A review of international bodies that provide science advice to government

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EXECUTIVE SUMMARY

This report forms part of a study of structures that provide science advice to governments. The purpose of the study is to offer proposals that can contribute towards the development of an enhanced structure to provide science advice to government in South Africa. The main findings of the study are discussed in the report *Providing science advice to government in South Africa: Review and proposals*. This report is a supplementary work, and discusses various aspects of science advisory structures in foreign countries.

The report at first sets out to identify components of science advice to government. This is approached from the vantage point that science advice is an activity that can be divided into two components, viz. the science advisory body as the provider of science advice, and the government as the receiver of science advice.

With regards to the advisory body providing science advice to government, certain structural components, functional issues and processes have been identified. The structural components include the membership of the body and supporting structures of the body (i.e. secretariat). The functional issues include the scope of work of the advisory structure, independence from the entities that it is advising, transparency and budgets. The science advisory body follows certain processes in advising the receiver of science advice. The advisory processes are divided into two groups, namely generation and delivery (which includes the method through which the body's position on the advice that it gives is established) and evaluation and impact of science advice (this includes the processes of assessment for the body's effectiveness).

With regard to government as the receiver of science advice, two branches of government potentially in need of science advice are considered, viz. the executive and the legislative branches. With respect to the executive branch, science advice to the highest level (head of state and cabinet) as well as science advice to the ministerial level or government departmental level is considered.

Following the main elements of the first component (the science advisory body), as was identified in the previous section, an overview of the operational and structural aspects of science advisory bodies across 20 EU countries as surveyed by Glynn et al (2003) is discussed in this report.

The work was supplemented by further analysis of the structures of the science advisory bodies as they provide science advice to government to the two branches of government that is considered in this report. A number of countries were selected as examples. The competitiveness of countries as given in the World Economic Forum's annual global competitiveness report was used as a general selection mechanism, with Australia and Canada as representatives of other Commonwealth countries also included.

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The investigation of science advisory structures in a number of foreign countries proved to a very informative exercise. It was found that there are many similarities in the structures that provide science advice to government but that there are also a number of country specific differences. The report provides a useful and necessary background, and benchmark of international practices, that places a discussion of a future South African structure to provide science advice to government, in perspective.

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Chapter 1

Introduction

This report forms part of a study of structures that provide science advice to governments. The purpose of the study is to offer proposals that can contribute towards the development of an enhanced structure to provide science advice to government in South Africa. The main findings of the study are discussed in the report *Providing science advice to government in South Africa: Review and proposals*[1]. This report is a supplementary work, and discusses various aspects of science advisory structures in foreign countries.

Since the publication of the White Paper on Science and Technology in 1996, the environment in which science and technology policy make an impact and influence life in almost all respects, has changed dramatically. There has been a steady advancement of the country's standing in the international arena, an evolvement of the Government's national policies as well as significant changes in the national and international science, technology and innovation domains. Whereas the establishment of the Department of Arts, Culture, Science and Technology (DACST) after the 1994-elections was in itself a new and welcome development in South Africa, its subsequent unbundling led to the establishment of the Department of Science and Technology (DST) in 2002. This paved the way for a more focused national science, technology and innovation strategy. There have also been significant developments with regard to best practices in respect of providing science advice to government, internationally as well as locally. This has contributed to substantial learning from experience from NACI itself as well as from international best practices regarding the nature of providing science advice to government and the nature and structure of such advisory bodies.

The National Advisory Council on Innovation (NACI) is a statutory body that advises the Minister of Science and Technology on aspects relating to the National System of Innovation (NSI). NACI reviewed its own mandate with regard to providing advice to the Minister of Science and Technology, and provided advice to the Minister in this regard in 2006. It found that not only was it necessary to review NACI's role in the NSI, but that it was also necessary to rethink the entire apparatus whereby science advice is provided to government. Given the importance of science, technology and innovation to economic prosperity and growth, competitiveness, the quality of life and the social well-being of the citizenry, and subsequently also the necessity for government to be provided with science advice, it was foreseen that it would be necessary to establish a more structured system and constellation of organisations to provide "science advice to government". The study, of which this report forms a part, aimed to address this need.

In order to develop proposals for a science advice structure in South Africa, it is also necessary to investigate the nature of science advisory structures in other countries, and to extract best practices as they may apply to a future South African system. The science advisory structures in a number of foreign countries were subsequently

[1] Calie Pistorius, *Providing science advice to government: Review and proposals*, University of Pretoria 2008.

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investigated. The investigation also revealed that it is necessary to explore that nature of government departments to whom science advice is to be provided, particularly with regard to the composition and combinations of their portfolios. To what extend are “Science” and “Technology” grouped with “Research”, “Higher Education” and “Innovation”, for example?

This report draws heavily on work by Glynn et al, who performed a similar investigation from an EU perspective. The Glynn report is not copied here, but liberal references are made to that report, and the reader is encouraged to consider the Glynn report whilst interpreting this one.

Chapter 2 of this report sets out to define components of science advice to government. The purpose of this discussion is to find important elements that have to be addressed when trends in the structure and operations of science advisory entities are considered. Following the development of the generic structure for a science advisory body that is discussed in Chapter 2, Chapter 3 provides an overview of the operational and structural aspects of science advisory bodies surveyed across 20 countries in the European Union. Throughout the chapter, general practice of science advisory bodies is extracted from the analysis.

Science advisory entities however do not operate on their own, they exist within government structures at various levels. Chapter 4 subsequently provides an overview of a number of international examples of science advisory structures that exist within nine of the most competitive countries in the world. From the analysis, comparisons are made between the countries analysed. Certain conclusions are drawn from the findings in terms of the most important trends that have been observed.

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Chapter 2

The nature of advice

2.1 Introduction

The need for science advice is recognised and acknowledged internationally[2]. Science advice plays a significant role in making informed decisions and in developing government policies. Interest in strengthening the role of scientific advice builds on a long tradition of employing the latest available scientific results to influence international decision-making.

In the United Nations (UN) system, for example, the availability of quality science advice to governing bodies, member governments and executives of the UN system is seen as pivotal to the successful achievement of sustainable development. The role of science advice for sustainable development was recognised in the work programmes of the United Nations Conference on Environment and Development. The UN specifically called upon states to (NRC, 2002):

> "…strengthen science and technology advice to the highest levels of the UN and other international institutions, in order to ensure the inclusion of science and technology know-how in sustainable development policies and strategies."

In 2006, the United Kingdom (UK) Science and Technology Committee for Parliament issued a call to strengthen the role of Government Scientific Advisers. The UK government welcomed the committee's report entitled *Scientific Advice, Risk and Evidence Based Policy Making* (UK, 2006a). This report clearly acknowledges the importance of the role of scientific advice for policy making:

> "Many of the most high profile policy issues are critically dependent on the input of scientists. These include: securing the economic development of the UK through the knowledge economy; protecting the population of the country against an avian influenza pandemic and other infectious diseases; mitigating and adapting to climate change; safeguarding the UK's energy supply; detecting and averting potential terrorist threats; and tackling obesity. In each case, effective policy development requires both an effective scientific advisory system and appropriate use of evidence and advice on science and risk by Government" (UK, 2006a).

Several major issues, including mad cow disease (BS), foot-and-mouth disease as well as genetically modified crops, have focused attention in the UK government on the importance of public communication of risk. John Denham, the UK Secretary of State for the Department Innovation, Universities and Skills, reiterated the important role that science advice plays in a democracy (GNN, 2008):

> "If policy makers do not have access to world class scientific evidence

[2] See Calie Pistorius, *Providing science advice to government in South Africa,* University of Pretoria, 2008.

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> and advice, we will not be able to make the best decisions about the tough challenges facing the country. If the public do not have the capacity to understand scientific evidence and risk, they face being unable to make the best decisions for themselves and their families or, in a democracy, put the most appropriate pressure on politicians."

The Canadian Council for Science and Technology Advice also acknowledged both the growing reliance on technical and scientific facts in decision-making as well as the importance of science advice (Keough, 2000):

> "The emergence of the knowledge-based society has underscored the importance of sound science advice as a key input to policy formulation both nationally and internationally. The pervasiveness of science and technology is such that they now impact most core government functions. The issues facing governments are increasingly complex and require decisions that have profound impacts on societies and economies. Many of these decisions involve risk assessments that arouse public concerns about their health, safety and long-term well-being; others attempt to capitalize on the opportunities afforded by advancements in science and technology.
>
> There is every indication that the importance of science advice will grow as the emergence of new science-based issues intensifies. The issues facing governments are increasingly complex and require decisions that have profound impacts on societies and economies. Fuelled by increased access to information, there is heightened public interest in science-based issues, and greater emphasis on public participation in decision-making. The public expects government to capture the full benefits of new scientific discoveries and new technologies. Government must be diligent in using science advice to capitalize on the opportunities afforded by advancements in science and technology. These principles and guidelines address science advice as one input in government decision-making.
>
> Clearly, decision-making in government must consider a wide range of other inputs (including traditional knowledge, ethical and cultural considerations, etc.) and decision makers must consult, as appropriate, advisors competent in many aspects of public policy (including law, public administration, international affairs, etc.). Decision makers must exercise their legitimate role to weigh these multiple inputs and make choices. Science advice has an important role to play by contributing to government decisions that serve Canada's strategic interests and concerns in areas such as public health and safety, food safety, environmental protection, sustainable development, innovation, and national security. The effective use of science advice may also contribute to Canada's ability to influence international solutions to global problems."

From the discussion above, it evident that a number of governments the world over acknowledge the crucial part that science advice fulfils in a democracy and in the

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policy making process.

A question that can be raised regarding these countries that acknowledge the importance of science advice is: What have these governments done to ensure that they are provided with sound science advice?

The purpose of this report is to research and discuss this question, and to explore the structures and processes in a number of the world's advanced economies. The research attempts to gain insights into possible methods and structures that have been created for the purpose of providing government with science advice.

2.2 Components of science advice

The objective of this section is to describe and discuss the structure of the research document and the discussion on international examples of science advisory structures. In order to develop a structure for the discussion, it is imperative that the typical components of science advice be considered.

When developing the concept of the components of science advice, it is useful to consider the Science Advisory Body (SAB) as an entity. Questions regarding this concept immediately arise, including: What are these bodies typically like? and How do these bodies typically operate?

A second set of questions regarding the application of these entities also begs consideration. The questions include: Where do these entities operate and how and where are they placed within government structures?

The receivers of science advice will to a large extent determine the structures in which the SABs that serve them will be organised.

The concept of science advice can be divided into two parts, namely the SAB as an entity on the one hand and the existence of these entities in the government structures in which they operate on the other.

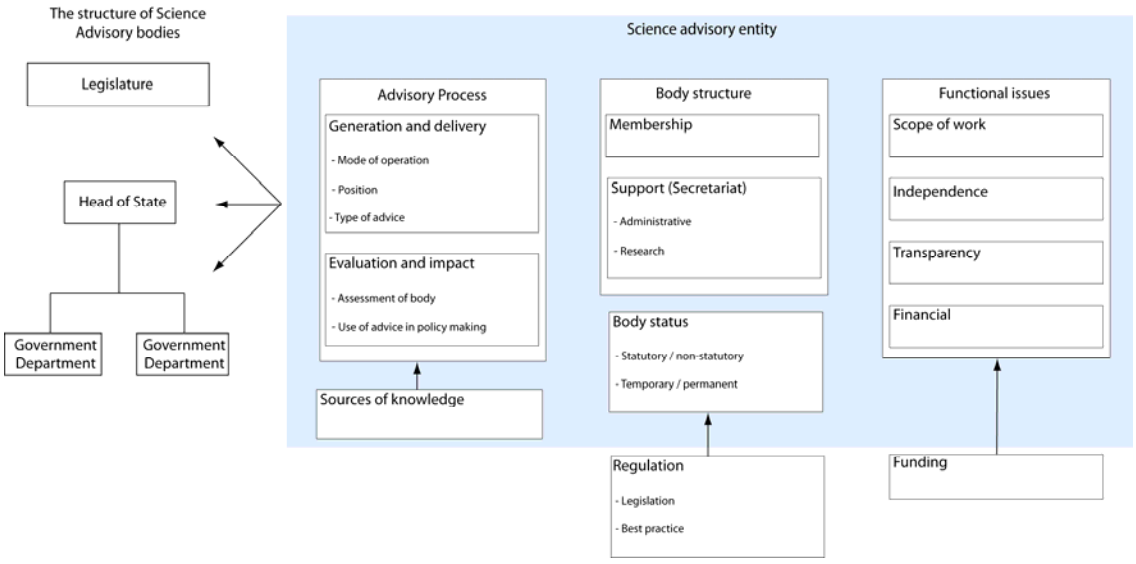

Figure 1: Components of science advice to government

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In order to demonstrate this concept, Figure 1 is divided into two main sections. The first depicts the SAB as the provider of science advice, while the second illustrates the government as the receiver of science advice.

The first section of the figure allows for a generic body that could be advising government on any of its levels. The purpose of the inclusion of this block is to map the elements of practice of science advice to the science advisory entity.

The SAB has certain structural components, including:

- *Membership*: How many members does the body have?; and
- *Support*: Does the body have a secretariat that plays a supporting function? What functions does the secretariat perform?

Certain functional issues pertain to the science advisory entity. These include:

- *Scope of work:* How broad or narrow is the focus of the body's work?;
- *Independence*: To what extent is the body's operation and advice independent from the entities that it advises?;
- *Transparency*: To what extent is the body's work and the advice that it gives transparent?; and
- *Financial*: What is the advisory body's budget?

The SAB follows certain processes in advising the receiver of science advice. The advisory processes to be investigated are divided into the following two groups:

- *Generation and delivery*, which includes the body's mode of operation as well as the method through which the body's position on the advice that it gives is established; and
- *Evaluation and impact of science advice*, which includes the processes of assessment for the body's effectiveness and to what extent the body's advice has been used in policy making.

The second section depicted in Figure 1 above considers the branches of government potentially in need of science advice. The schematic includes the two branches of government considered in this report, namely, the executive and the legislative branches. For the executive branch, science advice to the highest level, that is, head of state and cabinet, as well as science advice to the ministerial level or government departmental level is considered.

2.3 The discussion to follow

This report deals mainly with foreign science advisory structures. The discussion in Chapters 3 and 4 follows the structure of Figure 1. As mentioned above, the first element identified for discussion is the SAB as an entity. The SAB has certain components and elements in its make-up. Chapter 3 provides an overview of the operational and structural aspects of SABs surveyed across 20 European Union (EU) countries. Throughout the chapter, general practice of SABs is extracted from the analysis.

The second section of Figure 1 above considers the branches of government

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potentially in need of science advice. SABs exist within these government structures to provide the structures with the necessary and required advice. Chapter 4 provides an overview of a number of international examples of science advisory structures that exist within nine of the most competitive countries in the world.

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Chapter 3
Operation and structure of science advisory bodies

3.1 Introduction

Components of science advice were identified in Chapter 2. Figure 2 below outlines the first part of Figure 1, namely the science advisory entity.

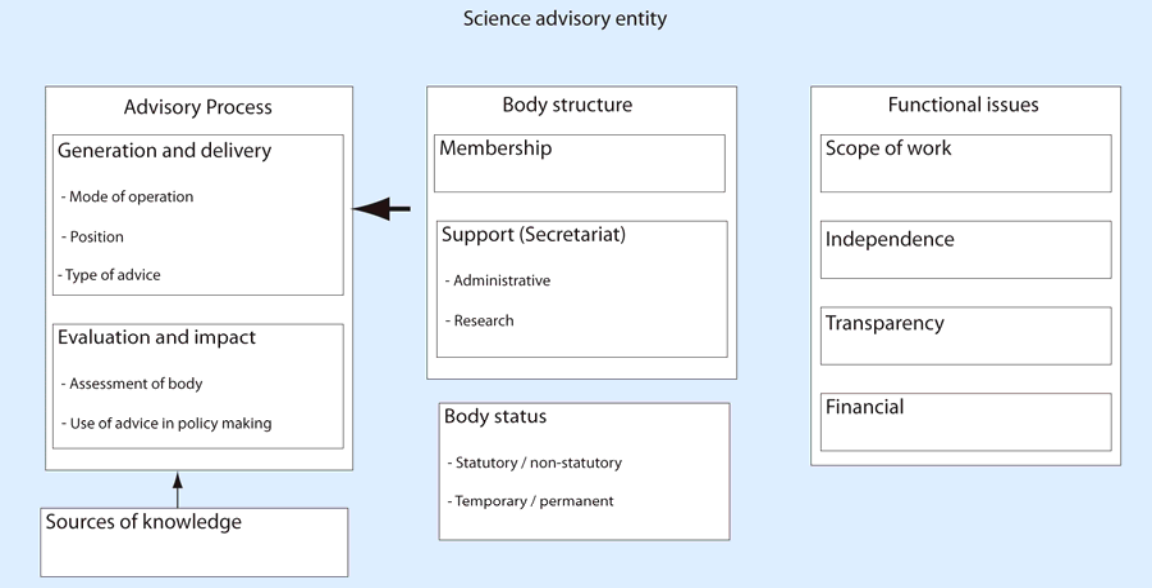

Figure 2: Components of the science advisory entity

This chapter considers the general practice of SABs as extracted from a study by Glynn, Cunningham and Flanagan (2003) in terms of:

- The legal status of science advisory entities;
- Structural components;
- Functional issues; and
- Advisory processes.

An overview of the operational and structural aspects of SABs surveyed across 20 EU countries is also introduced and discussed.

