490,970
26	0.0000	2022	6	14,075	47,339	102,854	193,515	730,652	1,562,373	2,452,648	4,550,287	4,140,418	4,004,509	1,247,796	7,642	0	0	0	0	0	19,054,134	575,317,532	594,371,645
27	0.0000	2023	3	5,912	20,636	46,540	90,904	356,385	791,446	1,290,627	2,488,002	2,353,098	2,366,422	767,057	4,889	0	0	0	0	0	10,581,922	554,253,564	564,835,486
28	0.0000	2024	1	2,393	8,669	20,288	41,133	167,413	386,039	653,789	1,309,231	1,286,625	1,344,894	453,284	3,006	0	0	0	0	0	5,676,763	393,791,961	399,468,723
29	0.0000	2025	0	933	3,508	8,521	17,931	75,752	181,343	318,894	663,213	677,045	735,360	257,612	1,776	0	0	0	0	0	2,941,890	367,489,725	370,431,615
30	0.0000	2026	0	351	1,368	3,449	7,531	33,022	82,055	149,802	323,491	342,969	386,959	140,857	1,009	0	0	0	0	0	1,472,865	191,063,425	192,536,290
		2027	0	127	515	1,345	3,048	13,870	35,770	67,783	151,961	167,288	196,021	74,121	552	0	0	0	0	0	712,402	153,415,160	154,127,562
		2028	0	127	186	506	1,189	5,614	15,024	29,548	68,760	78,584	95,612	37,547	290	0	0	0	0	0	332,989	47,683,166	48,016,155
		2029	0	127	186	183	447	2,190	6,081	12,411	29,974	35,558	44,914	18,314	147	0	0	0	0	0	150,534	45,754,584	45,905,118
		2030	0	127	186	183	162	823	2,372	5,023	12,590	15,501	20,323	8,603	72	0	0	0	0	0	65,966	43,855,155	43,921,121
		2031	0	127	186	183	162	298	892	1,959	5,096	6,511	8,859	3,893	34	0	0	0	0	0	28,201	0	28,201
		2032	0	127	186	183	162	298	323	737	1,988	2,635	3,721	1,697	15	0	0	0	0	0	12,074	0	12,074
		2033	0	127	186	183	162	298	323	267	747	1,028	1,506	713	7	0	0	0	0	0	5,548	0	5,548
		2034	0	127	186	183	162	298	323	267	271	386	588	288	3	0	0	0	0	0	3,084	0	3,084
		2035	0	127	186	183	162	298	323	267	271	140	221	113	1	0	0	0	0	0	2,293	0	2,293
		2036	0	127	186	183	162	298	323	267	271	140	80	42	0	0	0	0	0	0	2,081	0	2,081





Enabling R&D	219,554	149,913,524	296,541,408	623,811,315	948,843,827	980,072,569	808,734,307	667,863,038	504,989,008	306,532,368	220,941,352	114,456,349	14,272,580	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7,669	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,669	487,759	495,427
1998	14,541	5,236,336	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,250,877	140,374,804	145,625,681
1999	19,956	9,928,762	10,357,907	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,306,626	12,078,307	32,384,933
2000	23,495	13,626,440	19,639,917	21,789,132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55,078,984	41,132,800	96,211,784
2001	25,026	16,042,632	26,954,231	41,314,980	33,142,206	0	0	0	0	0	0	0	0	0	0	0	0	0	117,479,076	82,798,485	200,277,561
2002	24,697	17,088,286	31,733,659	56,701,540	62,841,861	34,232,996	0	0	0	0	0	0	0	0	0	0	0	0	202,623,040	79,338,071	281,961,112
2003	22,868	16,863,630	33,802,051	66,755,654	86,245,480	64,910,138	28,248,315	0	0	0	0	0	0	0	0	0	0	0	296,848,136	132,467,014	429,315,150
2004	20,017	15,614,482	33,357,661	71,106,770	101,538,220	89,084,027	53,562,417	23,327,816	0	0	0	0	0	0	0	0	0	0	387,611,411	91,785,792	479,397,203
2005	16,645	13,668,085	30,886,742	70,171,942	108,156,454	104,880,088	73,510,178	44,232,523	17,638,782	0	0	0	0	0	0	0	0	0	463,161,440	245,034,846	708,196,286
2006	13,194	11,365,976	27,036,607	64,974,060	106,734,541	111,716,144	86,544,739	60,705,636	33,445,387	10,706,882	0	0	0	0	0	0	0	0	513,243,167	588,407,525	1,101,650,693
2007	9,991	9,008,847	22,482,845	56,874,828	98,828,339	110,247,433	92,185,703	71,469,742	45,901,146	20,301,618	7,717,270	0	0	0	0	0	0	0	535,027,761	119,170,936	654,198,697
2008	7,242	6,822,213	17,820,248	47,295,429	86,509,058	102,081,018	90,973,754	76,128,121	54,040,173	27,662,363	14,632,930	3,997,851	0	0	0	0	0	0	528,170,401	189,387,155	717,557,556
2009	5,030	4,944,651	13,494,904	37,487,082	71,938,381	89,356,280	84,235,009	75,127,279	57,562,498	32,802,618	20,082,539	7,580,436	498,528	0	0	0	0	0	495,115,434	251,668,887	746,784,321
2010	3,352	3,434,614	9,780,931	28,388,191	57,019,463	74,306,047	73,734,835	69,562,338	56,805,734	34,940,897	23,643,503	10,403,548	945,272	0	0	0	0	0	442,968,725	337,698,168	780,666,893
2011	2,145	2,288,766	6,793,953	20,575,391	43,179,659	58,896,112	61,315,714	60,891,161	52,597,934	34,481,535	25,184,580	12,248,268	1,297,311	0	0	0	0	0	379,752,527	175,910,774	555,663,302
2012	1,318	1,464,406	4,527,369	14,291,915	31,296,054	44,600,806	48,599,775	50,635,294	46,041,426	31,927,367	24,853,483	13,046,607	1,527,346	0	0	0	0	0	312,813,165	118,298,960	431,112,125
2013	779	900,214	2,896,718	9,523,877	21,738,617	32,326,082	36,803,603	40,134,310	38,286,692	27,947,514	23,012,498	12,875,086	1,626,898	0	0	0	0	0	248,072,888	88,436,636	336,509,523
2014	443	531,972	1,780,698	6,093,601	14,486,226	22,454,088	26,674,771	30,392,882	30,346,619	23,240,329	20,143,914	11,921,383	1,605,509	0	0	0	0	0	189,672,434	92,341,318	282,013,753
2015	242	302,332	1,052,285	3,745,918	9,268,630	14,963,002	18,528,619	22,028,364	22,980,866	18,420,641	16,751,085	10,435,343	1,486,583	0	0	0	0	0	139,963,910	97,072,856	237,036,766
2016	127	165,309	598,038	2,213,610	5,697,702	9,573,683	12,347,140	15,301,168	16,656,232	13,949,570	13,277,166	8,677,724	1,301,276	0	0	0	0	0	99,758,745	107,138,257	206,897,002
2017	65	86,989	326,995	1,258,047	3,366,996	5,885,227	7,899,992	10,196,425	11,569,620	10,110,466	10,054,523	6,878,097	1,082,103	0	0	0	0	0	68,715,544	8,449,218	77,164,762
2018	31	44,066	172,071	687,874	1,913,544	3,477,812	4,856,360	6,523,914	7,709,788	7,022,852	7,287,387	5,208,640	857,691	0	0	0	0	0	45,762,030	7,756,987	53,519,017
2019	15	21,494	87,165	361,972	1,046,286	1,976,524	2,869,814	4,010,444	4,932,905	4,679,903	5,061,907	3,775,154	649,512	0	0	0	0	0	29,473,093	4,091,686	33,564,779
2020	7	10,097	42,516	183,363	550,574	1,080,722	1,630,984	2,369,929	3,032,403	2,994,313	3,373,164	2,622,268	470,756	0	0	0	0	0	18,361,096	0	18,361,096
2021	3	4,569	19,972	89,438	278,903	568,695	891,788	1,346,887	1,791,966	1,840,693	2,158,230	1,747,432	326,994	0	0	0	0	0	11,065,569	0	11,065,569
2022	1	1,992	9,037	42,014	136,039	288,082	469,275	736,450	1,018,417	1,087,738	1,326,728	1,118,049	217,903	0	0	0	0	0	6,451,723	0	6,451,723
2023	1	837	3,939	19,011	63,905	140,516	237,719	387,533	556,849	618,187	784,016	687,298	139,419	0	0	0	0	0	3,639,229	0	3,639,229
2024	0	339	1,655	8,287	28,916	66,008	115,951	196,311	293,024	338,012	445,575	406,151	85,705	0	0	0	0	0	1,985,934	0	1,985,934
2025	0	132	670	3,481	12,605	29,868	54,468	95,754	148,436	177,868	243,631	230,825	50,647	0	0	0	0	0	1,048,384	0	1,048,384
2026	0	50	261	1,409	5,294	13,020	24,646	44,981	72,402	90,102	128,203	126,210	28,784	0	0	0	0	0	535,362	0	535,362
2027	0	18	98	550	2,143	5,469	10,744	20,353	34,011	43,948	64,943	66,414	15,738	0	0	0	0	0	264,430	0	264,430
2028	0	18	36	207	836	2,213	4,513	8,872	15,390	20,645	31,677	33,643	8,282	0	0	0	0	0	126,331	0	126,331
2029	0	18	36	75	314	863	1,827	3,727	6,709	9,342	14,880	16,410	4,195	0	0	0	0	0	58,395	0	58,395
2030	0	18	36	75	114	325	712	1,508	2,818	4,072	6,733	7,709	2,046	0	0	0	0	0	26,166	0	26,166
2031	0	18	36	75	114	118	268	588	1,141	1,710	2,935	3,488	961	0	0	0	0	0	11,452	0	11,452
2032	0	18	36	75	114	118	97	221	445	692	1,233	1,521	435	0	0	0	0	0	5,004	0	5,004
2033	0	18	36	75	114	118	97	80	167	270	499	639	190	0	0	0	0	0	2,302	0	2,302
2034	0	18	36	75	114	118	97	80	61	102	195	258	80	0	0	0	0	0	1,232	0	1,232
2035	0	18	36	75	114	118	97	80	61	37	73	101	32	0	0	0	0	0	841	0	841
2036	0	18	36	75	114	118	97	80	61	37	27	38	13	0	0	0	0	0	712	0	712

