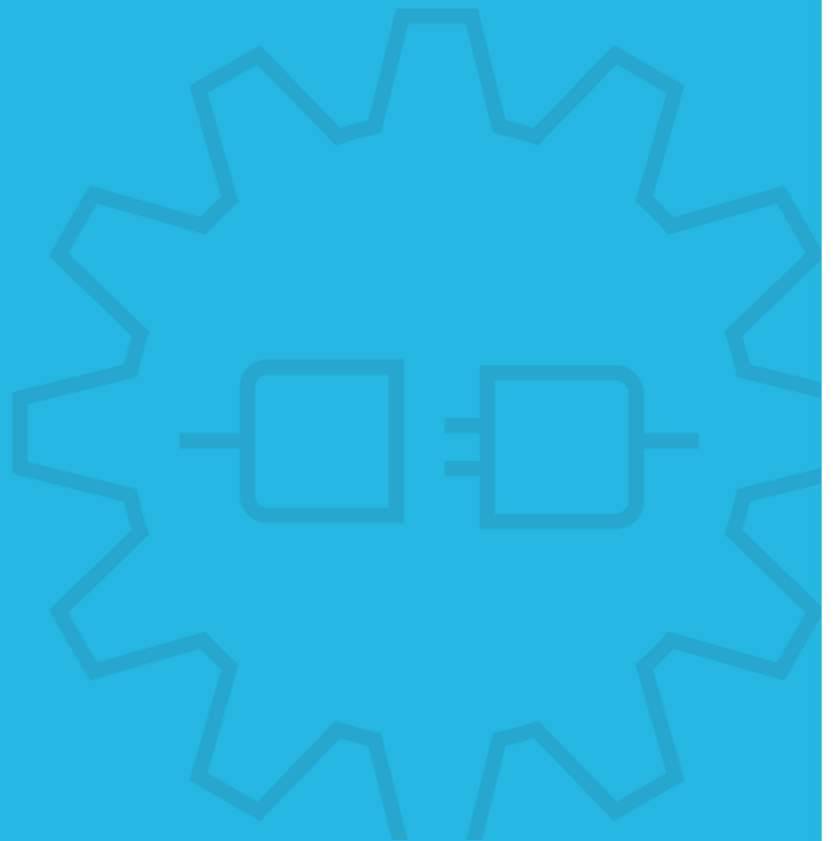




APIS IN GOVERNMENT

MAY, 2019





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Good Policy. Better Canada. The Public Policy Forum builds bridges among diverse participants in the policy-making process and gives them a platform to examine issues, offer new perspectives and feed fresh ideas into critical policy discussions. We believe good policy is critical to making a better Canada—a country that's cohesive, prosperous and secure. We contribute by:

- Conducting research on critical issues
- Convening candid dialogues on research subjects
- Recognizing exceptional leaders

Our approach—called **Inclusion to Conclusion**—brings emerging and established voices to policy conversations, which informs conclusions that identify obstacles to success and pathways forward. PPF is an independent, non-partisan charity whose members are a diverse group of private, public and non-profit organizations.

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INTRODUCTION

Successive Canadian governments have attempted to improve IT and modernize service delivery for Canadians. One major goal of service-delivery modernization is to enable citizens to access and use government services online in a manner that more closely resembles the convenience and ease of use on offer from private sector digital services. But governments have had difficulty achieving this.

Application programming interfaces (APIs) have become a foundational technological component of modern digital architectures, [impacting every sector of the global economy](#). Now considered an essential element of modern digital service delivery, APIs are [“a kind of an infrastructure”](#) and are [“the key to unlocking the digital economy.”](#) APIs have the potential to accelerate and improve digital service delivery, enhance interoperability, facilitate open-data initiatives and allow for the co-creation of digital services between the public and private sectors.

In the private sector, APIs have driven major market disruptions. Netflix’s internal API, which handles two billion requests a day, enabled [Netflix to successfully compete with Blockbuster](#) by quickly developing and packaging new services for different platforms. Amazon Web Services, which offers access to their cloud via APIs, has created a business that could now be worth [\\$400 billion](#). Spotify, the [largest on-demand music service in the world](#), relies on the use of APIs for its business. As of 2019, Spotify had [207 million active monthly users](#) and revenue just under [€1.5 billion](#) for the fourth quarter of 2018.