3.2 Sources of information

This chapter has as its source of information a study performed by the European Commission (Glynn et al, 2003). In this study, 20 EU countries' science advisory systems were analysed. The study, entitled *Typifying Scientific Advisory Structures and Scientific Advice Production Methodologies*, represented the first attempt to map and characterise the most significant SABs across the EU in a systematic manner. In the study, a database was developed where the following two levels of information were collected: a full set comprising 231 advisory bodies and a set with partial information on another 178 bodies.

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The report of Glynn et al should be used as an appendix to this section. This section extracts the main findings regarding general practice of SABs from their report.[3]

Glynn et al (2003) note in their report that once all the relevant data had been gathered, it was decided that a further classification was needed to distinguish between:

- Those bodies for which scientific advice provision is a primary function, for instance a scientific advisory committee; and
- Those bodies that might have a more varied function, for instance a research institute or research council.

These bodies have been classified as type A and type B respectively.

> "This step was necessary because of the dangers of making comparisons between a dedicated scientific advisory committee on the one hand, and a research council, which may have a budget of millions of Euros and thousands of employees on the other. This is both a qualitative and quantitative issue. For example, there is a significant difference between an advisory body that funds a modest amount of research as a source of information on which to base its advice, and a research council that funds research as its primary function" (Glynn et al, 2003, p 21).

3.3 General practice of SABs

3.3.1 Status of advisory bodies

From the bodies surveyed across the 20 EU countries, Glynn et al (2003) found that the vast majority of advisory bodies are statutory, thus established by law, and permanent. For more detail, see table 5.6 in the report from Glynn et al. The data reveals that 72% of the bodies surveyed indicated that they are statutory and permanent, while 14% indicated that they are non-statutory and permanent.

3.3.2 Structural components

3.3.2.1 Membership

Generally, type A bodies, that is, advisory councils, have a membership of between 10 to 30 people with a committee type structure. See figure 5.2 in the Glynn et al report for more detail. Glynn et al (2003) believe that the usefulness of the membership count as an indicator for type B bodies, that is, research councils and research institutes, can be questioned. If all the staff members employed in the type B bodies are counted as members, the membership count could run into the thousands. However, if only the

[3] The Glynn report can be accessed at http://ec.europa.eu/research/science-society/pdf/advice_final_report_en.pdf

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highest decision makers in type B bodies are considered, the membership structure is similar to type A bodies.

The Glynn et al report clearly reveals that the SABs surveyed generally employ "academic experts in natural and physical sciences" as members of advisory bodies. See table 5.9 in the Glynn et al report for more detail. This is particularly true for type A bodies, as 75% of the membership of these bodies are made up of academic experts in natural and physical sciences. Groups that would reflect a wider input into the advisory process from, for instance academic experts in social sciences, industry representatives, Non-governmental Organisation (NGO) representatives, lay people and parliamentarians, seem to be poorly represented. Type B bodies look quite different from type A bodies in terms of the background of membership, as type B bodies' membership is made up of a significant portion of civil servants and members from the 'other' category. This high number of civil servants can largely be ascribed to by the significant number of large government organisations included in the database.

3.3.2.2 Support (secretariat)

Table 5.7 in the Glynn et al report states that it is general practice for nearly all type A bodies to have secretariats. A total of 93% of type A bodies indicated that they have secretariats. "For type A bodies the size of the secretariats tends to be between 1 and 7 persons" (Glynn et al, 2003).

As indicated in table 5.8 in the Glynn et al report, it is often common that the role of the secretariat goes beyond that of administrative support for the body's operations. "Background work by the secretariat" seems to be a source of advice that is used quite often by SABs. "This kind of background support may in many cases involve the gathering and reviewing of scientific data to identify important matters that need to be brought to the attention of the advisory body" (Glynn et al, 2003).

3.3.3 Functional issues

3.3.3.1 Scope of work

Table 5.13 in the Glynn et al report clearly reveals a general trend for most type A bodies in the sample under review to have a focused scope[4], whereas the scope of type B bodies tend to be broad. This finding is not surprising if the nature of the type B bodies, that is, science councils or science institutes, is considered.

Table 5.14 in the Glynn et al report indicates that the most common activity that type A SABs engage in, apart from the actual provision of science advice, is "raising public awareness" and "update review on state-of-the-art". The most common activities engaged in for type B bodies include "research performance", "update review on state of the art" and "raising public awareness". Type B bodies therefore seem to focus primarily on performing research and, to a lesser extent, on funding research. This finding concurs with the fact that most of the type B bodies are research councils and research

[4] Open scope: body can examine any issue or area, Broad scope: body can examine a range of issues within a policy area, Focused scope: body can examine one main issue within a policy area

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institutes.

3.3.3.2 Independence

As stated by Glynn et al (2003) in their report, it is particularly difficult to construct indicators that address the degree of independence of science advice. The following section considers a number of the indicators that Glynn et al (2003) consider linked to the measurement of the independence of the SABs in the sample.

Table 5.15 in the Glynn et al (2003) report indicates a general trend for type A bodies to select members for their advisory bodies through appointment. From the options available for selection, appointment might seem the least independent selection mechanism. According to Glynn et al (2003), this is, however, dependent on the context. In the UK, all appointments are governed by the Code of Practice for Ministerial Appointments to Public Bodies, which is administered by the Commissioner for Public Appointments. The aforesaid is aimed at ensuring that the appointment process is open and fair.

Type B bodies tend to select members through advertisement and open selection. If the employees that comprise the research councils and research institutes are all regarded as members, the selection of members through advertisement and open selection makes sense, as employees are selected for employment within these bodies by means of an application for work.

A second possible measure of advisory bodies' independence is the issue as to whether the body is allowed to make its own selection of topics to be examined. For more detail, see table 5.16 in the Glynn et al report. The majority of bodies in the sample under review, that is, 75% of type A and 87% of type B, tend to have the option of selecting the topics on which it wants to provide advice.

A third possible measure of advisory bodies' independence is whether the body provides advice to the requesting institution in final form or whether the body engages in dialogue with the requesting institution. For more detail, see table 5.17 in the Glynn et al report. Glynn et al (2003) argues that if the advice is presented in final form, a greater degree of independence is achieved, as there is no opportunity for policy makers to request that the advice be reworked. For the majority of the bodies under review, that is, 61% of type A and 56% of type B, the most common form of delivering advice to those requesting it is in its final form. In line with the above argument, this could be an indication of independence of advice of these bodies.

A further possible indicator for the level of independence of advice is whether the body disseminates advice beyond those requesting it. See table 5.18 in the Glynn et al report for more detail. This aspect is an indication of whether the body will make the results of the science advisory reports available to a wider audience. Covert science advisory reports could have serious repercussions for the quality of the advice and could provide a means for policy makers to hide unwelcome advice. The majority of bodies in the sample under review, that is, 79% of type A and 94% of type B, tend to disseminate

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advice beyond those requesting it.

As far as the method of disseminating advice goes, Glynn et al found that "websites was the most common medium, closely followed by press releases and the production of information leaflets. In general, most bodies employed a combination of these strategies". For more information, see table 5.19 in the Glynn et al report.

3.3.4 Transparency

Transparency of SABs is increasingly seen as an important issue. Glynn et al (2003) employ a number of indicators to measure the degree of transparency in the science advisory entities under review.

Glynn et al (2003) argue that a code of practice ensures a higher degree of transparency, as this allows the bodies to identify any deviations from the expected practice. 73% of type A bodies and 77% of type B bodies have a code of practice in place (see table 5.20 in Glynn et al report).

With regards to transparency, conflict of interest for members of the SAB is an important issue. It can be argued that where bodies require their members to declare any conflicts of interest, a higher level of transparency might be achieved. Glynn et al (2003) found, however, that this argument does not hold true across the board (see table 5.21 in the Glynn et al report). Only 45% of type A bodies and 36% of type B bodies require that members declare conflicts of interest.

Glynn et al (2003) found that confidentiality of materials used in generating advice is a feature of many of the bodies' operations. According to tables 5.22 and 5.23 in the Glynn et al report, 63% of type A bodies and 48% of type B bodies required that members keep materials confidential. A similar trend can be seen regarding whether members of bodies are required to keep discussions confidential: A total of 58% of type A bodies and 43% of type B bodies indicated that members are required to keep discussions confidential. It must, however, be added that advisors often consider some degree of confidentiality essential to ensure open discussion with the advisees.

Table 5.24 in the Glynn et al report reveals that it is uncommon for bodies' remit, advice reports and activity reports to be confidential. It is, however, more common for bodies to require confidentiality regarding their agendas and meeting minutes.

An indicator of the transparency of SABs' operations is whether the body holds public meetings. Glynn et al (2003) found that it is unusual for open meetings to be held. Table 5.29 in the Glynn et al report reveals that only 19% of type A bodies and 27% of type B bodies hold public meetings.

3.3.4.1 Financial

According to Glynn et al (2003), it was particularly difficult to obtain information on budgets of the SABs under review. In many cases, it was also difficult to break budgets down into components of how resources are spent.

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According to figure 5.3 in the Glynn et al report, the distribution of budgets for type A bodies seems lower than those for type B bodies. Details are as follows:

- Type A bodies' budgets seem to fall between €20,000 and €5 million; and
- Type B bodies generally have higher budgets that fall between €1 million and €100 million. Note that theses bodies are not dedicated to providing science advice, and most of the budgets may typically be allocated for other work.

Glynn et al (2003) found that the close relationship between many type A bodies and the ministries they serve seem to complicate the estimation of budgets. This situation makes it difficult to distinguish the advisory body's budget from that of the parent ministry. In addition, where the ministry was found to provide the secretariat, it was difficult to estimate the costs of the secretariat. However, in those instances where a separate secretariat budget could be determined, the budget amount for type A bodies was often between €5,000 and €500,000.

3.3.5 Advisory process

3.3.5.1 Generation and delivery

Glynn et al (2003) found that the most widely used mode of operation for type A bodies is regular meetings, followed closely by the formation of subgroups. Type B bodies, on the other hand, most often operate continuously, followed closely by regular meetings and the formation of subgroups. For more detail, see table 5.26 in the Glynn et al report.

According to table 5.27 in the Glynn et al report, 62% of type A bodies and 55% of type B bodies indicated that the body presents a common position to those requesting the advice when advice is provided. This position is usually presented to those who requested it in its final form.

Further analysis performed from the database obtained from Glynn et al concluded that all the UK bodies considered in the sample reach a common position through consensus (see Table 1). A significant number of bodies in the Nordic countries under review, that is, Sweden, Denmark and Finland, do not provide advice through consensus, but provide the full range of opinions. In Germany and Hungary, a significant number of bodies have indicated that they reach consensus through a majority vote.

According to Table 5.30 in the Glynn report, it is unusual for policy makers to have a formal requirement to respond to the advice received from the bodies under review.

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Table 1: Type A bodies by country: Does the body agree on a common position or does it present a range of opinions? (TSAS database)

	Common Position Agreed by Majority Vote	Common Position Agreed through Consensus	No Common Position – Full Range of Opinions Communicated to those Requesting Advice	Number of Responses to Question
Austria	3	2	1	4
Cyprus	1	2	0	3
Czech Republic	1	0	0	1
Denmark	0	4	3	7
EU	1	17	3	21
Finland	1	7	3	9
France	0	4	0	4
Germany	5	4	1	8
Greece	1	2	2	5
Hungary	5	6	2	12
Ireland	0	0	0	0
Italy	2	7	1	9
Netherlands	0	2	1	3
Portugal	2	2	0	4
Slovakia	0	2	0	2
Slovenia	2	1	1	3
Spain	0	2	0	2
Sweden	1	7	6	11
UK	0	12	0	12

3.3.5.2 Evaluation and impact

Table 2: Is there a formal assessment of the body? (TSAS database, 2003)

	Type A		Type B	
	Yes	***No***	***Yes***	***No***
Austria	0	4	2	5
Cyprus	1	2	0	0
Czech Republic	0	1	2	0
Denmark	3	4	3	5
EU	1	20	0	0
Finland	3	4	0	5
France	0	2	0	1
Germany	0	8	0	1
Greece	3	6	0	0
Hungary	5	7	5	3
Ireland	0	0	0	1
Italy	1	8	2	4
Netherlands	3	0	7	0
Portugal	2	2	1	5
Slovakia	1	0	0	6
Slovenia	1	2	3	1
Spain	1	2	1	10
Sweden	2	7	1	5
UK	11	0	2	0
Total	**38**	**79**	**29**	**52**

Table 2 above reveals that the majority of advisory bodies surveyed in the database do

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not undergo any formal evaluation. A number of countries, namely the UK and Netherlands, submitted its bodies to assessments, while very few bodies in other countries, such as Sweden, Germany and the EU, undergo formal assessments.

With regards to bodies that undergo assessments, it was found that the number of bodies submitted to assessments by the sponsoring organisation and the number of bodies conducting their own assessments are evenly divided. For type A bodies, the majority of instances in which the sponsoring organisation conducted the assessment, apply to UK bodies.

3.4 Conclusion

In conclusion, the survey of 231 SABs in the EU examined in the Glynn et al report revealed that:

- The majority of the bodies, that is, 72%, are statutory;
- The membership of type A bodies tend to fall between 10 to 30 persons. Due to its nature, it is more difficult to use membership as an indicator for type B bodies;
- 75% of members of science advisory councils are experts in the natural and physical sciences;
- 93% of type A bodies have a secretariat. This also applies to the majority of type B bodies, that is 79%;
- Secretariats tend to play an important role in the development of the advice. In many cases, secretariats also assist in gathering and reviewing scientific data;
- Type A bodies tend to focus on “update review on state of the art” and “raising public awareness”
- As type B bodies perform a wider range of activities, the bodies’ scope of work tends to be broader;
- A number of indicators were employed to determine the degree of bodies’ independence. It is, however, difficult to draw strong conclusions from these indicators without further investigation. The following conclusions can nevertheless be drawn:
  - Most bodies can select its own topics for research, indicating a degree of independence;
  - Most bodies provide advice to policy makers in final form, indicating a degree of independence; and
  - Most of the bodies disseminate advice to a wider audience, which serves as a further factor indicating independence.
- The issue of transparency is not straightforward. Certain indicators were, however, used to provide an indication of the degree of transparency with which these bodies operate. The following conclusions can be drawn:
  - 73% of type A and 77% of type B bodies have some form of a code of practice that regulates the way in which it operates;
  - Only 45% of type A bodies and 36% of type B bodies indicated that members have to declare conflicts of interest;
  - Many advisory bodies have confidentiality requirements covering selected materials. Advisors often consider some degree of confidentiality essential to

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ensure open discussion with the advisees; and
    - Advisory bodies appear to be fairly open in regards with the publication of their operations, advice and activities.
- Type A bodies tend to have budgets between €20,000 and €5 million per annum;
- Due to their nature, the budgets for type B bodies tend to be higher, falling between €1 million and €100 million per annum;
- It seems to be general practice for SABs to form subgroups to focus on more specific issues;
- Bodies tend to determine their position on a topic through discussion and then arrive at a consensus. In general, this involves the advice being delivered in final form;
- In terms of the operation of the bodies, type A bodies meet regularly, while type B bodies operate continuously due to their nature; and
- Most advisory bodies under review do not undergo any formal evaluation.

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Chapter 4
Case studies of science advisory structures

4.1 Introduction

This chapter provides an overview of a number of international examples of science advisory structures.

A number of countries were selected as examples. The competitiveness of countries, as depicted in the World Economic Forum's annual *Global Competitiveness Report*, was used as a general selection mechanism. Canada and Australia were also included as further examples of Commonwealth countries.

Table 3: Global competitiveness index rankings (World Economic Forum, 2007-2008)

Rank	Country	Section Overview (in this report)
1	United States of America (USA)	Section 4.2.9
2	Switzerland	Not discussed
3	Denmark	Section 4.2.3
4	Sweden	Section 4.2.6
5	Germany	Section 4.2.4
6	Finland	Section 4.2.4
7	Singapore	Not discussed
8	Japan	Section 4.2.5
9	United Kingdom (UK)	Section 4.2.8
13	Canada	Section 4.2.2
19	Australia	Section 4.2.1

Brief summaries of the selected countries' science advisory systems are provided in the following sections.

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4.2 International examples

4.2.1 Australia[5]

A simplified schematic of the science advisory structure in Australia is presented in Figure 3.