Environment R&D	30,696,686	193,822,632	359,836,825	365,565,807	338,703,629	324,810,934	423,074,220	460,604,941	497,038,504	324,599,490	188,814,894	110,328,034	70,545,741	44,060,299	29,179,475	23,281,075	21,254,803	4,758,656	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	1,072,206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,072,206	0	1,072,206
1998	2,033,039	6,770,039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,803,078	136,589,611	145,392,689
1999	2,790,186	12,836,860	12,568,756	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28,195,801	21,718,967	49,914,768
2000	3,284,931	17,617,574	23,831,968	12,768,864	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57,503,336	5,318,852	62,822,188
2001	3,499,042	20,741,459	32,707,490	24,211,398	11,830,593	0	0	0	0	0	0	0	0	0	0	0	0	0	92,989,982	4,560,626	97,550,608
2002	3,453,041	22,093,381	38,507,065	33,228,227	22,432,318	11,345,335	0	0	0	0	0	0	0	0	0	0	0	0	131,059,367	7,534,406	138,593,774
2003	3,197,262	21,802,924	41,016,945	39,120,138	30,786,581	21,512,206	14,777,577	0	0	0	0	0	0	0	0	0	0	0	172,213,632	109,238,776	281,452,408
2004	2,798,713	20,187,905	40,477,703	41,669,978	36,245,547	29,523,799	28,020,176	16,088,489	0	0	0	0	0	0	0	0	0	0	215,012,310	177,317,708	392,330,018
2005	2,327,327	17,671,415	37,479,377	41,122,151	38,608,022	34,758,854	38,455,474	30,505,833	17,361,079	0	0	0	0	0	0	0	0	0	258,289,532	136,371,298	394,660,830
2006	1,844,675	14,695,028	32,807,448	38,076,089	38,100,450	37,024,427	45,274,261	41,866,842	32,918,826	11,337,949	0	0	0	0	0	0	0	0	293,945,993	210,224,031	504,170,025
2007	1,396,934	11,647,504	27,281,706	33,329,777	35,278,216	36,537,674	48,225,225	49,290,520	45,178,483	21,498,202	6,595,123	0	0	0	0	0	0	0	316,259,364	496,545,766	812,805,131
2008	1,012,480	8,820,414	21,623,899	27,716,060	30,880,669	33,831,200	47,591,217	52,503,263	53,189,369	29,504,580	12,505,197	3,853,653	0	0	0	0	0	0	323,032,000	595,134,198	918,166,199
2009	703,281	6,392,921	16,375,331	21,968,174	25,679,453	29,614,028	44,065,969	51,813,012	56,656,238	34,736,227	17,162,394	7,307,018	2,464,095	0	0	0	0	0	314,938,141	693,742,765	1,008,680,905
2010	468,654	4,440,600	11,868,626	16,636,643	20,353,928	24,626,153	38,572,999	47,975,041	55,911,389	37,000,325	20,205,568	10,028,304	4,672,240	1,538,984	0	0	0	0	294,298,853	839,238,684	1,133,537,537
2011	299,856	2,959,136	8,244,091	12,057,587	15,413,608	19,519,066	32,076,169	41,994,792	51,769,837	36,513,888	21,522,561	11,806,487	6,412,279	2,918,111	1,019,211	0	0	0	264,526,679	934,184,057	1,198,710,736
2012	184,330	1,893,326	5,493,715	8,375,346	11,171,582	14,781,384	25,424,063	34,921,631	45,316,054	33,809,177	21,239,608	12,576,031	7,549,281	4,004,876	1,932,555	813,186	0	0	229,466,643	982,095,306	1,211,561,949
2013	108,926	1,163,883	3,515,009	5,581,181	7,759,916	10,713,355	19,253,116	27,679,420	37,683,910	29,594,750	19,666,316	12,410,696	8,041,341	4,715,006	2,652,278	1,541,904	742,410	0	192,823,419	887,877,622	1,080,701,041
2014	61,906	687,784	2,160,780	3,570,971	5,171,069	7,441,626	13,954,408	20,961,051	29,868,845	24,610,121	17,214,844	11,491,392	7,935,623	5,022,329	3,122,571	2,116,141	1,407,704	166,215	156,965,382	873,036,465	1,030,001,848
2015	33,849	390,884	1,276,890	2,195,182	3,308,572	4,958,966	9,692,900	15,192,297	22,619,057	19,506,359	14,315,357	10,058,952	7,347,804	4,956,301	3,326,099	2,491,368	1,931,962	315,165	123,917,966	587,746,745	711,664,711
2016	17,812	213,727	725,687	1,297,219	2,033,878	3,172,864	6,459,175	10,552,753	16,393,998	14,771,762	11,346,571	8,364,728	6,431,876	4,589,171	3,282,371	2,653,754	2,274,531	432,540	95,014,417	364,469,559	459,483,976
2017	9,023	112,467	396,790	737,241	1,201,898	1,950,454	4,132,733	7,032,166	11,387,469	10,706,381	8,592,523	6,630,011	5,348,558	4,017,115	3,039,235	2,618,866	2,422,784	509,236	70,844,951	201,771,681	272,616,632
2018	4,401	56,972	208,798	403,108	683,067	1,152,600	2,540,514	4,499,346	7,588,406	7,436,781	6,227,749	5,020,770	4,239,349	3,340,515	2,660,384	2,424,877	2,390,933	542,428	51,420,998	164,163,658	215,584,656
2019	2,067	27,789	105,770	212,122	373,487	655,050	1,501,289	2,765,882	4,855,241	4,955,738	4,325,870	3,638,989	3,210,371	2,647,743	2,212,297	2,122,608	2,213,828	535,297	36,361,439	145,206,755	181,568,194
2020	935	13,054	51,591	107,454	196,535	358,168	853,219	1,634,468	2,984,661	3,170,798	2,882,682	2,527,686	2,326,835	2,005,081	1,753,500	1,765,099	1,937,867	495,645	25,065,279	47,947,625	73,012,904
2021	408	5,907	24,235	52,412	99,558	188,474	466,522	928,907	1,763,753	1,949,184	1,844,408	1,684,404	1,616,248	1,453,257	1,327,890	1,399,044	1,611,473	433,862	16,849,946	44,922,127	61,772,074
2022	171	2,575	10,966	24,621	48,561	95,475	245,492	507,907	1,002,383	1,151,849	1,133,813	1,077,722	1,077,039	1,009,450	962,437	1,059,467	1,277,278	360,786	11,047,992	35,990,789	47,038,781
2023	69	1,082	4,780	11,141	22,812	46,569	124,358	267,270	548,082	654,623	670,014	662,508	689,115	672,679	668,520	767,888	967,256	285,965	7,064,732	32,768,548	39,833,280
2024	27	438	2,008	4,856	10,322	21,876	60,657	135,390	288,411	357,934	380,785	391,502	423,619	430,396	445,490	533,384	701,055	216,555	4,404,706	0	4,404,706
2025	10	171	813	2,040	4,500	9,899	28,494	66,038	146,099	188,351	208,205	222,500	250,333	264,577	285,035	355,438	486,961	156,956	2,676,421	0	2,676,421
2026	4	64	317	826	1,890	4,315	12,893	31,022	71,262	95,413	109,561	121,658	142,270	156,349	175,220	227,417	324,502	109,024	1,584,007	0	1,584,007
2027	4	23	119	322	765	1,812	5,620	14,037	33,475	46,539	55,500	64,019	77,790	88,857	103,544	139,800	207,624	72,652	912,504	0	912,504
2028	4	23	43	121	298	734	2,361	6,119	15,147	21,862	27,071	32,430	40,935	48,585	58,847	82,613	127,633	46,484	511,309	0	511,309
2029	4	23	43	44	112	286	956	2,570	6,603	9,892	12,717	15,818	20,736	25,566	32,176	46,951	75,423	28,575	278,496	0	278,496
2030	4	23	43	44	41	108	373	1,040	2,773	4,312	5,754	7,431	10,114	12,951	16,932	25,672	42,865	16,886	147,366	0	147,366
2031	4	23	43	44	41	39	140	406	1,123	1,811	2,508	3,362	4,751	6,317	8,577	13,509	23,438	9,597	75,733	0	75,733
2032	4	23	43	44	41	39	51	153	438	733	1,054	1,466	2,150	2,967	4,184	6,843	12,333	5,247	37,812	0	37,812
2033	4	23	43	44	41	39	51	55	165	286	426	616	937	1,343	1,965	3,338	6,248	2,761	18,384	0	18,384
2034	4	23	43	44	41	39	51	55	60	108	166	249	394	585	889	1,568	3,047	1,399	8,765	0	8,765
2035	4	23	43	44	41	39	51	55	60	39	63	97	159	246	388	709	1,432	682	4,174	0	4,174
2036	4	23	43	44	41	39	51	55	60	39	23	37	62	100	163	309	648	320	2,060	0	2,060