Governments can learn from and mimic some aspects of these private sector models, benefitting from [economies of scale](#) in supply and demand, [easier interoperability](#), [service innovation](#) and new ways of [using data](#). In the public sector, APIs enable departments and agencies to achieve their aims of opening up government data and modernizing service delivery to citizens. Data and services held in one agency or department can be shared within government—with software developers and even publicly with all citizens—with minimal development effort. For example, in the United Kingdom, the top English-speaking country in the OECD’s [OURdata Index on Open Government Data](#), Her Majesty’s Revenue & Customs has used a model similar to that employed by the Canada Revenue Agency (CRA)—an example we discuss further below—to enable third-party software developers to create products and services that help people [manage their taxes](#). Open APIs provided by the UK’s Department for Environment, Food & Rural Affairs have enabled citizens to [view online flood maps and subscribe to alerts](#) about specific rivers.

When made publicly available, government data can create opportunities for developers to provide useful services. For example, many municipalities make public transportation data available to software developers using APIs. When combined with the location data from an individual’s smart phone, applications can help citizens make travel choices in real time. In addition to enabling access to useful applications, governments provide economic stimulus when they create these opportunities. Transport for London’s policy of working with major IT players (Google, Apple, Waze, etc.), while allowing the data to be available via the [Open](#)

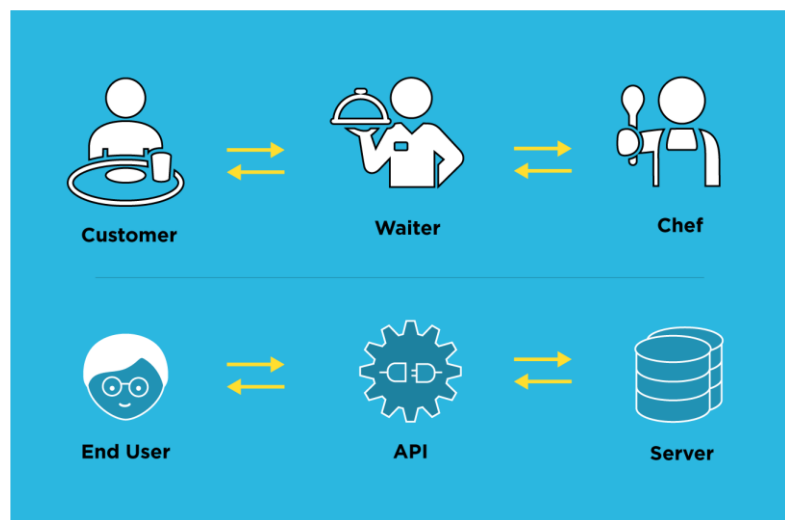
[Government License](#), has led to the creation of additional economic activity exceeding [£100 million](#) of direct value, and has enabled more than [1,000 jobs](#).

Use of APIs enables effective and flexible government operations by automating the exchange of information in real time. This is more effective than [downloading data into a spreadsheet, creating charts and slide decks, and sharing by email](#), as often happens. In the UK, APIs are used for cross-governmental data sharing, but only limited examples exist. To give two, [GOV.UK Notify](#) alerts people on the progress of an application for a government service and [GOV.UK Pay](#) accepts payments from users of government services. Estonia's X-Road system, "[the backbone of e-Estonia](#)", is a far more robust example, where all Estonian departments and private-sector utilities [maintain independent databases](#) but enable other public government institutions to securely access them. And citizens can use [a single password](#) to access all their data—from medical records to insurance history.

In this report, we examine two Government of Canada case studies where APIs have been used to improve service delivery: namely, the development of NETFILE by the CRA; and the EnerGuide API, developed by the Canadian Digital Service (CDS) and Natural Resources Canada (NRCan). Additional insights into APIs were developed during a roundtable discussion where experts from the public and private sectors provided input on what can be learned from each case study.

WHAT IS AN API?