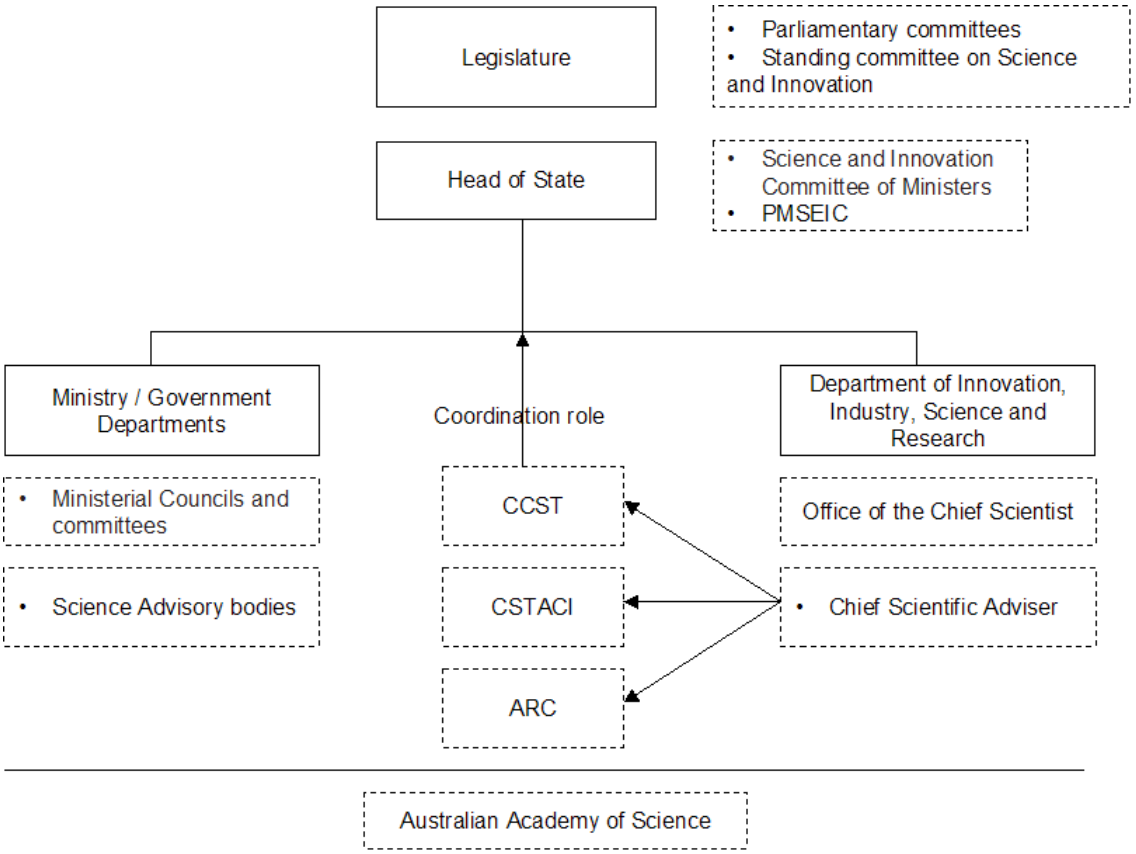

Figure 3: Simplified science advisory structure in Australia

4.2.1.1 Science advice to the highest level

To co-ordinate its long-term strategic approach to science, the Australian government relies on data and advice from many agencies and portfolios, as well as the advice of specially convened committees. The governance structures for science advice are detailed below. It should, however, be noted that in light of the Australian National System of Innovation review[6], these structures are subject to the review's outcomes.

The *Prime Minister's Science, Engineering and Innovation Council* (*PMSEIC*) provides independent advice on major scientific challenges by involving the leaders of many scientific, educational and business groups (Office of the Chief Scientist (OCS), 2008). The full council of PMSEIC meets twice a year, with the Standing Committee of PMSEIC, comprising the non-ministerial members, meeting four times per year. The

[5] The OCSs of Australia drafted sections of this account of the science advisory system in Australia. OCS, 2008. *Science Advice in Australia*, Government of Australia, May 2008.
[6] The recommendations of the review of Australia's NSI were expected at the end of August 2008.

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Standing Committee responds to issues referred by government or key stakeholders and identifies and develops a range of issues to be considered by PMSEIC. A great amount of the Standing Committee's work is undertaken through working groups. Generally, two working groups present to each full council meeting. The Standing Committee's work includes chairing and overseeing working groups. Working groups also comprise experts from industry, universities, science and research as well as government, were appropriate.

"The Australian Government makes use of the Chief Scientist for advice that covers the full spectrum of science, technology and innovation, including goals and priorities for national investment" (Australia, 2006). The Chief Scientist's other roles include:

- Providing links between government and science, engineering, innovation and industry groups as well as facilitating active communication and input into strategic thinking; and
- Promoting Australian science internationally and focusing national thinking on science through activities across the states and territories reflecting the spread of science and innovation responsibilities across government at all levels.

The OCS enables Australia's Chief Scientist to render comprehensive and timely advice to government on a wide range of scientific and technological issues. This is done through the support of his engagement with the research and industry communities, learned societies and other portfolios and governments. The OCS is located in the Department of Innovation, Industry, Science and Research. The average staffing level for OCS is 10 full-time staff members. Generally, at least one officer from another department is seconded to OCS. This officer acts as a liaison for the home department (OCS, 2008).

"The Chief Scientist is the Executive Officer of PMSEIC and advises on membership, agenda and operations. The Chief Scientist also chairs the non-ministerial standing committee, which discusses strategies and directions for PMSEIC and gives advice on science and technology issues, including goals and priorities for national investment" (Australia, 2004). The Chief Scientist is a member of, or participates in:

- The *Co-ordinating Committee on Science and Technology* (CCST), which involves all Australian government departments and agencies that fund or undertake scientific activity. The CCST complements the work of the PMSEIC and provides a whole-of-government co-ordination mechanism. Where appropriate, CCST provides input to the PMSEIC standing committee to advise on matters that might be of concern and which may require a "whole of government response" (CCST, 2008);
- The *Commonwealth, States and Territories Advisory Council on Innovation* (CSTACI) was established by Australian industry ministers. CSTACI consists of the Commonwealth's Chief Scientist and his state counterparts as members. CSTACI provides the Australian government with an avenue for briefing the states and territories on developments in science policy and programmes. The council improves the effectiveness, integration and co-ordination of the National Innovation System (NIS) with a targeted and strategic approach to innovation issues (CSTACI,

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2008);
- The *Prime Minister's Prizes for Science Committee*;
- The *Co-operative Research Centres Committee*;
- The *Publicly Funded Research Agencies Committee*;
- The *National Collaborative Research Infrastructure Strategy Committee*;
- The *National Innovation System* review;
- The *Higher Education Endowment Fund* panel;
- The *National Science Forum*;
- The *Scientists in Schools Committee*;
- The Questacon Review; and
- The Square Kilometre Array Science and Technology Advisory Group.

Government may also request the Chief Scientist to undertake reviews or prepare specific reports from time to time.

4.2.1.2 Ministerial arrangements for advice

To facilitate co-operation between state and territory governments and the federal government in different policy areas, Ministerial Councils are established. These councils monitor, develop, initiate and help resolve inter-governmental issues in policy reform. The councils consist of more than four federal and state/territory government ministers and are aimed at producing joint policy that enables efficient outcomes (Thorburn, 2005). Examples of these committees are the *Sustainable Environment Committee of Cabinet*, the *Biotechnology Australia Ministerial Council*, the *National Oceans Ministerial Board* and the *National Food Industry Council* (Australia, 2004).

Examples of SABs on government departmental level include the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO), the *Australian Nuclear Science and Technology Organisation* (ANSTO), the *Defence Science and Technology Organisation* (DSTO), and the *Australian Institute of Marine Science* (AIMS). The primary function of these agencies is to conduct publicly funded research in areas of national priority on behalf of the Australian government. The agencies' role also includes providing scientific advice to government. Government, in turn, uses the advice when considering and developing policy.

The agencies are discussed in more detail below:

- Australia's national science agency, CSIRO, is one of the largest science agencies in the world. "CSIRO research delivers solutions for agribusiness, energy and transport, environment and natural resources, health, information technology, telecommunications, manufacturing and mineral resources" (CSIRO, 2008);
- ANSTO is the centre of Australia's nuclear science capabilities and expertise. "ANSTO's goal is to be recognised as an international centre of excellence in nuclear science and technology for the benefit of Australia. ANSTO produces radiopharmaceuticals to help in the diagnosis and treatment of a range of serious illnesses, as well as helping to solve a wide range of industrial and environmental problems". ANSTO also provides strategic advice to government on a range of

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important long-term issues, including climate change, power generation and counter-terrorism (ANSTO, 2008);

- DSTO forms part of Australia's Department of Defence. “The DSTO delivers expert, impartial advice and innovative solutions for Defence and other elements of national security” (DSTO, 2008); and
- AIMS, a leader in tropical marine science, is committed to the protection and sustainable use of Australia's marine resources. “Its research programs support the management of tropical marine environments around the world, with a primary focus on the Great Barrier Reef World Heritage Area, the pristine Ningaloo Marine Park in Western Australia and northwest Australia” (AIMS, 2008).

4.2.1.3 State and territory government level science advice

The Australian government as well as the state and territory governments regard science, co-ordination and co-operation as important. A number of Commonwealth, State and Territory Ministerial Councils have an interest in science. On a state government level, examples exist of state government structures for the provision of science advice to government. Chief Scientists and science advisory councils on state level exist for the provision of science advice to government on this level.

South Australia for example, established the *Premier’s Science and Research Council* (PSRC) and appointed a Chief Scientist for South Australia. It is the role of the PSRC to provide advice to the South Australian government on a wide range of issues related to research and development and science, including industry needs and partnerships, funding opportunities and priority areas for research (PSRC, 2008).

A number of state and territory Chief Scientists have been appointed in, amongst others, Western Australia, Victoria and Queensland.

The *National Science Forum* (NSF) links the Commonwealth with the state and territories. The NSF was established in 2005, comprising middle to senior level officials from the Commonwealth, states/territories and New Zealand. The Australian and state Chief Scientists attend this meeting. Meetings independent of NSF are also held. NSF’s role is to enable dialogue on areas of mutual interest and promote programmes and policies of national importance.

4.2.1.4 Science inquiry in parliament

One or both houses of federal parliament establish parliamentary committees to scrutinise and assess government activities, legislation, policy and administration (Thorburn 2005).

For the duration of the 41st parliament, the *Standing Committee on Science and Innovation* (SCSI) was established to handle inquiries and to undertake investigations. The SCSI is one of thirteen general-purpose investigatory committees established by the House of Representatives of the parliament of Australia.

In conclusion, the role of the SCSI was to carry out inquiries into matters referred by the

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House of Representatives or a minister of the Commonwealth government. The committee could also inquire into matters raised in annual reports of Commonwealth government departments and authorities or reports by the Commonwealth Auditor-General. The Committee produced only two reports during its existence in the 41st parliament (SCSI, 2008). Under the 42nd parliament, the *Standing Committee on Industry, Science and Innovation* has replaced the SCSI.

4.2.1.5 Other sources of science advice

Other sources of science advice include the *Australian Academy of Science* (AAS), the *Federation of Australian Scientific and Technological Societies* (FASTS), and the *Australian Academy of Technological Science and Engineering* (ATSE). The head of each of these organisations is an ex-officio member of PMSEIC (OCS, 2008).

The AAS

The AAS provides independent science advice to the Australian government. AAS has published many reports on public issues, such as human cloning, pesticides, ecological reserves, national research policy setting, genetic engineering, stem cell research, food quality, space science and climate change (AAS, 2008).

As an independent body of Australia's leading research scientists, AAS can converge experts from universities, industry and government to consider and report on scientific issues. AAS also makes submissions to government ministers and parliamentary inquiries (AAS, 2008).

The FASTS

The FASTS represents 60 000 working scientists and technologists. It promotes their views on a wide range of policy issues to government, industry and the community. "The societies which make up FASTS represent the professional interests of scientists and technologists in Australia. Members include organisations such as the Australian Society for Biophysics, Australian Neuroscience Society, the Australian Council of Deans of Science the Royal Australian Chemical Institute and the Women in Science Enquiry Network" (FASTS, 2008).

The ATSE

ATSE is an independent NGO dedicated to the promotion of scientific and engineering knowledge for practical purposes in Australia (ATSE, 2008).

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4.2.2 Canada

A simplified schematic of the science advisory structure in Canada is presented in Figure 4.

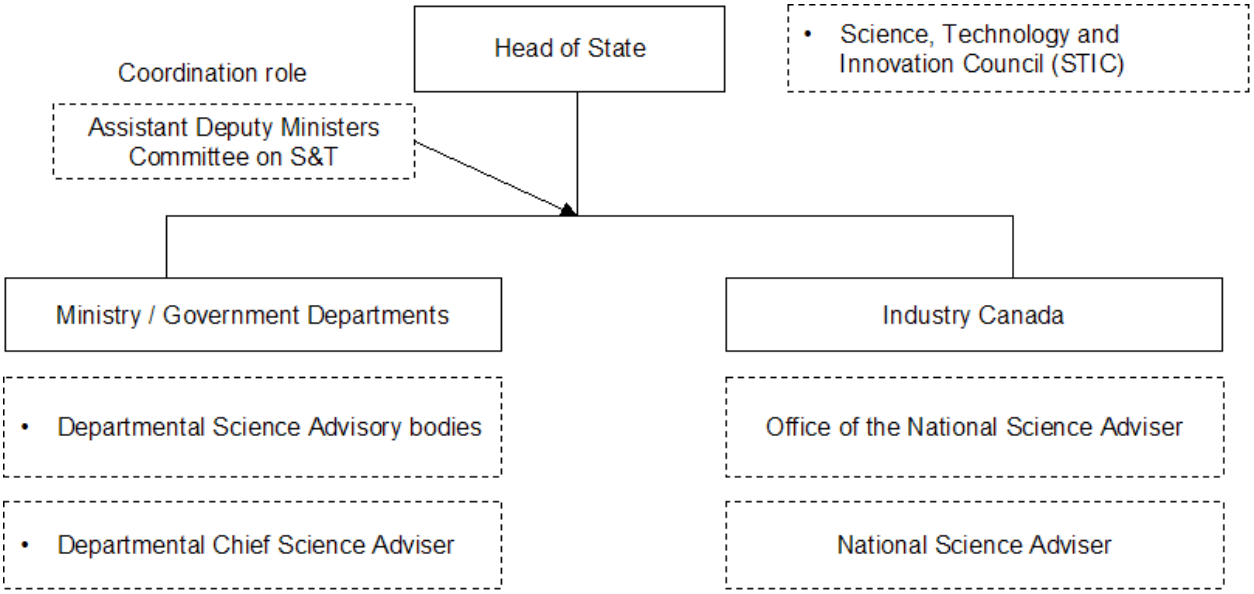

Figure 4: Simplified science advisory structure in Canada

4.2.2.1 High-level advisory bodies

In 1996, the federal government of Canada's science strategy entitled *Science and Technology for the New Century,* called for science-based departments and agencies to increase their reliance on external, expert advice. As a result, many of these departments and agencies established SABs (Glynn et al, 2003). A number of bodies, including the following were established (Canada, 2007):

- The *Advisory Council on Science and Technology* was established to advise government on the creation of a more innovative economy;
- The *Council of Science and Technology Advisors* (CSTA) was established to advise government on the strengthen of the federal science enterprise; and
- The *Canadian Biotechnology Advisory Committee* was established to provide government with advice on important policy issues associated with biotechnology.

In 2007, the federal government of Canada consolidated the roles of the three councils discussed above into one single council, namely the *Science, Technology and Innovation Council* (STIC) (Canada, 2007). The STIC is an essential element of Canada's Science and Technology Strategy, announced in May 2007, which encourages a more competitive economy and better quality of life for Canadians through science and technology. "The Council is an advisory body that provides the Government of Canada with external policy advice on science and technology issues, and produces regular national reports that measure Canada's science and technology performance against international standards of excellence" (STIC, 2008).

The *Assistant Deputy Ministers Committee on Science and Technology* is the whole-of-

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government co-ordinating committee for science-based departments and agencies. This committee is the appropriate venue to continue efforts aimed at strengthening science and technology collaborations. The committee provides the Canadian cabinet with timely, clear and comprehensive information on the federal science and technology effort (Erawatch, 2008).

Former Prime Minister, Paul Martin, appointed Canada's National Science Adviser in 2004 to provide expert advice on the government's role in matters of science and science policy. Early in 2008, the Harper government abolished the position. The government reviewed a number of federal advisory bodies and decided to phase out the *Office of the National Science Adviser* from Industry Canada and discontinued the role of the National Science Adviser (McDonald, 2008).

4.2.2.2 Ministerial arrangements for advice

Further down the hierarchy of government, advisory structures are organised along the lines of departmental and ministerial responsibilities. Canada has a system of departmental SABs. These bodies are located in the Department of Fisheries and Oceans, Agriculture and Agri-Food Canada, Environment Canada, Natural Resources Canada, the Canadian Institutes of Health Research, Health Canada, the Canadian research councils, and so forth (Glynn, 2003).

As an example of science advisory structures at government departmental level, Canada's Department of Health, also known as Health Canada, is discussed below. Within Health Canada, many well-informed scientific experts provide science advice to the Minister as well as the Deputy Minister. Health Canada also seeks science advice from external independent experts, who are responsible for reviewing the quality of science performed and provide recommendations on policy and programs (Health Canada, 2008). "For example, the *Research Ethics Board* reviews all research involving human subjects funded or performed by Health Canada, while the *Science Advisory Board* provides advice to the Minister of Health on a range of issues related to the department's science. Health Canada also benefits from the suggestions of over 100 advisory committees and panels." These committees and panels assist in the early identification of issues and bring to the table views and findings that may otherwise be overlooked (Health Canada, 2008).

Health Canada has a Chief Scientist operating in the OCS. The OCS provides leadership for and promotes awareness of Health Canada's science and research. Health Canada's OCS encourages and supports the science community within and outside Health Canada. This assists in ensuring that the department has the scientific information needed to make health-related decisions. The priorities of the Chief Scientist include science advice, science management and science promotion (OCS-Health Canada, 2008).

4.2.2.3 Other advisory structures

In the late 1990s, the *Canadian Academy of Engineering*, the *Royal Society of Canada*, and the *Canadian Institute of Academic Medicine* jointly initiated efforts to create the

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Council of Canadian Academies (CCA).

The *CCA* provides government with independent, in-depth, expert assessments on that which is known of relevant topics of interest. “A primary objective of the Council is to provide Canada with an authoritative and independent way to build public confidence that regulatory decisions and policy are being based on widely accepted scientific knowledge and evidence” (CCA, 2008).