Adv Man IRAP	0	0	16,107,000	75,151,453	71,881,673	46,611,885	45,438,466	32,029,372	12,430,117	10,908,621	1,919,938	0	0	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	562,602	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	562,602	0	562,602
2000	0	0	1,066,765	2,624,968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,691,734	19,534,217	23,225,950
2001	0	0	1,464,051	4,977,276	2,510,758	0	0	0	0	0	0	0	0	0	0	0	0	0	8,952,085	17,042,439	25,994,524
2002	0	0	1,723,652	6,830,917	4,760,718	1,628,109	0	0	0	0	0	0	0	0	0	0	0	0	14,943,395	20,293,305	35,236,700
2003	0	0	1,835,999	8,042,150	6,533,709	3,087,102	1,587,122	0	0	0	0	0	0	0	0	0	0	0	21,086,082	48,340,903	69,426,985
2004	0	0	1,811,861	8,566,336	7,692,243	4,236,803	3,009,386	1,118,755	0	0	0	0	0	0	0	0	0	0	26,435,384	36,026,805	62,462,189
2005	0	0	1,677,650	8,453,716	8,193,621	4,988,058	4,130,145	2,121,303	434,172	0	0	0	0	0	0	0	0	0	29,998,665	37,014,478	67,013,142
2006	0	0	1,468,526	7,827,519	8,085,901	5,313,178	4,862,487	2,911,321	823,246	381,028	0	0	0	0	0	0	0	0	31,673,205	34,660,700	66,333,906
2007	0	0	1,221,183	6,851,793	7,486,950	5,243,327	5,179,423	3,427,546	1,129,840	722,477	67,062	0	0	0	0	0	0	0	31,329,599	38,438,877	69,768,476
2008	0	0	967,928	5,697,749	6,553,677	4,854,935	5,111,330	3,650,952	1,330,179	991,543	127,157	0	0	0	0	0	0	0	29,285,450	24,791,203	54,076,653
2009	0	0	732,992	4,516,123	5,449,844	4,249,751	4,732,716	3,602,954	1,416,879	1,167,360	174,513	0	0	0	0	0	0	0	26,043,133	21,936,576	47,979,708
2010	0	0	531,263	3,419,966	4,319,630	3,533,968	4,142,767	3,336,070	1,398,252	1,243,448	205,458	0	0	0	0	0	0	0	22,130,822	10,447,895	32,578,717
2011	0	0	369,022	2,478,747	3,271,166	2,801,077	3,445,003	2,920,218	1,294,679	1,227,100	218,849	0	0	0	0	0	0	0	18,025,861	5,343,290	23,369,151
2012	0	0	245,909	1,721,768	2,370,899	2,121,198	2,730,562	2,428,367	1,133,293	1,136,205	215,972	0	0	0	0	0	0	0	14,104,172	3,380,524	17,484,696
2013	0	0	157,339	1,147,355	1,646,855	1,537,416	2,067,798	1,924,761	942,413	994,573	199,974	0	0	0	0	0	0	0	10,618,484	2,097,988	12,716,472
2014	0	0	96,721	734,105	1,097,435	1,067,908	1,498,713	1,457,582	746,971	827,058	175,047	0	0	0	0	0	0	0	7,701,538	0	7,701,538
2015	0	0	57,156	451,276	702,165	711,635	1,041,024	1,056,436	565,665	655,539	145,564	0	0	0	0	0	0	0	5,386,460	0	5,386,460
2016	0	0	32,483	266,677	431,641	455,321	693,720	733,813	409,987	496,426	115,376	0	0	0	0	0	0	0	3,635,444	0	3,635,444
2017	0	0	17,761	151,559	255,074	279,899	443,858	489,000	284,782	359,803	87,372	0	0	0	0	0	0	0	2,369,108	0	2,369,108
2018	0	0	9,346	82,869	144,965	165,403	272,853	312,874	189,774	249,923	63,326	0	0	0	0	0	0	0	1,491,333	0	1,491,333
2019	0	0	4,734	43,607	79,264	94,003	161,240	192,333	121,422	166,545	43,987	0	0	0	0	0	0	0	907,134	0	907,134
2020	0	0	2,309	22,090	41,710	51,399	91,636	113,657	74,641	106,559	29,312	0	0	0	0	0	0	0	533,314	0	533,314
2021	0	0	1,085	10,775	21,129	27,047	50,105	64,594	44,109	65,505	18,755	0	0	0	0	0	0	0	303,102	0	303,102
2022	0	0	491	5,061	10,306	13,701	26,366	35,319	25,068	38,710	11,529	0	0	0	0	0	0	0	166,550	0	166,550
2023	0	0	214	2,290	4,841	6,683	13,356	18,585	13,707	22,000	6,813	0	0	0	0	0	0	0	88,489	0	88,489
2024	0	0	90	998	2,191	3,139	6,515	9,415	7,213	12,029	3,872	0	0	0	0	0	0	0	45,461	0	45,461
2025	0	0	36	419	955	1,420	3,060	4,592	3,654	6,330	2,117	0	0	0	0	0	0	0	22,584	0	22,584
2026	0	0	14	170	401	619	1,385	2,157	1,782	3,206	1,114	0	0	0	0	0	0	0	10,849	0	10,849
2027	0	0	5	66	162	260	604	976	837	1,564	564	0	0	0	0	0	0	0	5,039	0	5,039
2028	0	0	2	25	63	105	254	426	379	735	275	0	0	0	0	0	0	0	2,263	0	2,263
2029	0	0	2	9	24	41	103	179	165	332	129	0	0	0	0	0	0	0	984	0	984
2030	0	0	2	9	9	15	40	72	69	145	59	0	0	0	0	0	0	0	420	0	420
2031	0	0	2	9	9	6	15	28	28	61	26	0	0	0	0	0	0	0	183	0	183
2032	0	0	2	9	9	6	5	11	11	25	11	0	0	0	0	0	0	0	88	0	88
2033	0	0	2	9	9	6	5	4	4	10	4	0	0	0	0	0	0	0	53	0	53
2034	0	0	2	9	9	6	5	4	1	4	2	0	0	0	0	0	0	0	41	0	41
2035	0	0	2	9	9	6	5	4	1	1	1	0	0	0	0	0	0	0	38	0	38
2036	0	0	2	9	9	6	5	4	1	1	0	0	0	0	0	0	0	0	38	0	38

Adv Mat IRAP	0	0	7,319,638	23,701,489	20,277,217	10,370,810	21,101,955	20,274,739	21,759,164	9,442,178	719,523	0	0	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	255,668	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	255,668	0	255,668
2000	0	0	484,779	827,870	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,312,649	0	1,312,649
2001	0	0	665,321	1,569,748	708,264	0	0	0	0	0	0	0	0	0	0	0	0	0	2,943,333	79,402	3,022,735
2002	0	0	783,293	2,154,355	1,342,959	362,242	0	0	0	0	0	0	0	0	0	0	0	0	4,642,849	629,829	5,272,678
2003	0	0	834,348	2,536,357	1,843,104	686,858	737,071	0	0	0	0	0	0	0	0	0	0	0	6,637,739	2,433,021	9,070,760
2004	0	0	823,379	2,701,676	2,169,917	942,658	1,397,581	708,177	0	0	0	0	0	0	0	0	0	0	8,743,389	460,839	9,204,228
2005	0	0	762,389	2,666,158	2,311,352	1,109,807	1,918,069	1,342,795	760,027	0	0	0	0	0	0	0	0	0	10,870,596	15,903,416	26,774,013
2006	0	0	667,354	2,468,666	2,280,965	1,182,144	2,258,175	1,842,879	1,441,108	329,806	0	0	0	0	0	0	0	0	12,471,097	23,209,954	35,681,052
2007	0	0	554,952	2,160,939	2,112,006	1,166,603	2,405,362	2,169,652	1,977,807	625,355	25,132	0	0	0	0	0	0	0	13,197,807	18,483,549	31,681,356
2008	0	0	439,864	1,796,973	1,848,737	1,080,188	2,373,739	2,311,069	2,328,504	858,250	47,654	0	0	0	0	0	0	0	13,084,978	19,604,351	32,689,329
2009	0	0	333,100	1,424,308	1,537,355	945,539	2,197,908	2,280,686	2,480,275	1,010,432	65,401	0	0	0	0	0	0	0	12,275,005	8,293,249	20,568,254
2010	0	0	241,426	1,078,599	1,218,531	786,282	1,923,931	2,111,748	2,447,668	1,076,291	76,998	0	0	0	0	0	0	0	10,961,475	7,280,479	18,241,954
2011	0	0	167,698	781,755	922,769	623,220	1,599,884	1,848,511	2,266,360	1,062,142	82,017	0	0	0	0	0	0	0	9,354,355	2,613,136	11,967,491
2012	0	0	111,751	543,016	668,811	471,951	1,268,093	1,537,168	1,983,851	983,465	80,938	0	0	0	0	0	0	0	7,649,044	595,929	8,244,973
2013	0	0	71,501	361,856	464,564	342,064	960,301	1,218,383	1,649,712	860,873	74,943	0	0	0	0	0	0	0	6,004,196	97,409	6,101,605
2014	0	0	43,954	231,524	309,577	237,602	696,013	922,656	1,307,587	715,876	65,601	0	0	0	0	0	0	0	4,530,391	0	4,530,391
2015	0	0	25,974	142,325	198,075	158,334	483,459	668,729	990,209	567,415	54,552	0	0	0	0	0	0	0	3,289,071	0	3,289,071
2016	0	0	14,762	84,105	121,762	101,306	322,169	464,507	717,690	429,691	43,239	0	0	0	0	0	0	0	2,299,231	0	2,299,231
2017	0	0	8,071	47,799	71,954	62,276	206,131	309,539	498,516	311,435	32,744	0	0	0	0	0	0	0	1,548,465	0	1,548,465
2018	0	0	4,247	26,136	40,893	36,801	126,715	198,051	332,202	216,326	23,732	0	0	0	0	0	0	0	1,005,104	0	1,005,104
2019	0	0	2,152	13,753	22,360	20,915	74,881	121,748	212,551	144,156	16,485	0	0	0	0	0	0	0	628,999	0	628,999
2020	0	0	1,049	6,967	11,766	11,436	42,557	71,945	130,661	92,234	10,985	0	0	0	0	0	0	0	379,601	0	379,601