4.2.3 Denmark

A simplified schematic of the science advisory structure in Denmark is presented in Figure 5.

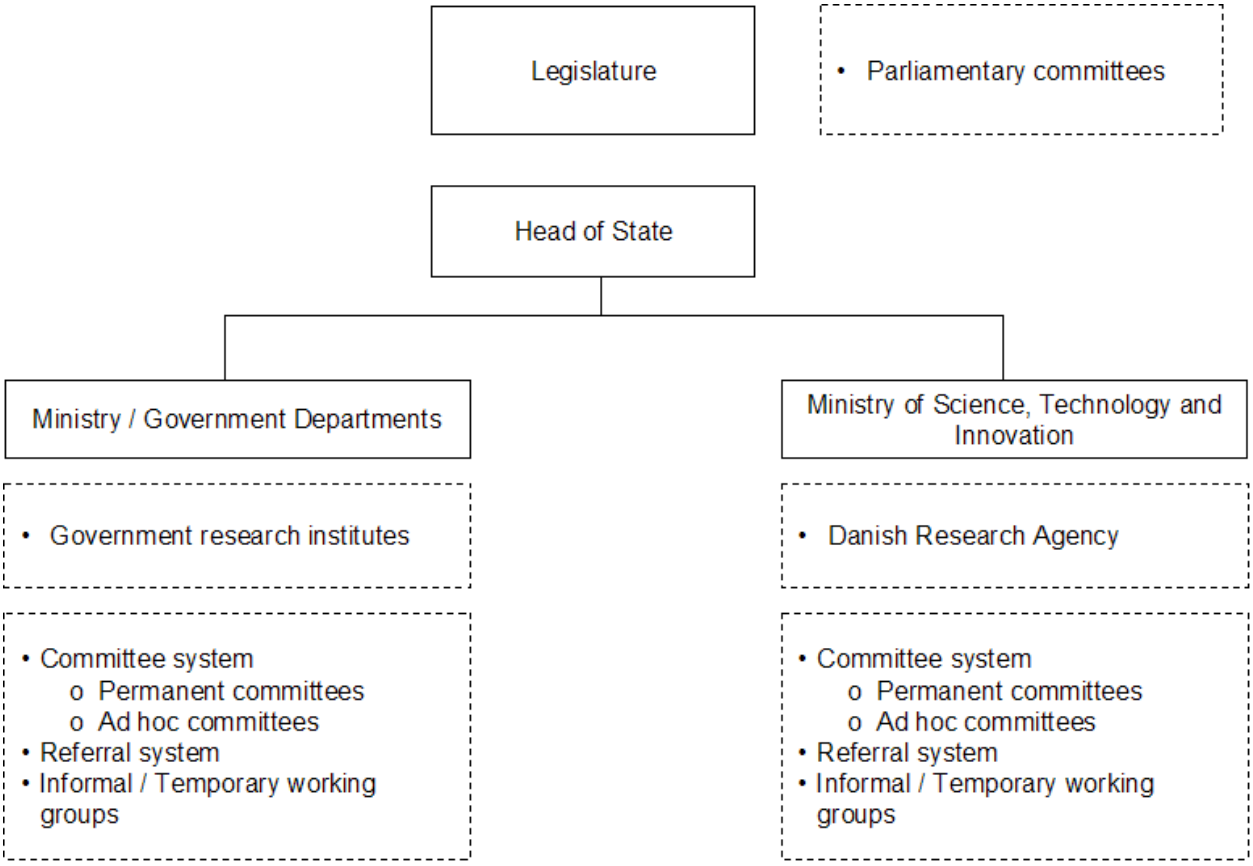

Figure 5: Simplified science advisory structure in Denmark

As in the case of the other Nordic countries reviewed in the analysis, Denmark is often characterised as a corporative political system. “In Denmark this is, for example, expressed in a large number of permanent councils and committees with, primarily, representatives from different interest organisations” (Glynn et al, 2003).

In Denmark as well as the other Nordic counties under review, ad hoc committees play an important role in providing scientific advice into the policy development process. In contrast with Sweden where the cabinet appoints ad hoc committees, the parliament, a single minister or the cabinet appoints ad hoc committees in Denmark. The number of

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ad hoc committees in Denmark is, however, not as large as in Sweden and Finland (Glynn et al, 2003).

The committee system in Denmark is not as formalised as in Sweden and Finland. Informal working groups prove more common in Denmark. The referral system in Denmark is also not as institutionalised as in Sweden. Denmark has a large number of permanent committees and councils with advisory functions. Some bodies also have explicit functions as SABs (Glynn et al, 2003):

- "The main current research advisory council, the *Danish Council for Research Policy*, was established in early 2004. The council gives advice to the Minister of Science, Technology and Innovation on Danish and international research policy, and consists of recognised researchers (chairman and eight members)" (Erawatch, 2008);
- The Danish Board of Technology provides policy advice to the Danish government and parliament. The Board is also responsible for the development of foresight studies (Erawatch, 2008);
- Examples of private agencies that engage in research policy issues are the *Confederation of Danish Industries*, The *Danish Federation of Small and Medium-Sized Enterprises* and *The Danish Academy of Technical Sciences* (Erawatch, 2008); and
- The Danish Innovation Council engages private companies, ministries and public institutions. The council's role is to discuss and encourage innovation and research in the Danish economy (Erawatch, 2008).

The research councils are an important group of advisory bodies and explicit functions as advisory bodies to the government in their specific fields (Glynn et al, 2003).

The Danish government research institutes provide mission-oriented research to the ministries. In contrast with Sweden, where universities perform the majority of sectoral research, the research institutes under the auspices of different ministries mostly perform the mission-oriented research in Denmark. In Denmark, research institutes produce approximately 25% of total public sector research. These research institutes thus play an important role in the provision of science advice to ministries (Glynn et al, 2003).

Furthermore, informal networks and temporary working groups, dominated by civil servants, play an important role in providing scientific advice. In Denmark, scientific advice is in many areas provided to a large extent through informal channels. These informal channels normally involve different expert institutions, such as sectoral institutes or universities (Glynn et al, 2003).

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Table 4 below summarises the Danish structures for science advice (Glynn et al, 2003):

Table 4: The Danish science advisory structure

Policy Area	Ministry Responsible	Important Advisory Bodies
Research	• The Ministry of Science, Technology and Innovation handles the overall research policy. • The ministry's objective is to promote interaction of trade and industry as well as centres of research and education.	• The Analyses and Strategies Division within the Department of Research in the Ministry of Science, Technology and Innovation. • The Danish Council for Research Policy plays an advisory role to the minister for science, technology and innovation (DCRO, 2008). • The Danish Institute for Studies in Research and Research Policy.
Energy	• This is the responsibility of the Ministry of Economic and Business Affairs. • An office within the department handles the energy policy. • The Danish Energy Agency is responsible for implementing the policy.	The Advisory Committee for Energy Research appointed by the Minister of Energy.
Transport	• This is the responsibility of the Ministry of Transport. • A number of relatively autonomous agencies, for instance the Danish National Railway Agency and the Civil Aviation Administration, handle the implementation of this policy.	The Danish Transport Research Institute functions as an advisor to the ministry.
Environment	The responsibility lies with the Ministry of the Environment.	• The National Environmental Research Institute under the Danish Ministry of Environment. • A number of advisory councils, for instance the Danish Advisory Committee on Pesticide Research, play an important role.
Health and the Consumer	The responsibility lies with the Ministry of the Interior and Health, the Ministry of Social Affairs, which is responsible for the social policy, and the Ministry of Food, Agriculture and Fisheries.	• Scientific advice is usually organised in ad hoc committees and working groups. • The National Board of Health. • The Danish National Institute of Social Research. • The Public Health Institute. • Advisory Committee on Health Care Research.
Agriculture	This is the responsibility of the Department of Food and the Environment within the Ministry of Food, Agriculture and Fisheries.	• The Danish Institute of Agricultural Sciences. • The Advisory Committee on Agriculture, Fisheries and Food Research.

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4.2.3 Finland

A simplified schematic of the science advisory structure in Finland is presented in Figure 6.

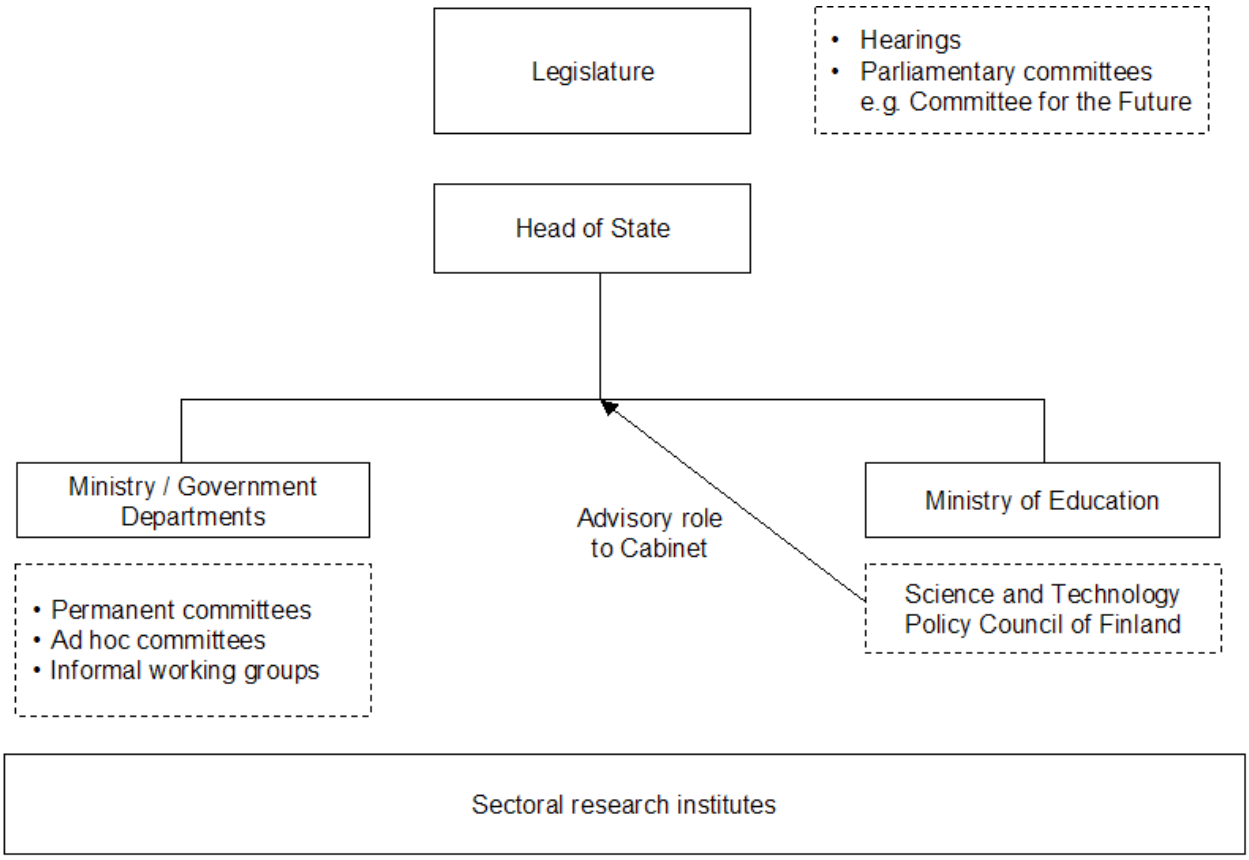

Figure 6: Simplified science advisory structure in Finland

4.2.3.1 Ministerial arrangements for science advice

The formation of committees to provide science advice to policy makers plays an important role in the provision of science advice to the Finnish government. Where new issues come onto the agenda or where a new piece of legislation has to be prepared, the responsible minister usually appoints ad hoc committees. These ad hoc committees draw mostly on their members' expertise as a primary source of information and it has become less common for these committees to commission external research or investigations. Civil servants have dominated these committees, with members of parliament and representatives from interest groups playing a less prominent role (Glynn et al, 2003).

A large number of permanent committees and councils exist in Finland. Although their historical function was to integrate different interest groups into the work of the government, a number of these permanent committees also have objectives that concern science advice more explicitly (Glynn et al, 2003).

An example of such a committee is the *Science and Technology Policy Council (STPC)*

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of Finland. *The STPC of Finland*, chaired by the Prime Minister, advises the Council of State and its ministries on important matters concerning research and technology. "The Council is responsible for the strategic development and co-ordination of Finnish science and technology policy as well as of the national innovation system as a whole" (STPC, 2008):

- The Council falls formally under the Ministry of Education. In practice, however, the council operates as a truly horizontal body under the chairmanship of the Prime Minister; and
- Council membership comprises the Minister of Education, the Minister of Trade and Industry, the Minister of Finance and up to four other ministers appointed by the Council of State.

Another example of a body that plays an important role in the provision of science advice to government is the *Academy of Finland*. "Besides providing funding for research and various research related activities, the Academy conducts science policy reviews, implements evaluations and assessments, foresights developments in different fields of research and assesses the impacts of research funding" (Erawatch, 2008).

The academy has four research councils that take research-funding decisions within their respective scopes of expertise. The four research councils are (CSTA, 2008):

- The Research Council for Bio-sciences and Environment;
- The Research Council for Culture and Society;
- The Research Council for Natural Sciences and Engineering; and
- The Research Council for Health.

"Sectoral research institutes play important roles as providers of scientific research in the Finnish system. This is partly done within different kinds of committees and working groups, but also through research projects commissioned by the Ministries, and by informal contacts". These institutes not only play the part of knowledge producers to government, but are also expert agencies within their policy fields (Glynn et al, 2003).

There are 20 government research institutes in Finland. "Most of these research institutes are sector-specific and provide information, testing, etc. for the fields and purposes of their respective sectoral ministries. Examples of significant government research institutes include: the Ministry of Agriculture and Forestry's *Forest Research Institute* and *Agrifood Research Institute*; the Ministry of Social Affairs and Health's *National Public Health Institute* and *Institute of Occupational Health*; and the Ministry of the Environment's *Environment Institute*. By far the largest research institute is the Ministry of Trade and Industry's *Technical Research Centre of Finland*. This is a multi-sectoral contract research organization, with personnel of around 3 000 and a research volume of about 212 million euros" (CSTA, 2008).

"Overall the process of scientific advice in the Finnish system relies on a number of sources, and the possibilities for civil servants at different levels to initiate investigations

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is extensive". The current trend in Finland is for informal working groups to increasingly replace more formal committees in preparing political decisions (Glynn et al, 2003).

In contrast with Sweden, Finland does not have an institutionalised referral system. It is, however, becoming more common for ministries to send out committee reports to experts and interest groups for comment (Glynn et al, 2003).

The following table outlines the most important role players in the science advisory structure in Finland (Glynn et al, 2003).

Table 5: Important role players in the science advisory structure in Finland

Policy Area	Ministry Responsible	Important Advisory Bodies
Research	• Finland does not have a dedicated ministry responsible for science. • Research is the responsibility of two ministries, namely the Ministry of Education and the Ministry of Trade and Industry. • Together, these ministries control 80% of government funding for research and development.	• The Science and Technology Policy Council of Finland under auspices of the Ministry of Education. • The Academy of Finland under auspices of the Ministry of Education. • The National Technology Agency (TEKES) under auspices of the Minister of Trade and Industry.
Energy	The Ministry of Trade and Industry primarily handles the energy policy.	• Advice is to large extent provided by ad hoc working groups. • Energy Market Authority. • TEKES.
Transport	The Ministry of Transport and Communication is responsible for preparing and implementing decisions.	• A number of large government enterprises, for instance the Finnish Road Enterprise and Telecom Administration Centre, dominate the policy area. • A research department within the Ministry of Transport and Communication. • TEKES also provides expert advice.
Environment	The Finnish Ministry of Environment is responsible for preparing and implementing decisions.	• The Finnish Environment Institute produces research and fulfils an advisory function to government. • Ad hoc committees with advisory functions.
Health and the Consumer	The Ministry of Social Affairs and Health directs and guides policy.	Bodies under the auspices of the Ministry of Social Affairs and Health, including: • Medical Agency; • National Research; and • Development Centre for Welfare and Health.

4.2.3.2 Science advice to the Legislature

In the parliamentary arena, members of parliament employ hearings to gain information from different role players. An example of a committee working in this area is the *Committee for the Future*. This committee is a specific parliamentary committee working with technology assessment and future studies (Glynn et al, 2003).

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4.2.4 Germany

A simplified schematic of the science advisory structure in Germany is presented in Figure 7.