2021	0	0	493	3,398	5,960	6,018	23,269	40,888	77,213	56,699	7,029	0	0	0	0	0	0	0	220,967	0	220,967
2022	0	0	223	1,596	2,907	3,048	12,245	22,357	43,882	33,506	4,321	0	0	0	0	0	0	0	124,085	0	124,085
2023	0	0	97	722	1,366	1,487	6,203	11,765	23,994	19,042	2,553	0	0	0	0	0	0	0	67,229	0	67,229
2024	0	0	41	315	618	698	3,025	5,960	12,626	10,412	1,451	0	0	0	0	0	0	0	35,146	0	35,146
2025	0	0	17	132	269	316	1,421	2,907	6,396	5,479	793	0	0	0	0	0	0	0	17,730	0	17,730
2026	0	0	6	54	113	138	643	1,366	3,120	2,775	418	0	0	0	0	0	0	0	8,632	0	8,632
2027	0	0	2	21	46	58	280	618	1,465	1,354	211	0	0	0	0	0	0	0	4,056	0	4,056
2028	0	0	1	8	18	23	118	269	663	636	103	0	0	0	0	0	0	0	1,839	0	1,839
2029	0	0	1	3	7	9	48	113	289	288	48	0	0	0	0	0	0	0	806	0	806
2030	0	0	1	3	2	3	19	46	121	125	22	0	0	0	0	0	0	0	343	0	343
2031	0	0	1	3	2	1	7	18	49	53	10	0	0	0	0	0	0	0	144	0	144
2032	0	0	1	3	2	1	3	7	19	21	4	0	0	0	0	0	0	0	61	0	61
2033	0	0	1	3	2	1	3	2	7	8	2	0	0	0	0	0	0	0	30	0	30
2034	0	0	1	3	2	1	3	2	3	3	1	0	0	0	0	0	0	0	19	0	19
2035	0	0	1	3	2	1	3	2	3	1	0	0	0	0	0	0	0	0	16	0	16
2036	0	0	1	3	2	1	3	2	3	1	0	0	0	0	0	0	0	0	16	0	16

Aero IRAP	0	0	2,866,601	13,890,858	2,522,053	10,355,654	16,328,501	3,775,185	2,964,549	2,324,265	3,014,511	2,341,740	0	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	100,128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100,128	0	100,128
2000	0	0	189,855	485,194	0	0	0	0	0	0	0	0	0	0	0	0	0	0	675,049	0	675,049
2001	0	0	260,561	919,991	88,093	0	0	0	0	0	0	0	0	0	0	0	0	0	1,268,644	2,170,127	3,438,772
2002	0	0	306,762	1,262,614	167,035	361,713	0	0	0	0	0	0	0	0	0	0	0	0	2,098,125	3,780,389	5,878,514
2003	0	0	326,757	1,486,497	229,243	685,854	570,339	0	0	0	0	0	0	0	0	0	0	0	3,298,690	2,914,705	6,213,395
2004	0	0	322,461	1,583,386	269,891	941,281	1,081,435	131,864	0	0	0	0	0	0	0	0	0	0	4,330,318	7,901,270	12,231,589
2005	0	0	298,575	1,562,569	287,483	1,108,185	1,484,185	250,030	103,549	0	0	0	0	0	0	0	0	0	5,094,577	10,101,555	15,196,132
2006	0	0	261,357	1,446,824	283,703	1,180,416	1,747,355	343,147	196,342	81,184	0	0	0	0	0	0	0	0	5,540,329	9,197,167	14,737,496
2007	0	0	217,337	1,266,473	262,688	1,164,898	1,861,247	403,992	269,464	153,936	105,294	0	0	0	0	0	0	0	5,705,329	4,309,269	10,014,598
2008	0	0	172,264	1,053,162	229,943	1,078,610	1,836,778	430,324	317,244	211,265	199,651	81,795	0	0	0	0	0	0	5,611,035	3,822,704	9,433,740
2009	0	0	130,452	834,752	191,214	944,157	1,700,721	424,667	337,922	248,726	274,005	155,093	0	0	0	0	0	0	5,241,709	1,191,550	6,433,260
2010	0	0	94,550	632,140	151,559	785,133	1,488,720	393,210	333,479	264,937	322,591	212,853	0	0	0	0	0	0	4,679,175	488,004	5,167,179
2011	0	0	65,676	458,167	114,773	622,309	1,237,976	344,195	308,777	261,454	343,617	250,596	0	0	0	0	0	0	4,007,540	444,314	4,451,853
2012	0	0	43,765	318,248	83,186	471,262	981,239	286,223	270,287	242,087	339,099	266,929	0	0	0	0	0	0	3,302,326	404,534	3,706,860
2013	0	0	28,002	212,075	57,782	341,564	743,072	226,865	224,763	211,910	313,981	263,420	0	0	0	0	0	0	2,623,434	368,317	2,991,751
2014	0	0	17,214	135,691	38,505	237,255	538,569	171,800	178,150	176,218	274,842	243,908	0	0	0	0	0	0	2,012,151	0	2,012,151
2015	0	0	10,172	83,413	24,636	158,102	374,096	124,518	134,910	139,673	228,551	213,504	0	0	0	0	0	0	1,491,576	0	1,491,576
2016	0	0	5,781	49,292	15,145	101,158	249,291	86,492	97,781	105,772	181,153	177,543	0	0	0	0	0	0	1,069,407	0	1,069,407
2017	0	0	3,161	28,014	8,950	62,185	159,502	57,637	67,920	76,662	137,183	140,724	0	0	0	0	0	0	741,937	0	741,937
2018	0	0	1,663	15,317	5,086	36,747	98,051	36,877	45,260	53,250	99,429	106,567	0	0	0	0	0	0	498,249	0	498,249
2019	0	0	843	8,060	2,781	20,884	57,942	22,670	28,959	35,485	69,064	77,238	0	0	0	0	0	0	323,927	0	323,927
2020	0	0	411	4,083	1,463	11,419	32,930	13,396	17,802	22,704	46,023	53,651	0	0	0	0	0	0	203,883	0	203,883
2021	0	0	193	1,992	741	6,009	18,005	7,613	10,520	13,957	29,447	35,752	0	0	0	0	0	0	124,229	0	124,229
2022	0	0	87	936	362	3,044	9,475	4,163	5,979	8,248	18,102	22,875	0	0	0	0	0	0	73,269	0	73,269
2023	0	0	38	423	170	1,485	4,800	2,191	3,269	4,687	10,697	14,062	0	0	0	0	0	0	41,821	0	41,821
2024	0	0	16	185	77	697	2,341	1,110	1,720	2,563	6,079	8,310	0	0	0	0	0	0	23,098	0	23,098
2025	0	0	6	78	34	316	1,100	541	871	1,349	3,324	4,723	0	0	0	0	0	0	12,341	0	12,341
2026	0	0	3	31	14	138	498	254	425	683	1,749	2,582	0	0	0	0	0	0	6,377	0	6,377
2027	0	0	1	12	6	58	217	115	200	333	886	1,359	0	0	0	0	0	0	3,186	0	3,186
2028	0	0	0	5	2	23	91	50	90	157	432	688	0	0	0	0	0	0	1,539	0	1,539
2029	0	0	0	2	1	9	37	21	39	71	203	336	0	0	0	0	0	0	719	0	719
2030	0	0	0	2	0	3	14	9	17	31	92	158	0	0	0	0	0	0	326	0	326
2031	0	0	0	2	0	1	5	3	7	13	40	71	0	0	0	0	0	0	143	0	143
2032	0	0	0	2	0	1	2	1	3	5	17	31	0	0	0	0	0	0	63	0	63
2033	0	0	0	2	0	1	2	0	1	2	7	13	0	0	0	0	0	0	29	0	29
2034	0	0	0	2	0	1	2	0	0	1	3	5	0	0	0	0	0	0	15	0	15
2035	0	0	0	2	0	1	2	0	0	0	1	2	0	0	0	0	0	0	10	0	10
2036	0	0	0	2	0	1	2	0	0	0	0	1	0	0	0	0	0	0	8	0	8

Biotech IRAP	0	0	10,571,832	23,887,007	22,073,793	35,727,579	18,863,460	14,410,500	15,237,286	7,707,575	1,078,814	0	0	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	369,264	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	369,264	0	369,264
2000	0	0	700,172	834,350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,534,522	12,858,116	14,392,638
2001	0	0	960,930	1,582,035	771,016	0	0	0	0	0	0	0	0	0	0	0	0	0	3,313,982	944,407	4,258,389
2002	0	0	1,131,319	2,171,218	1,461,946	1,247,930	0	0	0	0	0	0	0	0	0	0	0	0	6,012,412	5,098,558	11,110,970
2003	0	0	1,205,058	2,556,210	2,006,405	2,366,235	658,883	0	0	0	0	0	0	0	0	0	0	0	8,792,791	4,536,407	13,329,198
2004	0	0	1,189,215	2,722,823	2,362,173	3,247,470	1,249,326	503,345	0	0	0	0	0	0	0	0	0	0	11,274,353	7,573,152	18,847,505
2005	0	0	1,101,126	2,687,027	2,516,139	3,823,300	1,714,601	954,406	532,224	0	0	0	0	0	0	0	0	0	13,328,823	24,449,515	37,778,338
2006	0	0	963,867	2,487,989	2,483,060	4,072,502	2,018,627	1,309,847	1,009,164	269,218	0	0	0	0	0	0	0	0	14,614,276	31,211,486	45,825,761
2007	0	0	801,523	2,177,853	2,299,131	4,018,961	2,150,201	1,542,105	1,384,998	510,472	37,882	0	0	0	0	0	0	0	14,922,927	25,269,515	40,192,442
2008	0	0	635,300	1,811,038	2,012,537	3,721,263	2,121,933	1,642,619	1,630,581	700,583	71,450	0	0	0	0	0	0	0	14,347,303	11,548,535	25,895,838
2009	0	0	481,099	1,435,457	1,673,566	3,257,395	1,964,754	1,621,023	1,738,862	824,807	98,059	0	0	0	0	0	0	0	13,093,023	4,055,851	17,148,875
2010	0	0	348,695	1,087,042	1,326,494	2,708,754	1,719,841	1,500,949	1,714,028	878,568	115,447	0	0	0	0	0	0	0	11,399,816	3,017,034	14,416,850
2011	0	0	242,207	787,874	1,004,527	2,147,000	1,430,169	1,313,850	1,587,064	867,018	122,971	0	0	0	0	0	0	0	9,502,679	2,506,951	12,009,631
2012	0	0	161,403	547,267	728,068	1,625,878	1,133,574	1,092,559	1,389,231	802,795	121,355	0	0	0	0	0	0	0	7,602,129	408,275	8,010,404
2013	0	0	103,269	364,689	505,725	1,178,415	858,432	865,979	1,155,244	702,724	112,366	0	0	0	0	0	0	0	5,846,842	371,722	6,218,564
2014	0	0	63,483	233,336	337,006	818,542	622,180	655,788	915,664	584,364	98,359	0	0	0	0	0	0	0	4,328,722	0	4,328,722
2015	0	0	37,514	143,439	215,624	545,462	432,174	475,307	693,413	463,176	81,792	0	0	0	0	0	0	0	3,087,901	0	3,087,901
2016	0	0	21,320	84,764	132,551	348,999	287,993	330,154	502,577	350,754	64,830	0	0	0	0	0	0	0	2,123,941	0	2,123,941
2017	0	0	11,658	48,173	78,329	214,540	184,265	220,009	349,096	254,222	49,094	0	0	0	0	0	0	0	1,409,385	0	1,409,385
2018	0	0	6,134	26,340	44,516	126,780	113,273	140,767	232,631	176,585	35,583	0	0	0	0	0	0	0	902,610	0	902,610
2019	0	0	3,107	13,861	24,341	72,052	66,937	86,533	148,843	117,673	24,716	0	0	0	0	0	0	0	558,065	0	558,065
2020	0	0	1,516	7,021	12,808	39,397	38,042	51,136	91,498	75,290	16,471	0	0	0	0	0	0	0	333,179	0	333,179
2021	0	0	712	3,425	6,488	20,731	20,801	29,062	54,070	46,283	10,538	0	0	0	0	0	0	0	192,110	0	192,110
2022	0	0	322	1,609	3,165	10,502	10,946	15,890	30,729	27,351	6,478	0	0	0	0	0	0	0	106,991	0	106,991
2023	0	0	140	728	1,487	5,122	5,545	8,362	16,802	15,544	3,828	0	0	0	0	0	0	0	57,558	0	57,558
2024	0	0	59	317	673	2,406	2,705	4,236	8,842	8,499	2,176	0	0	0	0	0	0	0	29,912	0	29,912
2025	0	0	24	133	293	1,089	1,270	2,066	4,479	4,472	1,190	0	0	0	0	0	0	0	15,017	0	15,017
2026	0	0	9	54	123	475	575	971	2,185	2,266	626	0	0	0	0	0	0	0	7,283	0	7,283
2027	0	0	4	21	50	199	251	439	1,026	1,105	317	0	0	0	0	0	0	0	3,412	0	3,412
2028	0	0	1	8	19	81	105	191	464	519	155	0	0	0	0	0	0	0	1,544	0	1,544
2029	0	0	1	3	7	31	43	80	202	235	73	0	0	0	0	0	0	0	676	0	676
2030	0	0	1	3	3	12	17	33	85	102	33	0	0	0	0	0	0	0	288	0	288
2031	0	0	1	3	3	4	6	13	34	43	14	0	0	0	0	0	0	0	122	0	122
2032	0	0	1	3	3	4	2	5	13	17	6	0	0	0	0	0	0	0	55	0	55
2033	0	0	1	3	3	4	2	2	5	7	2	0	0	0	0	0	0	0	29	0	29
2034	0	0	1	3	3	4	2	2	2	3	1	0	0	0	0	0	0	0	20	0	20
2035	0	0	1	3	3	4	2	2	2	1	0	0	0	0	0	0	0	0	18	0	18
2036	0	0	1	3	3	4	2	2	2	1	0	0	0	0	0	0	0	0	18	0	18