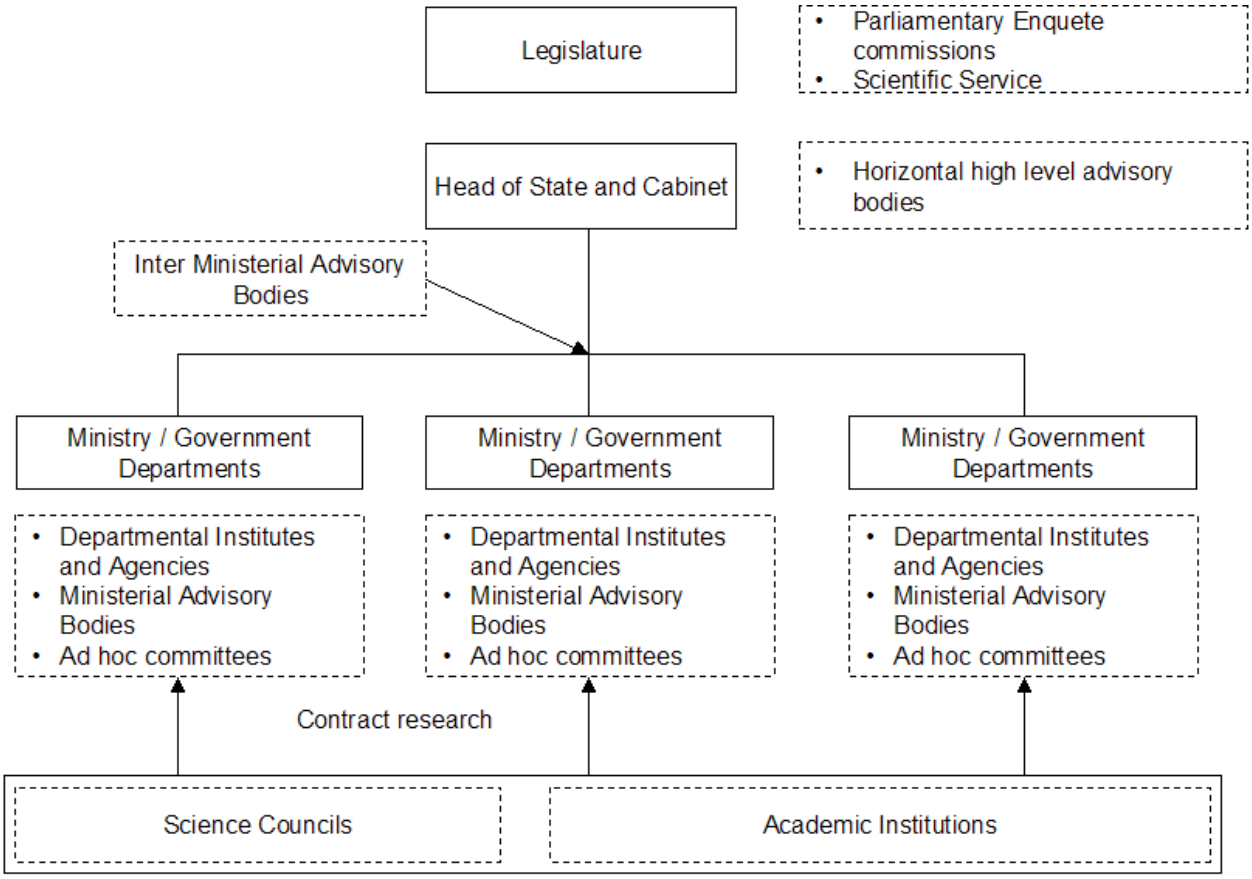

Figure 7: Simplified science advisory structure in Germany

The German political system can be described as a consensus-oriented, multi-level system. In the context of an investigation into the German science advisory system, this is highly significant, since consensus-building draws on the development of good arguments and therefore creates a demand for science and technical advice.

Although the science advisory system in Germany is highly institutionalised, there are no general guidelines as to advisory structures and processes. “Ad hoc and permanent structures co-exist and unlike in some other countries, there are in general no issue-oriented intermediary structures that organise advice and research. Each level of government has its own structures” (Glynn et al, 2003).

4.2.4.1 Science advice to the highest level

In Germany, thematic, high-level advisory bodies spanning across ministries and reporting directly to cabinet or to inter-ministerial committees are common. Examples of such bodies include the *Council for Sustainable Development*, the *Council on Innovation*, the *Council on Education* and the *National Ethics Council*. These are all

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supplementary high-level advisory bodies that integrate various stakeholders. The bodies are highly visible and interact directly with the Chancellor. In general, the ministry with which it has the most thematic overlap will administer these bodies (Glynn et al, 2003).

4.2.4.2 Ministerial arrangements for science advice

In the German system, dominant modes of advice are contract research, departmental research institutes and Ministerial Advisory Bodies.

All ministries, except for the Federal Ministry of Education and Research, have their own departmental research institutes that provide a number of services to the departments. These departmental research institutes deliver ad hoc analysis on demand as well as independent basic research. The degree of the institutes' independence varies, depending on the personalities in departments and the institutes as well as the degree of research that these institutes can perform themselves. The functional separation between departmental ministerial institutes and ordinary institutes of the science system is unclear. Scientific institutes of all sorts also conduct contract research for the government on all levels, while departmental institutes also do independent research. Departmental institutes perform a 10% share of all research performed by the public research system in Germany. The aforesaid excludes universities. "In the context of research that is commissioned through specific programmes, a multitude of ad hoc expert groups accompany research programmes and projects". (Glynn et al, 2003).

In addition to the departmental institutes and agencies, many ministries have statutory scientific councils, which could play the role of general policy adviser. "In addition, there are numerous ad hoc expert groups, some of them inter-ministerial, some of them responsible for selected issue areas within a ministry" (Glynn et al, 2003).

4.2.4.3 Science advice to the Legislature

The German parliament or *Bundestag* has a differentiated internal advisory body called the Scientific Service. This service is a permanent entity that exists within the structures of the parliament. The Scientific Service provides scientific advice and information both as demanded as well as pro-actively through newsletters. Most of the service's work is to converge research that has been conducted outside the service. The service does, however, sometimes engage in research activities to provide the parliament with advice (Glynn et al, 2003).

Apart from the permanent structure of the Scientific Service, there are also joint "Enquete-Commissions"[7] that have grown in prominence over the past two decades, both in terms of number and public visibility. "Enquete-Commissions are mostly proposed by the parliamentary committee in charge of the issue at stake and are approved by the parliament". These Enquete-Commissions comprises members of the parliament and external scientific, industrial and societal experts (Glynn et al, 2003). An

[7] Enquete is the French word for inquiry or survey. Enquete-commissions are commissions of inquiry that are given a mandate to investigate a particular issue at hand.

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example of such a commission is the Enquete Commission on "Sustainable Energy Supply Against the Background of Globalisation and Liberalisation", that was established by the German *Bundestag* in February 2000. The commission was given the mandate to furnish scientific evidence to be used as a basis for the German *Bundestag's* future decision-making in the field of energy policy (Lehmann, 2002).

The table below summarises the existing science advisory structure in Germany (Glynn et al, 2003).

Table 6: Science advisory structures in Germany

Policy Area	Ministry Responsible	Important Advisory Bodies
Research	• The Federal Ministry for Economics and Technology is responsible for all innovation policies and industry-related research. • The Federal Ministry of Education and Research is mainly responsible for the federal science and research policy and develops the framework for the regulation of universities. • The demarcation between these two ministries is unclear and many issues are dealt with in both ministries.	• The Federal Ministry of Education and Research administrates the Council on Innovation. • A body has been institutionalised in the German parliament, namely the Office for Technology Assessment. The task of this body is to advise government on matters relating to research and technology.
Energy	• There is no ministry for energy. The main responsibility lies within the Federal Ministry of Economics and Technology. • As energy policy interferes with the environmental policy, there is constant communication between the Federal Ministry of Economics and Technology and the Federal Ministry of the Environment.	• The most important bodies for energy matters are horizontal bodies that deal with environmental issues in the broadest sense. These bodies include: o The Council for Sustainable Development; and o The Scientific Council of the Federal Government on Global Environmental Change. • There is no departmental energy research institute.
Transport	This policy area is the responsibility of the Federal Ministry of Transport.	• There are five departmental research institutes. • There is a horizontal advisory body on transport matters in general, namely the Scientific Council at the Federal Ministry of Transport, Building and Housing.
Environment	This policy area is administered within the Federal Ministry for the Environment.	• High-level horizontal bodies include: o The Council for Sustainability; and o The Scientific Council for World Climate Change. • Scientific councils include: o The German Council of Environmental Advisors; and o The Scientific Council of the Federal

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Policy Area	Ministry Responsible	Important Advisory Bodies
		Government on Global Environmental Change. • Departmental institutes of the Ministry include the Federal Environmental Agency.
Health and the Consumer	• The health policy is mainly administered in the federal government. • Consumer policy is dealt with in the Federal Ministry of Consumer Protection, Food and Agriculture.	• Departmental research institutes. • Permanent commission.
Agriculture	The Federal Ministry of Consumer Protection, Food and Agriculture is responsible for the federal agricultural policy of Germany.	• Departmental research institutes and agencies as well as ad hoc expert groups dominate the advisory system. • There are 11 departmental institutes under the auspices of the Federal Ministry of Consumer Protection, Food and Agriculture. • Agricultural policy has a very highly institutionalised structure and no prominent ad hoc committees and statutory expert groups beyond programme-related committees.

4.2.5 Japan

A simplified schematic of the science advisory structure in Japan is presented in Figure 8.

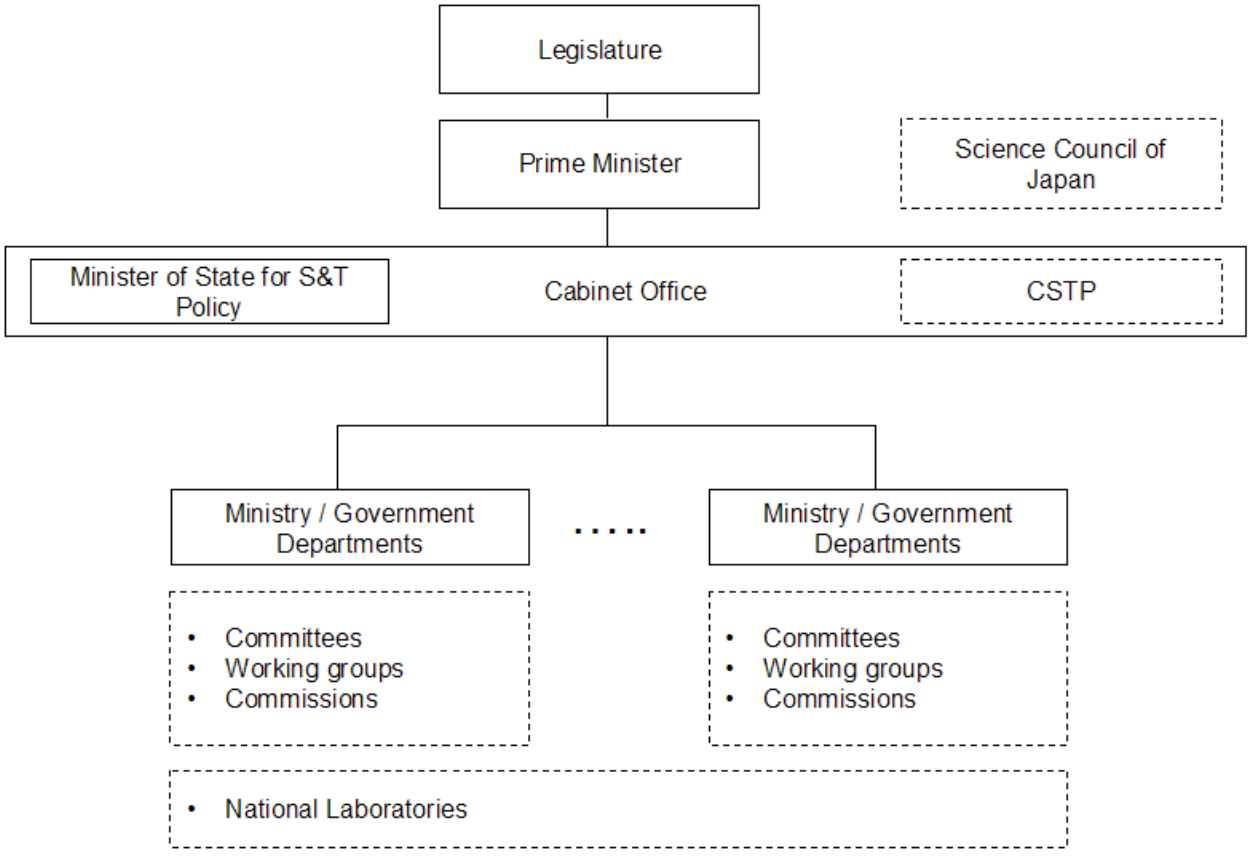

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Figure 8: Simplified science advisory structure in Japan

4.2.5.1 Science advice to the highest level

The *Council for Science and Technology Policy* (CSTP) was established in January 2001 within the Cabinet Office as one of the governmental top councils. It is the main forum for the discussion, development and assessment of science and technology policy in Japan. “This council develops general policy and also has a number of expert committees that review specific areas of Japan's science and technology governance, including Basic Policy, Evaluation of National Projects, Space, Intellectual Property and Bioethics. These committees provide many reports and findings that filter into CSTP policies” (CSTP, 2008) (Erawatch, 2008). The CSTP provides a source of science and technology advice to the Prime Minister and cabinet.

The CSTP comprises the Prime Minister, other relevant ministers, including those for the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Economy, Trade and Industry, other experts from academia, including the *Science Council of Japan* (SCJ) and experts from industry (CSTP, 2008). The Director General for Science and Technology Policy provides the CSTP with secretariat support. The staff of the secretariat includes people with academic, industry and government backgrounds (Glynn, 2003). “The CSTP discusses basic concepts for science and technology policy on a monthly basis and prioritises all national science and technology policies, which are then implemented by the various ministries and agencies” (Erawatch, 2008).

Attached to the Prime Minister’s office, although functioning as an independent body, is the *SCJ*. The SCJ was established in 1949 as a body representing the Japanese scientists, both nationally and internationally. The government may seek the opinion of the SCJ, and the council has the right to take the initiative in making recommendations to government (SCJ, 2008). “One of the main tasks of the SCJ is the provision of advice on science and technology issues, on a reactive or proactive basis, to the Government, for which it is able to draw on the expertise of a number of Standing Committees or specifically established Special Committees” (Glynn, 2003).

The SCJ represents approximately 80 000 scientists and consists of roughly 2 000 members with 210 serving as council members. The primary functions of the council are to promote international exchanges in the scientific field, to co-ordinate the scientific community, to make policy recommendations and deliberate on scientific issues as well as to communicate with society at large (Erawatch, 2008).

4.2.5.2 Ministerial arrangements for advice

In Japan, all ministries can create working groups, committees and commissions to examine science and technology issues and to provide advice directly to ministers. More than 200 of these committees have currently been created in this county and they are distributed across the entire range of science and technology relevant government departments and agencies. Furthermore, advice may also be sourced from the National Laboratories under the guidance of the ministries and departments (Glynn, 2003, p. 61).

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4.2.6 Sweden

Figure 9 represents a simplified structure of the Swedish science advisory system.

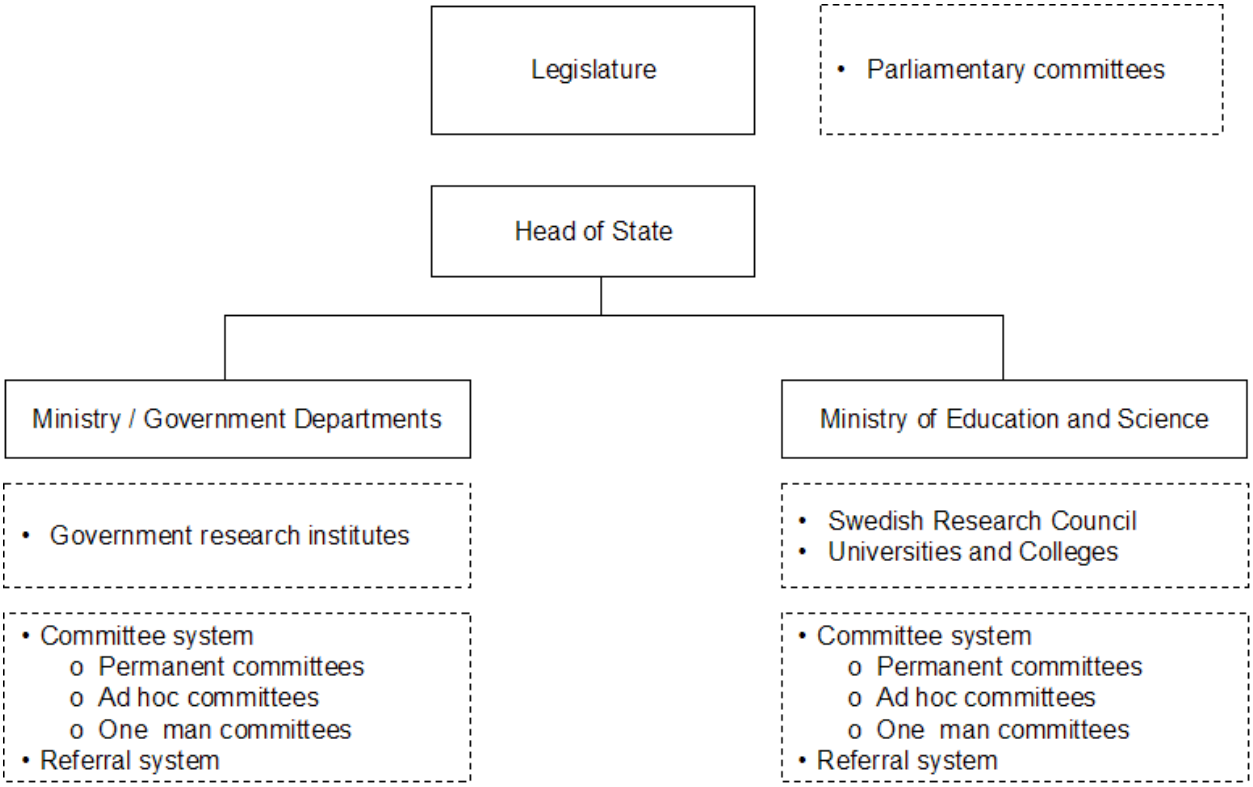

Figure 9: Simplified science advisory structure in Sweden

As in the other Nordic countries under review, the policy development process in Sweden is characterised by being consensus-oriented. Specific institutional arrangements are also advantageous for consensus-building between different interests in society.

There are a number of ways through which scientific advice can evolve into the Swedish policy process. Two important mechanisms for influence of scientific advice are the committee system and the referral system (Glynn et al, 2003):

- Most major legislation and significant political decisions are prepared within the *committee system*. Where an issue arises on the governmental agenda and the cabinet decides to deal with the issue, a procedure is followed whereby the minister will, on behalf of the cabinet, appoint a committee to investigate the issue. The committee can comprise experts from agencies and research organisations but also representatives of interest groups and political parties. In some cases, the minister may appoint one person to investigate an issue; and
- The committee's output and findings are published in specific reports. These reports are distributed to governmental as well as NGOs that are presumed to be affected, or have an interest at stake. "This is called the *referral system*, an institutional

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mechanism that is indirectly regulated in the constitution, and that guarantees a relatively open formulation process".

A major function of the committee system is to provide the policy development and formulation process with knowledgeable inputs. This can be achieved in a number of ways (Glynn et al, 2003):

- The knowledge can come from the membership of the body where the body might have representatives from universities or other research organisations. In most cases, these individuals will be connected to the committee as experts and not as formal members of the committee;
- "Committees can commission research or investigations in specific issues. These projects usually include researchers from universities or research institutes"; and
- The committee secretary plays an important role in leading the work of the committee, and in working out proposals. "These secretaries have traditionally to a high extent been civil servants of public agencies and ministries".

There have been a number of changes in the committee system that influences its ability to deliver advice. An important change is that the tendency to commission investigations by the committee seems to have decreased during the last two decades. An important reason for this trend is the fact that committees have shorter time periods in which they have to complete their work. In the 1960s and 1970s, committees could work for several years, which made commissioned research possible. However, in the 1980s the Swedish government decided that committees should complete their work in two years. "During the last years the committee system has also been criticised for bad quality due to the fact that the government does not give the committee enough time to do a proper job. The number of "one-man committees" has increased during the 1990s – this is a trend that is related to the higher speed of the policy process" (Glynn et al, 2003).

The referral system is usually considered to play an important role in the policy formulation process. In the referral system, ministries distribute committee reports to all relevant stakeholders. Usually, committee reports are distributed to relevant interest groups and other organisations. It is compulsory for all relevant public agencies to respond to committee reports sent to them. "Referrals are open to the public and are regularly quoted in the media, potentially also strengthening the public debate on scientific issues" (Glynn et al, 2003).

National agencies and boards play an important role in providing scientific advice to the government and the parliament. Many of these agencies have research departments, but are also connected with networks of scientists at higher education institutions. These agencies are important nodes in *informal networks* of scientists, ministries, interest groups etc. Agencies and boards are obliged to inform the Ministry of Education and Science regarding their strategies with regards to research in their policy areas. This has to be done even in the case of an instructed function, apart from the actual implementation, to provide government with expert advice (Glynn et al, 2003).

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There are few permanent bodies that deal explicitly with scientific advice, even though the scientific advice function seems to be receiving more attention through the creation of new permanent advisory bodies. In Sweden, there are, however, a number of permanent committees and councils connected to ministries and governmental agencies. "There are several permanent committees connected to ministries working with, for example, nuclear waste and biological diversity. The *Swedish Research Council* is an independent agency working with research funding, but also with advisory issues. A rather new scientific advisory body is the *Gene Technology Advisory Board*. There are also a number of smaller scientific advisory committees connected to, for example, the *Swedish Medicines Agency* and the *National Food Administration*" (Glynn et al, 2003).

There is quite an extensive opportunity in the Swedish system for scientific advice. Scientific advice is primarily provided through the committee system. The committee system seems to be more open to scrutiny and more formalised than in other Nordic countries considered. Unlike the state of affairs in Denmark and Finland sectoral research institutes play a limited role as knowledge providers to public agencies and ministries (Glynn et al, 2003).

Table 7 below summarises existing structures for science advice in Sweden (Glynn et al, 2003).

Table 7: Existing structures for science advice in Sweden

Policy Area	Ministry Responsible	Important Advisory Bodies
Research	• The Ministry of Education and Research has a major responsibility in this area. • The Ministry for Education has a specific responsibility to co-ordinate the general research policy and is responsible for basic funding of universities as well as the Swedish Research Council.	• The National Research Committee is a standing body that advises the government on matters regarding research policy. The Minister for Education and Research is the chairman of this committee, which also comprises researchers and industrial representatives. The committee is administratively connected to the Ministry of Education and Research. • The Swedish Research Council is primarily a co-ordinating agency for the support of basic research but also plays an advisory role to government. • Sectoral research councils play an advisor role in Sweden.
Energy	• The energy policy is primarily the responsibility of the Ministry of Industry, Employment and Communication. • The Ministry of the Environment also deals with issues concerning energy policy. • The state, through the Swedish Energy Agency	• The Swedish Energy Agency is responsible for technology procurement as well as research and development funding within the energy sector. • The advisory committee in this area is the National Council for Nuclear Waste.

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Policy Area	Ministry Responsible	Important Advisory Bodies
	controls the energy market.	
Transport	• The transport policy is primarily the responsibility of the Ministry of Industry, Employment and Communication.	• The National Road Administration. • The National Rail Administration. • The Swedish Institute for Transport and Communication.
Environment	• The main responsibility lies with the Ministry of the Environment, but the Ministry of Agriculture, Food and Fisheries also has responsibilities in this policy area.	• The ministerial level advisory committee is the Swedish Environmental Advisory Council.
Health and the Consumer	Several ministries deal with health issues. The most important role players are: • The Ministry of Health and Social Affairs; and • The Ministry of Agriculture, Food and Fisheries.	• The National Board of Health and Welfare. • The Medical Products Agency. • The National Food Administration uses a network of experts and scientists for advice.
Agriculture	• It is the responsibility of the Ministry of Agriculture, Food and Fisheries. • Implementation and a large part of the regulation is the responsibility of the Swedish Board of Agriculture.	• The Swedish Board of Agriculture is the central authority concerning scientific advice.

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4.2.8 United Kingdom

Figure 10 outlines a simplified schematic of the science advisory structure of the UK.

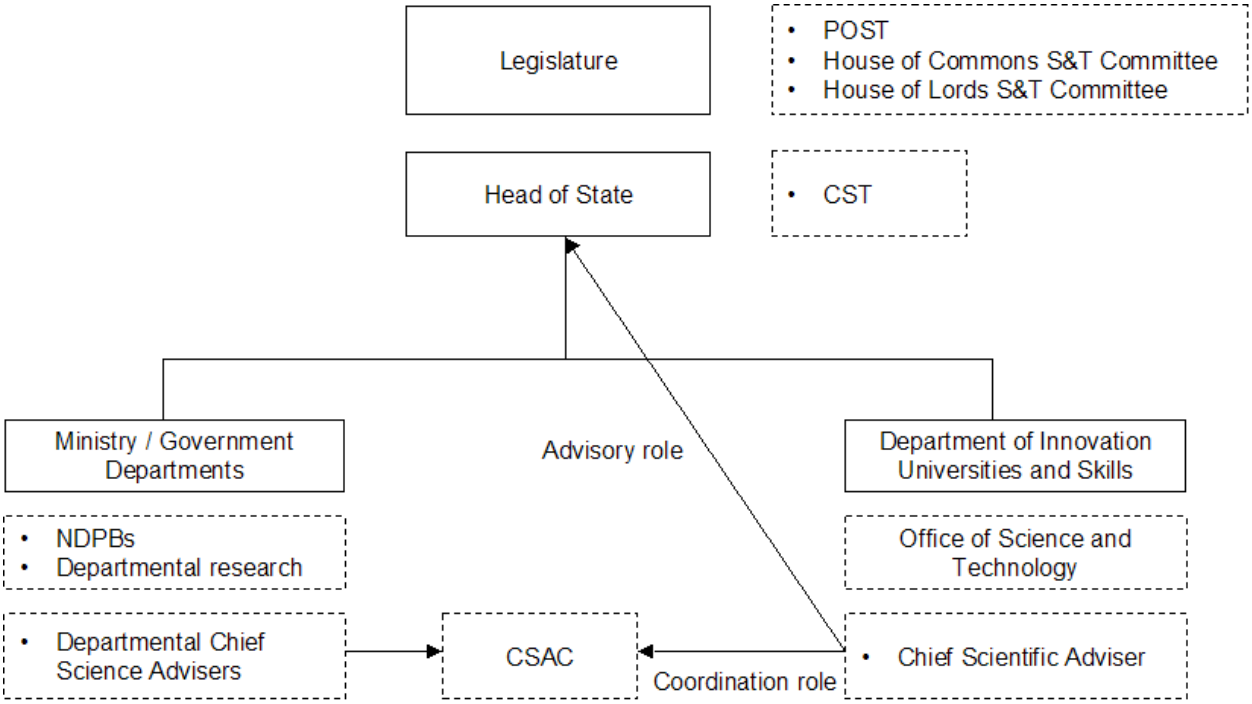

Figure 10: Simplified science advisory structure in the UK

4.2.8.1 Science advice to the highest level

The *Council for Science and Technology* (CST) was established in 1993, following the UK government's White Paper entitled *Realising our potential: a strategy for science, engineering and technology*. The CST replaced the *Advisory Council on Science and Technology*. CST's objective is to "advise the Prime Minister and the First Ministers of Scotland and Wales on strategic issues that cut across the responsibilities of individual government departments. The Council works on cross-cutting issues of strategic importance, taking a medium to longer-term approach" (CST, 2008). Appointed by the Prime Minister, the 15 members of the council are respected senior figures drawn from across the field of science, engineering and technology. CST also draws regularly on additional expertise by inviting non-members to join subgroups engaged in specific pieces of work. "Members are expected to attend meetings quarterly in London, with some work outside these meetings conducted through subgroups" (CST, 2008b).

The science advisory structure includes a Chief Scientific Adviser (CSA). The CSA provides science advice on science, engineering and technology issues directly to the Prime Minister, the cabinet, the Secretary of State for Trade and Industry as well as the Minister for Science. The CSA is the head of the Office of Science and Technology. The post is located within the Department for Innovation, Universities and Skills, whose Secretary of State holds the cabinet portfolio for UK science policy. The CSA is responsible for reviewing the UK research and development system and sits on virtually

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every important committee and advisory group, for example, the *Chief Scientific Adviser's Committee* (CSAC) and the CST.

As head of OST, the CSA is responsible for co-ordinating strategy on science and technology matters across government. In an attempt to ensure that such matters are handled properly, the CSA has regular meetings with the Departmental Chief Scientists through the CSAC. The CSAC is the principal committee at official level dealing with issues relating to science, engineering and technology. The committee:

- Provides advice to ministers, primarily through the *Cabinet Committee on Science* (SCI);
- Identifies and promulgates good practice in SET-related areas, including the use of scientific advice in policy making;
- Discusses and facilitates implementation of policy on SET; and
- Facilitates communication on particular high profile SET-related issues and those posing new challenges for government (CSAC, 2008).

4.2.8.1 Ministerial arrangements for science advice

The UK has a devolved structure of responsibility for science matters, with "each Government Department being responsible for the provision and use of the scientific advice it needs to discharge its individual mission" (OST, 1998). Departmental Chief Science Advisers (DCSA) have been appointed in the majority of government departments. The role the DCSAs forms part of the wider drive in the UK for evidence-based policy and improved service delivery, with the DCSAs shouldering the specific responsibility of ensuring the quality of scientific advice within their departments (BERR, 2008).

There are a variety of ways through which government departments can seek advice (Glynn et al, 2003). The first is through the department's own research programmes. Departments have their own research budgets. These funds can be used to maintain adequate support for broadly based long-term research and to allow for the commissioning of short-term, policy relevant studies. These departments follow a number of models to acquire research. A proportion of the research is put out to competitive tender, while other parts of the work will be commissioned directly. Most of the departments have links with old public sector laboratories. For many areas this method of acquiring research is one of the main sources of information on scientific issues.

The second method of seeking advice is through Non-Departmental Public Bodies (NDPBs), which are arguably the most important source of scientific advice. "An NDPB is a body that has a role in the process of national Government but is not a Government Department or part of one and which accordingly operates to a greater or lesser extent at arm's length from Ministers" (Cabinet Office, 2002).

Four types of NDPBs can be distinguished, with the Executive and Advisory NDPBs being relevant to the provision of science advice to government. Executive NDPBs carry

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out executive or commercial duties, while advisory NDPBs provide independent expert advice to ministers and officials.

An example of an Advisory NDPB is the *Defence Scientific Advisory Council* (DSAC), which provides independent advice to the Secretary of State for Defence on matters of concern to the Ministry of Defence (MoD) in the fields of science, engineering and technology. The characteristics of an Advisory NDPB are that it advises ministers and does not employ staff nor incur expenditure on its own account (MoD, 2008).

The third mechanism through which science advice is provided to government Departments is through executive agencies. These agencies are responsible for particular business areas. The fact that these executive agencies form part of a department and are accountable to it distinguishes executive agencies from NDPBs (Glynn et al, 2003).

4.2.8.2 Legislature

The business of parliament is conducted in two houses, namely the House of Commons and the House of Lords. "Their work is similar: making laws (legislation), checking the work of the government (scrutiny), and debating current issues. The House of Commons is also responsible for granting money to the government through approving Bills that raise taxes. Generally, the decisions made in one House have to be approved by the other. In this way the two-chamber system acts as a check and balance for both Houses. Both chambers have science and technology committees that hold inquiries and produce topical reports" (UK Parliament, 2008).

Since 1992 the *House of Commons' Science and Technology Committee* has examined "the expenditure, policy and administration of the Office of Science and Technology and its associated public bodies" (GOST, 2008). The function of the *House of Commons Science and Technology Committee* is to examine the expenditure, administration and policy of the *Office of Science and Innovation* and its associated public bodies. This includes the *CST*, the seven UK research councils, the Royal Academy of Engineering and the Royal Society (CSCT, 2008).

Since 1979, the *House of Lords Science and Technology Committee* has pursued its broad remit to consider science and technology. The Committee investigates activities across the whole range of government, including (HLSTC, 2008):

- Public policy areas, which ought to be informed by scientific research, for instance complementary and alternative medicine, health effects of air travel and legal status of cannabis;
- Technological challenges and opportunities that government faces, including human genetic databases, management of nuclear waste, resistance to antibiotics, innovations in micro processing and the implications of digital imaging for the law of evidence; and
- Public policy towards science itself, for instance how it affects research councils, schools and universities, public sector research establishments and industrial

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research and development.

The *Parliamentary Office for Science and Technology* (POST) is an independent office within parliament, serving the interests of both the House of Commons and the House of Lords. “POST is the UK Parliament’s in-house source of independent analysis of public policy issues related to science and technology” (GOST, 2008).

Administratively, POST forms part of the House of Commons and is run by its Board, comprising peers, members of parliament and some non-parliament figures. “POST is charged with providing independent and objective analyses and information across a broad range of science and technology-related issues of concern to Members of Parliament” (POST, 2008).

In addition to these science and technology committees, other parliamentary committees also consider science, engineering and technology related matters. For example, the *Select Committee on Environment, Food and Rural Affairs*, the *Trade and Industry Select Committee* and the *Select Committees on Agriculture, Defence, Education and Skills* as well as Health also consider science and technology related issues on a regular basis.

4.2.8.3 Other sources of science advice

The National Academies play a scientific advisory role in the UK. “The *Royal Society* is the UK's leading independent scientific body. As well as providing an authoritative voice and leadership for UK science, the society provides objective advice for policy makers and government on science, science education and the relationship of science with society” (Royal Society, 2008).

The *Royal Academy of Engineering* engages in the process of policy development on topics with an engineering aspect. “The Academy engages at both national and international levels by formulating own-initiative policy statements and submitting expert response to parliamentary and government bodies” (Royal Academy of Engineering, 2008).

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4.2.9 United States of America

Figure 11 outlines a simplified structure of the US's science advisory system.