Env IRAP	0	0	5,357,329	13,009,298	20,409,473	17,406,567	19,132,897	10,255,445	7,633,885	9,187,411	0	0	0	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	187,126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	187,126	0	187,126
2000	0	0	354,815	454,402	0	0	0	0	0	0	0	0	0	0	0	0	0	0	809,218	0	809,218
2001	0	0	486,956	861,605	712,883	0	0	0	0	0	0	0	0	0	0	0	0	0	2,061,444	587,869	2,649,314
2002	0	0	573,302	1,182,485	1,351,718	607,995	0	0	0	0	0	0	0	0	0	0	0	0	3,715,499	3,225,484	6,940,982
2003	0	0	610,669	1,392,158	1,855,126	1,152,836	668,294	0	0	0	0	0	0	0	0	0	0	0	5,679,083	4,668,731	10,347,814
2004	0	0	602,641	1,482,899	2,184,070	1,582,176	1,267,170	358,213	0	0	0	0	0	0	0	0	0	0	7,477,169	4,361,867	11,839,036
2005	0	0	558,001	1,463,404	2,326,427	1,862,722	1,739,091	679,217	266,644	0	0	0	0	0	0	0	0	0	8,895,506	25,916,009	34,811,515
2006	0	0	488,444	1,355,004	2,295,842	1,984,133	2,047,461	932,172	505,592	320,907	0	0	0	0	0	0	0	0	9,929,556	29,835,008	39,764,564
2007	0	0	406,176	1,186,098	2,125,781	1,958,048	2,180,913	1,097,462	693,885	608,482	0	0	0	0	0	0	0	0	10,256,845	20,419,829	30,676,674
2008	0	0	321,941	986,324	1,860,795	1,813,009	2,152,241	1,168,994	816,922	835,093	0	0	0	0	0	0	0	0	9,955,320	15,301,076	25,256,396
2009	0	0	243,799	781,776	1,547,383	1,587,011	1,992,817	1,153,625	870,168	983,168	0	0	0	0	0	0	0	0	9,159,749	11,290,744	20,450,493
2010	0	0	176,703	592,023	1,226,479	1,319,712	1,744,406	1,068,172	858,728	1,047,251	0	0	0	0	0	0	0	0	8,033,474	8,440,434	16,473,908
2011	0	0	122,740	429,090	928,787	1,046,024	1,450,597	935,021	795,119	1,033,483	0	0	0	0	0	0	0	0	6,740,861	6,559,304	13,300,166
2012	0	0	81,792	298,051	673,173	792,132	1,149,765	777,536	696,005	956,929	0	0	0	0	0	0	0	0	5,425,383	1,684,744	7,110,128
2013	0	0	52,332	198,616	467,594	574,127	870,693	616,287	578,777	837,645	0	0	0	0	0	0	0	0	4,196,072	630,262	4,826,334
2014	0	0	32,170	127,079	311,596	398,796	631,067	466,701	458,748	696,561	0	0	0	0	0	0	0	0	3,122,718	573,835	3,696,553
2015	0	0	19,011	78,119	199,367	265,750	438,347	338,259	347,400	552,105	0	0	0	0	0	0	0	0	2,238,358	522,460	2,760,818
2016	0	0	10,804	46,164	122,557	170,033	292,107	234,959	251,791	418,098	0	0	0	0	0	0	0	0	1,546,512	0	1,546,512
2017	0	0	5,908	26,236	72,424	104,525	186,897	156,572	174,897	303,032	0	0	0	0	0	0	0	0	1,030,489	0	1,030,489
2018	0	0	3,109	14,345	41,160	61,768	114,891	100,179	116,548	210,489	0	0	0	0	0	0	0	0	662,489	0	662,489
2019	0	0	1,575	7,549	22,505	35,104	67,894	61,583	74,570	140,266	0	0	0	0	0	0	0	0	411,046	0	411,046
2020	0	0	768	3,824	11,843	19,194	38,586	36,392	45,841	89,746	0	0	0	0	0	0	0	0	246,193	0	246,193
2021	0	0	361	1,865	5,999	10,100	21,098	20,682	27,089	55,169	0	0	0	0	0	0	0	0	142,364	0	142,364
2022	0	0	163	876	2,926	5,116	11,102	11,309	15,395	32,602	0	0	0	0	0	0	0	0	79,490	0	79,490
2023	0	0	71	396	1,375	2,496	5,624	5,951	8,418	18,528	0	0	0	0	0	0	0	0	42,859	0	42,859
2024	0	0	30	173	622	1,172	2,743	3,014	4,430	10,131	0	0	0	0	0	0	0	0	22,315	0	22,315
2025	0	0	12	73	271	530	1,289	1,470	2,244	5,331	0	0	0	0	0	0	0	0	11,220	0	11,220
2026	0	0	5	29	114	231	583	691	1,094	2,701	0	0	0	0	0	0	0	0	5,448	0	5,448
2027	0	0	2	11	46	97	254	313	514	1,317	0	0	0	0	0	0	0	0	2,555	0	2,555
2028	0	0	1	4	18	39	107	136	233	619	0	0	0	0	0	0	0	0	1,157	0	1,157
2029	0	0	1	2	7	15	43	57	101	280	0	0	0	0	0	0	0	0	506	0	506
2030	0	0	1	2	2	6	17	23	43	122	0	0	0	0	0	0	0	0	215	0	215
2031	0	0	1	2	2	2	6	9	17	51	0	0	0	0	0	0	0	0	91	0	91
2032	0	0	1	2	2	2	2	3	7	21	0	0	0	0	0	0	0	0	40	0	40
2033	0	0	1	2	2	2	2	1	3	8	0	0	0	0	0	0	0	0	21	0	21
2034	0	0	1	2	2	2	2	1	1	3	0	0	0	0	0	0	0	0	14	0	14
2035	0	0	1	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	12	0	12
2036	0	0	1	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	12	0	12