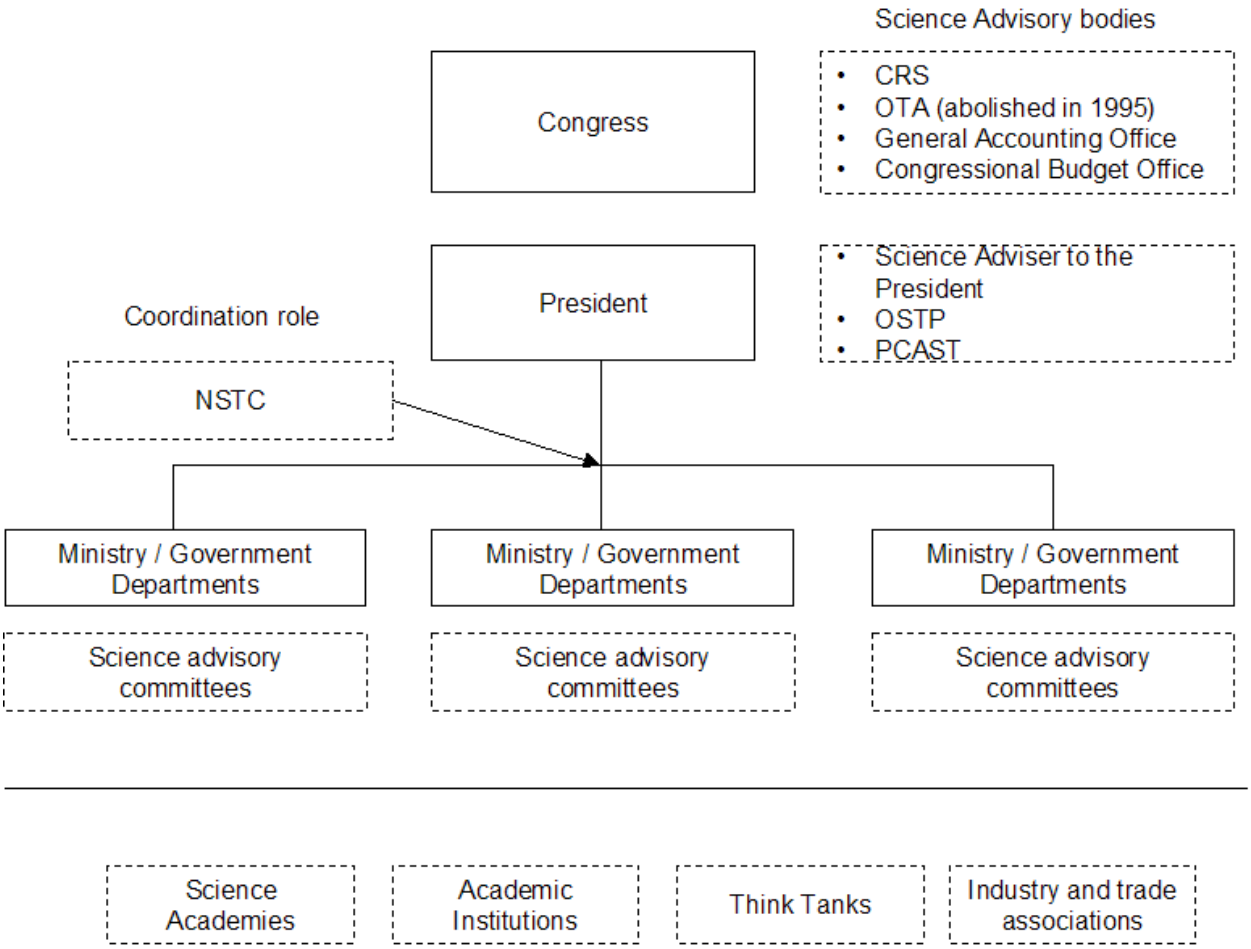

Figure 11: Simplified science advisory structure in the USA

4.2.9.1 Science advice to the highest level

In the USA, the President draws on a number of mechanisms for scientific advice. The most important of these are the *Office of Science and Technology Policy* (OSTP), the *National Science and Technology Council* (NSTC) as well as the *President's Council of Advisors on Science and Technology* (PCAST).

OSTP's mandate is to "advise the President and others within the Executive Office of the President on the effects of science and technology on domestic and international affairs". The OSTP has around 45 staff members; most of these staff members are experienced scientists functioning as policy analysts or assistant directors (OSTP, 2008).

President Clinton established the PCAST and the NSTC at the same time. PCAST was established to support the NSTC in securing private sector participation in its activities and to advise the President on matters involving science and technology. "The PCAST, which consists of distinguished individuals from industry, education and research

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institutions, and other non- governmental organizations, serves as the highest-level private sector advisory group for the President and the NSTC" (PCAST, 2008).

The PCAST is a body appointed by the President, comprising the Director of the OSTP and up to 45 members from outside the federal government. These members are distinguished individuals with diverse expertise in science and technology as well as the impact of science and technology. "PCAST has been expanded since its creation and currently consists of 35 members plus the Director of the OSTP who serves as the Co-Chair of the Council. The council members are appointed by the President and are drawn from education and research institutions, industry and other nongovernmental organizations" (PCAST, 2008).

The NSTC is a cabinet level council with the main means within the executive branch to organise science and technology policy across the varied entities that constitute the USA federal research and development system. A primary objective of the NSTC is "the establishment of clear national goals for Federal science and technology investments over a wide range of areas spanning almost all the mission areas of the executive branch. The Council prepares research and development strategies that are co-ordinated across Federal agencies to form investment packages aimed at accomplishing multiple national goals" (NSTC, 2008).

The President of the USA chairs the NSTC. The membership of the NSTC is made up of the "Vice President, the Director of the OSTP, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities" (NSTC, 2008). The work of the NSTC is primarily organised under four committees, namely:

- Science;
- Technology;
- Environment and Natural Resources; and
- Homeland and National Security.

Each of these committees oversees subcommittees and working groups focused on different aspects of science and technology (NSTC, 2008).

The USA's science advisory structure also provides for a scientific adviser. The Senate has also confirmed the Science Advisor to the President as Director of the OSTP. The Science Adviser to the President also co-chairs the PCAST and supports the NSTC (OSTP, 2008).

4.2.9.2 Federal government departmental arrangements for science advice

Departments responsible for the implementation of policy oversee a large number of agencies. These agencies uses advisory committees extensively to advise in the policy making process. Many federal departments and agencies have overarching advisory committees. Examples of government departments that operate such committees include (Stine, 2008) and (Glynn et al, 2003):

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- The Food and Drug Administration, which has approximately 50 advisory committees;
- The National Institutes of Health, which has approximately 140 advisory committees and undertake a diversity of advisory, assessment, review and evaluation tasks;
- The Department of Defence, which has a Defence Science Board; and
- The Environmental Protection Agency, which has a Science Advisory Board.

Federally Funded Research and Development Corporations (FFRDCs) are not-for-profit organisations funded by a federal government agency. These bodies are administered through a contract with the sponsoring agency. In the USA, the Department of the Environment and the Department of Defence sponsor the majority of these organisations. In May 2007, 38 FFRDCs was in existence. These bodies are tasked with performing independent research and providing advice to the federal government (Stine, 2008).

4.2.9.3 Science advice to the Legislature

In the USA, the hearings of the legislative committees are usually open to the public. The rational behind this is an attempt to obtain information and opinions on proposed legislation as well as to evaluate the activities of a government department or implementation of federal law. In congress, as is the case in the Executive Branch, the management of science and technology issues is scattered across many different organisations (Kelly, 2004). The three major organisations reporting directly to congress are the *General Accounting Office* (GAO), the *Congressional Budget Office* (CBO) and the *Congressional Research Service* (CRS) (Kelly, 2004).

The CRS is one of the most important sources of science advice (CRS, 2008). “The CRS serves as shared staff to congressional committees and Members of Congress. CRS experts assist at every stage of the legislative process from the early considerations that precede bill drafting, through committee hearings and floor debate, to the oversight of enacted laws and various agency activities. CRS has nearly 700 employees. This team, working in Washington, D.C., includes more than 450 policy analysts, attorneys, information professionals and experts in a variety of disciplines. Although the CRS does prepare some self-initiated reports on frequently requested topics, most of its work is done in response to short turn around requests for factual information. The CRS does not make policy recommendations and does not produce detailed analysis requiring extensive input from external experts” (Kelly, 2004).

In the USA, the *Office of Technology Assessment* (OTA) was created in 1972 because of an opinion expressed by the legislative branch that it was not obtaining appropriate advice regarding complex technical matters. Of the 200 staff members of the OTA, 88% had advanced degrees, including 54% with PhDs in relevant fields. As the need arose, the staff would be supplemented with outside panels of experts. “The studies undertaken by the OTA typically took from 18 to 24 months to complete, cost roughly $500,000 each, and were generally well received. Through the OTA, Congress was provided with immediate expert advice and with a body that would provide appropriate witnesses for hearing testimonies” (Kelly, 2004).

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On the political side, OTA was governed by the *Technology Assessment Board* (TAB), comprising six representatives and six senators, divided evenly between the two parties. On the expert side, OTA was advised by the *Technology Assessment Advisory Council*, comprising ten expert members of the public appointed by the TAB, the comptroller general, who heads the General Accounting Office, and the director of the CRS.

TAB exercised formal control over OTA's analytical agenda and remained engaged over OTA's history (Guston, 2001). The OTA was abolished in 1995. The public rationale for the abolishment of the OTA was congressional cost saving (Kelly, 2006). The OTA is regarded to have been an extremely successful organisation in terms of the provision of science advice. For this reason, there have been multiple calls for the reinstatement of the OTA (Kelly, 2004), (Kelly, 2006).

4.2.9.4 Other sources of science advice

In the USA, the *National Academy of Sciences* (NAS), *National Academy of Engineering* (NAE), *Institute of Medicine* (IOM), and *National Research Council* (NRC) form part of a private, non-profit institution that provides science, technology and health policy advice to the USA government. The four organisations are collectively referred to as the National Academies (NRC, 2008). Its operating arm, the NRC, conducts most of the National Academies' science policy and technical work. "The Academies are non-profit organisations, which provide a public service by working outside government framework to provide independent advice on matters of science, technology, and medicine" (NRC, 2008).

The results achieved through the academies' work have inspired some of the USA's most significant and lasting efforts to improve the health, education and welfare of the population (NAS, 2008). The NRC, on behalf of the National Academies, produces roughly 600 reports, workshops and roundtables per year.

The National Academies have taken over a significant portion of the analysis burden borne in the past by other organisations that have either been downscaled or used poorly. The academies are now performing many of the tasks that the OTA once carried out (Kelly, 2006).

A significant number of other bodies in the USA also provide inputs into policy development (Stine, 2008). These bodies include:

- Policy institutes or think tanks;
- Public and individual opinion leaders;
- Professional organisations and disciplinary societies;
- Universities and colleges;
- Advocacy, special interest or action groups;
- Industry and trade organisations; and
- Labour.

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4.3 Summary

The following sections provide a brief summary and comparison in tabulated format of the analysis of the science advisory structures performed in this report.

Table 8 highlights a number of similarities in the Nordic countries pertinent to the analysis. The discussion below serves as an extraction of the main points drawn from the analysis:

- The committee system seems to play an important role in Denmark, Finland and Sweden. It is common for ministries or the cabinet to form committees as new issues come onto the agenda;
- Compared to Denmark, the committee system seems to be relatively formalised in Finland and Sweden;
- There is evidence of a large number of permanent councils and committees in the Nordic countries under review;
- Although ad hoc committees play an important role in all three countries under review, the number of ad hoc committees in Denmark is relatively small compared to Sweden and Finland;
- Sweden has witnessed a number of changes in terms of the development of committee reports. This has given rise to an increase in one person committees in an attempt to speed up the process;
- The referral system, which is based on the concept that committee reports are forwarded to governmental and non-governmental bodies for review, is one of the main mechanisms used in Nordic countries to gain inputs on committee reports;
- Research councils seem to play an important role in Finland and Denmark, where these councils perform a large percentage of public research. In Denmark, research councils are responsible for 25% of public research; and
- In Finland, members of parliament employ hearings to gain advice on science and technology issues from different role players in the system.

Table 9 compares the scientific advisory bodies of the Commonwealth countries studied in this report, whereas Table 10 compares the scientific advisory bodies of the USA, Japan and Germany.

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Table 8: Summary of Nordic countries considered

	Finland	Sweden	Denmark
Advice to the highest level	• The Science and Technology Policy Council of Finland is chaired by the Prime Minister and advises the Council of State and ministers. • The STPC is responsible for the strategic development and co-ordination of Finnish science policy and the National System of Innovation as a whole (STPC, 2008).	• Two important mechanisms through which science advice enters the system are (Glynn et al, 2003): o Committee system: The minister on behalf of the cabinet appoints a committee to deal with an issue; and o Referral system: The committee reports are distributed to government and NGOs for review. • Due to a general push for higher speed policy making, one-man committees are becoming more common in Sweden (Glynn et al, 2003). • National agencies and boards play an important role in providing scientific advice and are important nodes in informal networks of advice • Few permanent bodies deal explicitly with scientific advice (Glynn et al, 2003). • Compared to Finland and Denmark, sectoral research institutes play a limited role (Glynn et al, 2003).	• Ad hoc committees play an important role in providing scientific advice for the policy-making process (Glynn et al, 2003). • Compared to Sweden and Finland, Denmark has a lower number of ad hoc committees. • The committee system is not as formalised as in Finland and Sweden (Glynn et al, 2003). • The referral system is also not as institutionalised as in Finland and Denmark (Glynn et al, 2003). • Denmark has a large number of permanent committees and councils with advisory functions. • The research councils and research institutes fulfil an important function in the development of science advice to government (Glynn et al, 2003). • Research institutes produce approximately 25% of total public sector research in Denmark (Glynn et al, 2003). • Informal networks and temporary working groups play an important role in providing science advice to government.
Ministerial arrangements for advice	• The committee institution plays an important role in the provision of science advice to government in Finland (Glynn et al, 2003). • The responsible minister appoints ad hoc committees if new issues come onto the agenda. • Ad hoc committees draw mostly on the expertise of their members. • There are also a large number of permanent committees and councils in Finland (Glynn et al, 2003).		
Advice to the Legislature	• Members of parliament make use of hearings to gain information from different role players. • There are some examples of parliamentary committees. The Committee of the Future is an example of a committee working with future studies and technology assessments.		
Other advisory structures	Sectoral research institutes play an important role as a provider of scientific research in the Finnish system.		

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Table 9: Summary of Commonwealth countries considered

	UK	Australia	Canada
Advice to the highest level	• The Council for Science and Technology (CST) advises the head of state on strategic issues that cut across the responsibilities of individual government departments (CST, 2008). • The Chief Scientific Adviser (CSA) is the head of the Office of Science and Technology, which is located within the Department for Innovation, Universities and Skills. • The CSA provides science advice directly to the Prime Minister, the cabinet, the Secretary of State for Trade and Industry, and the Minister for Science. • The CSA is responsible for reviewing the entire research system and sits on virtually every important committee and advisory, for instance the CST.	• The Australian government's Science and Innovation Committee of Ministers is chaired by the Prime Minister. • The Prime Minister's Science Engineering and Innovation Council (PMSEIC) provides independent advice on major scientific challenges. • The Chief Scientist provides advice that is current and covers the fill spectrum of science, technology and innovation. • The Office of the Chief Scientist provides support to the Chief Scientist. • The Coordination Committee on Science and Technology (CCST) provides a whole of government co-ordination mechanism and complements the work of the PMSEIC (CCST, 2008). • The Commonwealth, States and Territories Advisory Council (CSTACI) has the Chief Scientist as well as the sate counter parts as members and provides the government with an avenue to brief state and territories on science policy.	• The Science Technology and Innovation Council (STIC) is an advisor body that provides the Canadian government with external policy advice on science and technology issues (STIC, 2008). • The Assistant Deputy Ministers Committee on Science and Technology is the whole-of-government co-ordinating committee for science-based departments and agencies (Erawatch, 2008). • It was announced early in 2008 that the Canadian National Science Adviser post will be phased out.
Ministerial arrangements for advice	• Departmental Chief Science Advisers (DCSA) have been appointed in the majority of government departments (BERR, 2008) • Methods followed in government departments to obtain advice	• Examples of science advisory bodies on government departmental level exist. o The Defence Science and Technology Organisation (DSTO) is part of Australia's Department of Defence. The	• Advisory structures are organised along the lines of departmental and ministerial responsibilities • Canada has a system of Departmental Science Advisory Bodies located in Agriculture and Agri-Food Canada, the Department

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	UK	Australia	Canada
	(Glynn et al, 2003): o Department's own research programmes o Non-Departmental Public Bodies play major role in science advice to Ministries o Executive Agencies	DSTO delivers expert, impartial advice and innovative solutions for defence and other elements of national security.	of Fisheries and Oceans, Natural Resources Canada, Environment Canada, the Canadian Institutes of Health Research, Health Canada, the Canadian research councils (Glynn et al, 2003).
Advice to the legislature	• House of Commons Science and Technology Committee examine the expenditure, administration and policy of the Office of Science and Innovation and associated bodies (CSCT, 2008) • House of Lords Science and Technology Committee investigate activities across the whole range of government (HLSTC, 2008) • POST is an independent office within parliament serving as the UK parliament's in-house source of independent balanced and accessible analysis (GOST, 2008)	• Parliamentary committees are established by one or both houses of Federal parliament to scrutinise and assess government activities, legislation, policy and administration (Thorburn 2005). • The Standing Committee on Science and Innovation is one of thirteen general-purpose investigatory committees established by the House of Representatives of the Parliament of Australia (SCSI, 2008).	
Other advisory structures	• The National Academies play a scientific advisory role: o The Royal Society provides objective advice to government and policy makers (Royal Society, 2008); and o The Royal Academy of Engineering engages in the process of policy development on issues that have an engineering dimension (Royal Academy of Engineering, 2008).	• The Australian Academy of Science provides independent science advice to the Australian government. • The Academy has published many reports on public issues, such as national research policy setting, stem cell research, human cloning, pesticides, ecological reserves, food quality, genetic engineering, space science and climate change.	• The Council of Canadian Academies provides in-depth independent expert assessments (CCA, 2008). • The primary objective of the council is to provide Canada with an independent and authoritative way to build public confidence that policy and regulatory decisions are being based on broadly accepted scientific knowledge and evidence.

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Table 9 provides a summary of the Commonwealth countries (Australia, Canada and the UK) considered in this report. Although there are quite a number of differences in these systems, the following similarities have been identified:

- All three Commonwealth countries under review have councils that advise government at the highest level on science and technology policy issues:
  - In the UK, the *Council for Science and Technology* (CST) advises the Prime Minister on strategic issues that cut across the responsibilities of individual government departments;
  - In Australia, the *Prime Minister's Science, Engineering and Innovation Council* (PMSEIC) provides advice to government on major scientific challenges; and
  - In Canada, the *Science, Technology and Innovation Council* (STIC) provides the Canadian government with external policy advice.
- The position of Chief Scientist:
  - The position of Chief Scientist has been discontinued in Canada;
  - The Chief Scientist plays an important role in the development of science policy in the UK and Australia. The Chief Scientists sit on a number of councils and boards tasked with the development of policy and are responsible for reviewing the entire research system; and
  - The OCS provides support to the Chief Scientist in Australia and the UK.
- Departmental SABs:
  - Departmental Chief Scientific Advisers (DCSAs) have been appointed in the majority of government departments in the UK;
  - A number of Advisory Non-Departmental Public Bodies have been created in the UK to provide government departments with science advice. An example of such a body is the *Defence Scientific Advisory Council*, which provides advice to the Secretary of State of Defence on matters concerning the Ministry of Defence;
  - Australia also has a number of SABs that have been created on government departmental level. An example of such a body is the Defence Science and Technology Organisation; and
  - Canada has a system of Departmental Science Advisory Bodies located in government departments.
- Science advice to the Legislature:
  - The Legislature in the UK is provided with science advice through the *House of Commons Science and Technology Committee*, the *House of Lords Science and Technology Committee* as well as the *Parliamentary Office of Science and Technology* (POST) which is an independent office within parliament serving as the UK's in-house source of independent advice; and
  - In Australia, the houses of federal parliament establish parliamentary committees to scrutinise and assess government activities, legislation and policy. The Standing Committee on Science and Innovation (SCSI) is one of these committees.
- In all three the Commonwealth countries considered, the Academies of Science seem to play an important role in the provision of science advice to government.

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Table 10: Summary of the USA, Germany and Japan

	USA	Japan	Germany
Advice to the highest level	• The Office of Science and Technology Policy (OSTP) is uppermost body for science advice to the president. • The President's science adviser is director of the OSTP. • Functioning under OSTP are two important bodies namely, PCAST and NSTC. • PCAST advises the President on matters involving science and technology. It also assists the NSTC in securing private sector involvement in its activities (PCAST, 2008). • The NSTC is a cabinet level council with the principal means within the executive branch to co-ordinate science and technology policy (NSTC, 2008).	• CSTP exists within the Cabinet Office as one of the Japanese government's top councils. • The CSTP develops general policy and has a number of expert committees that review specific areas of Japan's science and technology governance (CSTP, 2008).	• The German Minister of Education and Research implemented the Innovation Council. The advice from this council is a basis for the minister's decisions in research policy. The council provides advice to the minister and cabinet (TSAS database, 2003). • Germany has thematic high-level advisory bodies that span across ministries and report directly to cabinet or to inter-ministerial committees (Glynn et al, 2003).
Ministerial arrangements for advice	• The use of advisory committees on the government departmental level is extensive. Examples include (Stine, 2008): o The Department of Defence has a Defence Science Board; and o The Environmental Protection Agency has a Science Advisory Board. • There exist Federally Funded Research and Development Corporations sponsored by agencies of the federal government.	• All ministries may constitute committees, working groups and commissions that examine specific science and technology issues (Glynn et al, 2003). • There are more than 200 of these committees, which are distributed across the entire rage of science and technology relevant departments (Glynn et al, 2003). • Advice may also be sourced from national laboratories under the guidance of ministries and departments (Glynn et al, 2003).	• In the German system, dominant modes of advice are contract research, departmental research institutes and ministerial advisory bodies (Glynn et al, 2003). • All ministries, except for the Federal Ministry of Education and Research, have their own departmental research institutes. These departmental research institutes deliver ad hoc analysis on demand as well as independent basic research (Glynn et al, 2003). • In addition to the departmental institutes and agencies, many ministries have statutory scientific councils, which could play the role

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	USA	Japan	Germany
			of general policy adviser. • There are numerous ad hoc expert groups. A number of these groups are inter-ministerial while others are responsible for selected issue areas within a ministry (Glynn et al, 2003)
Advice to the Legislature	The following three major organisations reporting directly to congress are (Kelly, 2004): • The General Accounting Office (GAO); • The Congressional Budget Office (CBO); and • The Congressional Research Service (CRS).		• The German parliament (*Bundestag*) has a differentiated internal advisory system known as the Scientific Service. • This service provides scientific advice and information on demand. The advice and information is, however, also distributed pro-actively through newsletters. • Apart from the permanent structure of the Scientific Service, there are also joint 'Enquete-Commissions'. • Enquete-Commissions are mostly proposed by the parliamentary committee in charge of the issue at stake and are approved by parliament.
Other advisory structures	• There is a high density of 'other sources of advice', for instance think tanks, in the academic sector. • The NRC produces roughly 600 reports, workshops and roundtables per year on behalf of the National Academies.	• The Science Council of Japan (SCJ) is attached to the Prime Minister's office. • The SCJ represents 80 000 scientists and has 2 000 members with roughly 210 council members. • The main task of the SCJ is to provide advice to government on a reactive or proactive basis.	Ad hoc and permanent structures co-exist. Unlike in various other countries, there are generally no issue-oriented intermediary structures that organise advice and research. Each level of government has its own structures (Glynn et al, 2003).

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Table 10 provides a summary of the remaining three countries considered in the analysis, namely the USA, Germany and Japan. The following is a brief overview of the science advisory structures that exist in each of the countries:

- As with the previous examples considered, that is, the Nordic and the Commonwealth countries, the USA, Germany and Japan have high-ranking advisory bodies for the provision of science advice to the head of state:
  - In the USA, there are a number of bodies that provide advice to the President and cabinet. The most important of these bodies advising the President is the *Office of Science and Technology* (OSTP), the *National Science And Technology Council* (NSTC) and the *President's Council of Advisors on Science and Technology* (PCAST);
  - In Japan, the *Council for Science and Technology Policy* (CSTP) exists within the Cabinet Office as one of Japan's top councils. The CSTP develops general policy and has a number of expert committees that review specific areas of Japan's science and technology governance; and
  - In Germany, the *Innovation Council* is a high-ranking advisory council to the Head of State and the Minister of Education and Research.
- Evidence of arrangements for science advice on the government departmental level also exists for all three these countries under review:
  - In the USA, extensive use of the advisory committees on the government departmental level exists;
  - In Japan, all ministries may constitute committees, working groups and commissions that examine specific science and technology issues; and
  - In Germany, all ministries, with the exception of the Federal Ministry of Education and Research, have their own departmental research institutes. These departmental research institutes deliver both ad hoc analyses on demand as well as independent basic research.
- Advice to the Legislature:
  - In the USA, the *Congressional Research Service* (CRS) serves as a shared staff to congressional committees and members of congress; and
  - In Germany, parliament has a differentiated internal advisory system known as the Scientific Service. This is a permanent entity that exists within the structures of parliament.
- In the USA, there is a high density of other sources of advice, for instance think tanks. The academic sector is also very active.

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Chapter 5
Conclusion

Concluding from the analysis of the individual country summaries, it is clear that there are many similarities in the structures that provide science advice to government. It is, however, also imperative to note the number of country specific differences. Many of the countries' science advisory structures exhibit a hierarchical system. This finding was also evident from the study conducted by Glynn et al (2003) on 20 EU countries.

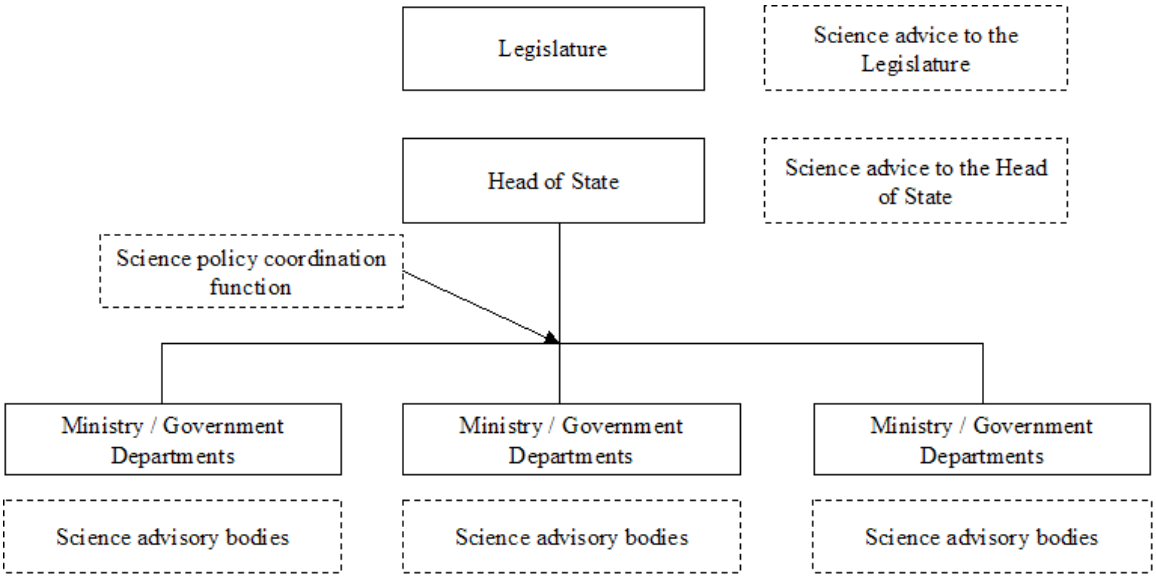

Figure 12: General structure of science advice

Hierarchical structure of the science advisory systems

The science advisory systems under review typically comprise one or two advisory groups at the highest level. Many of these bodies have a broad focus dealing with science and technology issues in general, for instance:

- In Australia, the *Prime Minister's Science Engineering and Innovation Council* (PMSEIC) advises the Prime Minister;
- The *Science and Technology Policy Council* of Finland is chaired by the Prime Minister and advises the Council of State and Ministries on important matters concerning research and technology;
- In Japan, the *Council for Science and Technology Policy* (CSTP), which is source of science and technology advice to the Prime Minister and cabinet, is located in the Cabinet Office. The CSTP is one of the top councils in Japan. The council develops general policy and also has a number of expert committees that review specific areas of Japan's science and technology governance;
- In the UK, the CST advises the Prime Minister on strategic issues that cut across the responsibilities of individual government departments; and
- In the USA, the President draws on a number of mechanisms for scientific advice.

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These mechanisms include the *Office of Science and Technology Policy* (OSTP), the *National Science and Technology Council* (NSTC) and the *President's Council of Advisors on Science and Technology* (PCAST).

In most instances, bodies also function on the next level. Ministries and government departments seek advice either through groups of internal experts or from agencies and other bodies that report to them. Further down the hierarchy of government, advisory structures are organised along the lines of departmental and ministerial responsibilities (Glynn et al, 2003).

The Chief Scientist

Out of the countries considered in this analysis, Australia and the UK employ a Chief Scientist to provide science advice and oversee the science and technology system. This position also existed in Canada, but it was discontinued early in 2008.

In Australia and the UK, the Chief Scientist's post is located in the government department responsible for science policy. In Australia, this post is located in the Department of Innovation, Industry, Science and Skills. In the UK, the post is located within the Department for Innovation, Universities and Skills. As Canada does not have a government Department for Science, this role was located in Industry Canada before its discontinuation.

Departmental Chief Scientists

The role of Chief Scientists does not only exist at the highest level. Canada has a system of Departmental Advisory Bodies located in science-based departments. A number of these departments also have Chief Scientists. Health Canada is an example of a government department with a Chief Scientist. This is also the case in the UK, where Departmental Chief Scientific Advisers (DCSA) have been appointed in the majority of government departments. The role of the DCSAs is to ensure the quality of scientific advice within the departments. The above endeavour forms part of the wider drive in the UK for evidence-based policy and improved service delivery.

Ad hoc committees

It is evident from the analysis in this report that ad hoc committees play an important role in the provision of science advice to government.

In Denmark, ad hoc committees play an important role in providing scientific advice into the policy development process. This also holds true for the other Nordic countries considered in this report, Ad hoc committees are appointed as new issues come onto the agenda or if a new piece of legislation has to be prepared.

Science advice to the Legislature

Evidence exists of science advisory mechanisms that have been implemented to provide parliament with needed advice:

- In Australia, parliamentary committees are established by both houses of parliament

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to scrutinise and assess government policies, legislation, policy and administration;
- In Finland, parliament employs hearings to gain information from different role players;
- German parliament (*Bundestag*) has a differentiated internal advisory system known as the 'Scientific Service'. This service is a permanent entity that exists within the structures of parliament. Germany also has Enquete Commissions, comprising members of parliament, scientific and industrial experts. These commissions are formed after being proposed by the parliamentary committee in charge of the issue at stake;
- The *Parliamentary Office for Science and Technology* (POST) is an independent office within the UK parliament serving the interest of both the House of Lord and the House of Commons. POST is the UK parliament's in-house source of independent, balanced and accessible analysis of public policy issues related to science and technology. A number of Select Committees in the UK consider science, engineering and technology issues. These committees include the Select Committee on Environment, Food and Rural Affairs, the Trade and Industry Select Committee and the Select Committee on Agriculture, Defence, Education and Skills; and
- In the USA, one of the most important sources of science advice to congress is the *Congressional Research Service* (CRS). The CRS serves as shared staff to congressional committees and members of congress. The CRS employs more than 450 policy analysts, attorneys, information professionals and experts across a variety of disciplines. Although the CRS does prepare a number of self-initiated reports, most of its work is done in response to short turn-around requests for information for congress.

The role of the Academy of Sciences

From the analysis performed, it is also evident that Academies of Science play an increasingly important role in the provision of science advice to government:

- In Australia, the Australian Academy of Science provides independent science advice to the government;
- The Council of Canadian Academies provides science advice to government;
- In the UK, the Royal Society is an important source of independent advice to the government. The Royal Academy on Engineering also plays a role in the process of policy development on issues with an engineering dimension; and
- In the USA, the National Academies have taken over a significant portion of the analysis burden borne in the past by other organisations that have either been downscaled or used poorly. The academies are now performing many of the tasks that the OTA once carried out (Kelly, 2006).

The role of research institutes

Research institutes can play an important role in the provision of analysis and information to government departments:

- In Denmark, research institutes under the auspices of government departments

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perform mission-oriented research. These research institutes produce approximately 25% of the total public sector research, thus playing an imperative role in the provision of science advice to ministries;

- In Finland, research institutes play important roles as providers of scientific research. These institutes do not only play the role as knowledge producers, but also are expert agencies in their policy fields; and
- In Germany, ministries have their own research institutes that provide a number of services to the departments. Research institutes deliver ad hoc analysis on demand as well as independent basic research. The Max Planck Institute and the Fraunhofer Institute are examples of research institutes that play an important role in Germany.

Informal networks

Informal networks can also play an important role in the provision of science advice. Informal networks and temporary working groups play a particularly important role in providing scientific advice in Denmark. In Finland, informal working groups are increasingly replacing more formal committees in preparing political decisions

The referral system

The referral system is a method employed in the Nordic countries under review to strengthen public debate on scientific issues. The system entails the reports published by committees being sent out to governmental and NGOs that are presumed to be affected or who might have an interest in the issue at hand. This process guarantees a relatively open formulation process.

In Sweden, it is compulsory for all relevant public entities to respond to the committee reports received. Referrals are open to the public and are also often quoted in the media.

Co-ordinating bodies

In a number of the countries considered in the analysis, evidence exists of bodies that play co-ordinating functions in terms of science and technology policy:

- Australia has a *Coordinating Committee on Science and Technology (CCST),* which provides a whole of government co-ordination mechanism of departments that fund or undertake scientific activity. Australia also has the *Commonwealth, States and Territories Advisory Council (CSTAC)* which is a platform from which the Chief Scientist of Australia can brief State Chief Scientists on science policy and programmes; and
- In the USA, the *National Science and Technology Council* (NSTC) is a cabinet level council with the principal means within the executive branch to co-ordinate science and technology policy across the diverse entities that comprise the USA federal research and development enterprise.

The ministry for science

Most of the countries considered have a minister responsible for science and

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technology. In many instances, the portfolio is grouped with the Higher Education portfolio.

A number of countries do not have a science portfolio per se, but a Research or Innovation portfolio. France, for example, has a Ministry of Higher Education and Research, while Sweden has a Ministry of Education and Research. The UK, on the other hand, has a Ministry of Innovation, Universities and Skills.

Countries where no science and technology or research-related portfolio exists are the USA, Canada, Slovakia, Belgium, Cyprus, Greece, Hungary, and the Czech Republic. In these countries science and technology is integrated into other government portfolios.

Table 11: Ministries for Science and Technology

Country	Ministry Name
Australia	Ministry of Innovation, Industry, Science and Research
Austria	Ministry of Science and Research
Belgium	-
Canada	-
Cyprus	-
Czech Republic	-
Denmark	Ministry of Science, Technology and Innovation
Finland	-
France	Ministry of Higher Education and Research
Germany	Two separate ministries, namely the Ministry of Education and Research as well as the Ministry of Economics and Technology
Greece	-
Hungary	-
India	Ministry of Science and Technology
Ireland	Ministry of Education and Science
Italy	Ministry of Universities and Research
Luxembourg	-
Japan	Ministry of Education, Culture, Sports, Science and Technology
Netherlands	Ministry of Education, Culture and Science
New Zealand	Ministry of Research, Science and Technology
Portugal	Ministry of Science, Technology and Higher Education
Slovakia	-
Slovenia	Ministry of Higher Education, Science and Technology
Spain	Ministry of Education and Science
Sweden	Ministry of Education and Research
UK	Ministry of Innovation, Universities and Skills
USA	-

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