ICT IRAP	0	0	11,923,179	80,446,672	126,748,332	151,083,749	120,713,651	82,913,814	55,742,318	49,103,460	5,267,507	0	0	0	0	0	0	0	Other	Direct	Total
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013			
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	416,465	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	416,465	31,599,302	32,015,767
2000	0	0	789,671	2,809,925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,599,597	629,495	4,229,091
2001	0	0	1,083,761	5,327,977	4,427,198	0	0	0	0	0	0	0	0	0	0	0	0	0	10,838,937	11,732,966	22,571,902
2002	0	0	1,275,930	7,312,227	8,394,533	5,277,211	0	0	0	0	0	0	0	0	0	0	0	0	22,259,901	42,250,131	64,510,032
2003	0	0	1,359,095	8,608,805	11,520,832	10,006,266	4,216,412	0	0	0	0	0	0	0	0	0	0	0	35,711,411	54,552,770	90,264,181
2004	0	0	1,341,227	9,169,925	13,563,665	13,732,808	7,994,857	2,896,100	0	0	0	0	0	0	0	0	0	0	48,698,582	122,490,748	171,189,330
2005	0	0	1,241,878	9,049,370	14,447,741	16,167,861	10,972,308	5,491,376	1,947,026	0	0	0	0	0	0	0	0	0	59,317,559	219,246,247	278,563,807
2006	0	0	1,087,073	8,379,051	14,257,800	17,221,678	12,917,878	7,536,479	3,691,810	1,715,137	0	0	0	0	0	0	0	0	66,806,906	166,454,885	233,261,791
2007	0	0	903,978	7,334,575	13,201,674	16,995,267	13,759,862	8,872,821	5,066,717	3,252,119	183,989	0	0	0	0	0	0	0	69,571,002	135,594,879	205,165,881
2008	0	0	716,507	6,099,216	11,556,042	15,736,368	13,578,964	9,451,149	5,965,129	4,463,276	348,867	0	0	0	0	0	0	0	67,915,517	70,232,358	138,147,875
2009	0	0	542,596	4,834,332	9,609,663	13,774,778	12,573,123	9,326,896	6,353,934	5,254,688	478,792	0	0	0	0	0	0	0	62,748,802	31,639,694	94,388,495
2010	0	0	393,266	3,660,939	7,616,767	11,454,699	11,005,841	8,636,020	6,270,400	5,597,187	563,689	0	0	0	0	0	0	0	55,198,809	17,611,607	72,810,416
2011	0	0	273,168	2,653,401	5,768,020	9,079,170	9,152,133	7,559,512	5,805,930	5,523,602	600,431	0	0	0	0	0	0	0	46,415,365	8,250,877	54,666,242
2012	0	0	182,034	1,843,085	4,180,585	6,875,467	7,254,121	6,286,267	5,082,201	5,114,449	592,537	0	0	0	0	0	0	0	37,410,746	2,769,717	40,180,463
2013	0	0	116,470	1,228,199	2,903,885	4,983,249	5,493,395	4,982,592	4,226,209	4,476,916	548,646	0	0	0	0	0	0	0	28,959,560	133,268	29,092,827
2014	0	0	71,597	785,830	1,935,097	3,461,425	3,981,541	3,773,213	3,349,758	3,722,871	480,255	0	0	0	0	0	0	0	21,561,589	0	21,561,589
2015	0	0	42,310	483,073	1,238,121	2,306,632	2,765,627	2,734,776	2,536,702	2,950,805	399,366	0	0	0	0	0	0	0	15,457,411	0	15,457,411
2016	0	0	24,046	285,467	761,110	1,475,838	1,842,964	1,899,608	1,838,569	2,234,583	316,544	0	0	0	0	0	0	0	10,678,728	0	10,678,728
2017	0	0	13,148	162,238	449,770	907,241	1,179,172	1,265,865	1,277,092	1,619,597	239,712	0	0	0	0	0	0	0	7,113,834	0	7,113,834
2018	0	0	6,919	88,708	255,615	536,124	724,872	809,930	851,031	1,124,992	173,740	0	0	0	0	0	0	0	4,571,931	0	4,571,931
2019	0	0	3,505	46,680	139,765	304,692	428,355	497,888	544,510	749,674	120,682	0	0	0	0	0	0	0	2,835,751	0	2,835,751
2020	0	0	1,709	23,646	73,547	166,599	243,445	294,222	334,726	479,659	80,420	0	0	0	0	0	0	0	1,697,974	0	1,697,974
2021	0	0	803	11,534	37,256	87,668	133,110	167,213	197,803	294,861	51,455	0	0	0	0	0	0	0	981,703	0	981,703
2022	0	0	363	5,418	18,172	44,409	70,045	91,429	112,416	174,245	31,631	0	0	0	0	0	0	0	548,129	0	548,129
2023	0	0	158	2,452	8,536	21,661	35,483	48,111	61,467	99,028	18,692	0	0	0	0	0	0	0	295,588	0	295,588
2024	0	0	67	1,069	3,863	10,175	17,307	24,372	32,345	54,146	10,623	0	0	0	0	0	0	0	153,966	0	153,966
2025	0	0	27	449	1,684	4,604	8,130	11,888	16,385	28,493	5,808	0	0	0	0	0	0	0	77,468	0	77,468
2026	0	0	11	182	707	2,007	3,679	5,584	7,992	14,433	3,057	0	0	0	0	0	0	0	37,651	0	37,651
2027	0	0	4	71	286	843	1,604	2,527	3,754	7,040	1,548	0	0	0	0	0	0	0	17,677	0	17,677
2028	0	0	1	27	112	341	674	1,101	1,699	3,307	755	0	0	0	0	0	0	0	8,017	0	8,017
2029	0	0	1	10	42	133	273	463	741	1,496	355	0	0	0	0	0	0	0	3,513	0	3,513
2030	0	0	1	10	15	50	106	187	311	652	161	0	0	0	0	0	0	0	1,494	0	1,494
2031	0	0	1	10	15	18	40	73	126	274	70	0	0	0	0	0	0	0	627	0	627
2032	0	0	1	10	15	18	14	27	49	111	29	0	0	0	0	0	0	0	276	0	276
2033	0	0	1	10	15	18	14	10	18	43	12	0	0	0	0	0	0	0	142	0	142
2034	0	0	1	10	15	18	14	10	7	16	5	0	0	0	0	0	0	0	96	0	96
2035	0	0	1	10	15	18	14	10	7	6	2	0	0	0	0	0	0	0	83	0	83
2036	0	0	1	10	15	18	14	10	7	6	1	0	0	0	0	0	0	0	82	0	82

SUMMARY

Total

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	$2,797,845,062		$3,741,166,880	$1,909,781,416	7.10
Company Expenditures	$8,644,407,620		$11,508,389,309	$5,852,158,379	
Total Expenditures	$11,442,252,682		$15,249,556,189	$7,761,939,794	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	$281,351,575,336	$84,405,472,601	$40,376,262,087	$14,300,588,608	
Spinoff Sales	$72,550,148,095	$21,599,348,749	$11,811,043,559	$4,138,198,907	
Diffusion Sales	$152,078,979,821	$4,223,230,959	$942,876,970	$352,850,660	
Domestic User Value				$5,697,375,629	
TOTAL	$517,422,955,934	$110,228,052,309	$68,379,738,804	$32,250,953,598	8.62

TPC R&D

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	$2,641,108,284		$3,523,551,701	$1,819,470,645	7.31
Company Expenditures	$8,293,336,724		$11,021,279,554	$5,649,522,409	
Total Expenditures	$10,934,445,007		$14,544,831,256	$7,468,993,054	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	$275,410,224,597	$82,623,067,379	$38,727,078,294	$13,974,370,532	
Spinoff Sales	$68,985,374,440	$20,590,568,792	$11,159,345,077	$3,993,218,893	
Diffusion Sales	$133,535,842,605	$3,890,006,929	$855,578,397	$328,932,886	
Domestic User Value				$5,331,106,929	
TOTAL	$488,865,886,649	$107,103,643,100	$65,286,833,023	$31,096,622,294	8.83

TPC IRAP

	Expenditures		Discounted Expenditures	Discounted Impact	Ratio
Program Expenditures	$156,736,778		$217,615,179	$90,310,771	3.62
Company Expenditures	$351,070,897		$487,109,755	$202,635,969	
Total Expenditures	$507,807,675		$704,724,933	$292,946,741	
	Sales	Attributed Sales	Discounted Attributed Sales	Discounted Impact	
Direct Sales	$5,941,350,739	$1,782,405,222	$1,649,183,793	$326,218,076	
Spinoff Sales	$3,564,773,656	$1,008,779,957	$651,698,482	$144,980,014	
Diffusion Sales	$18,543,137,216	$333,224,030	$87,298,573	$23,917,774	
Domestic User Value				$366,268,700	
TOTAL	$28,557,069,285	$3,124,409,209	$3,092,905,781	$1,154,331,305	5.30

Hickling•Arthurs•Low
Corporation

150 Isabella Street
Penthouse Floor
Ottawa, ON
K1S 1V7

Phone: (613) 237-2220
Fax: (613) 237-7347
Email: hal@hal.ca