An API is like a waiter at a restaurant. The waiter allows any customer (software application), to request whatever is available from the kitchen (the database). The waiter (API) retrieves the request from the kitchen (database) and delivers it to the customer (software application). As long as the customer receives her meal, she doesn't need to know what is happening in the kitchen. This means new staff can be hired or replaced with ease. Similarly, a software application calling an API doesn't need to know if the database has been upgraded or replaced. APIs provide an efficient way for the software application and the database to work together with minimal disruption stemming from changes to either.



From a technical perspective, an API is a set of functions and procedures enabling the creation of applications that access the features or data of an operating system, application or other service. APIs do not depend on a specific provider's technology platform, instead offering a flexible means of providing a programmable interface between applications. This means APIs can serve different audiences. They enable an application to interact with others in [the following ways](#):

- Accessing or querying the data held by another application;
- Sending data to another application;
- Updating data held in another application; and
- Requesting a service from another application.

APIs also allow control over who gets access to what and what can be modified. By making information available this way, APIs enable those who have access to them to build their own interface for interacting with the data. Using an API, information can flow in both directions. APIs can be read-only, providing information from a database to a software application, or read-write, allowing the database to be updated by a whitelisted set of applications. Public APIs allow information to be freely distributed, private APIs restrict those who have access to the information and hybrid APIs provide access to data with various levels of restrictions.

WHY APIS?

In 2002, Jeff Bezos, CEO of Amazon, took the lead on realizing the benefits of APIs, famously issuing [his "Big Mandate"](#). The essence of the mandate was this: All teams within Amazon were required to share their data and functionality with one another using APIs, no work arounds or back doors allowed. And every API had to be "externalizable"; that is, the APIs had to be designed to be usable by anyone, within Amazon or not.

Bezos' mandate created several advantages for Amazon. APIs made every team within Amazon interoperable; each team's data could be made available to every other team, as well as externally. And because every team was able to work with every other, they did. This created a service-oriented culture within Amazon, with each team focused on making their APIs as easy to use as possible. This shift also created a new source of revenue once the many services created within Amazon became external-facing products available through Amazon Web Services.

Today, many organizations use APIs as a source of revenue. Salesforce.com generates [50 percent](#) of its revenue through APIs. For Expedia.com it's [90 percent](#) and, for eBay, [60 percent](#). Facebook is also a heavy publisher of APIs, allowing anyone to develop products for the Facebook platform. By letting others do the development work and directly address users' needs quickly and effectively, Facebook created the conditions for an entire ecosystem of products to emerge. In the public sector, examples of generating

income from the provision of data are limited. One example is [UK's Ordnance Survey maps](#), which charges clients for digital maps of utility services targeted at a specific location.

The examples of Amazon and Facebook illustrate the power of APIs to open up data and allow third parties to build new products. We live in a networked age in which large, geographically distributed companies using APIs are able to create dramatically better services for their end users. The Government of Canada is also a large, geographically distributed organization that struggles to make data portable across teams and departments. In other words, focusing on APIs is a great first step towards opening up data and improving service delivery to citizens.

LEVERAGING THE POTENTIAL OF APIS

The potential offered by APIs is already being leveraged in the private sector, and there are opportunities to leverage them further within government. The two API case studies we examined above—the development of NETFILE by the CRA, and the development of the EnerGuide API by CDS and NRCan—alongside our roundtable discussions about the cases, offered four key insights for successful API deployment in government.

Enable hybrid co-creation models alongside API deployment

In [a report released in July 2017](#), Treasury Board Secretariat (TBS) summarized its findings after engaging with more than 1,000 individuals in 20 cities across Canada about how the federal government should develop a made-in-Canada approach to digital government. A section of that report is entitled “New Models for Co-Creation” and points out that the federal government has traditionally either “developed technological solutions in-house or procured services” and that “relying too much on either approach has risks.” The report notes that the “advent of open-source platforms and distributed models of collaboration were pointed out as having opened up new possibilities for a hybrid model that enables co-creation between government, civic technology communities and/or start-ups and entrepreneurs.”

The hybrid co-creation model specifically referred to in the report is the CRA's NETFILE program. NETFILE and EFILE are Canada's two electronic tax-filing services, based on APIs, which are maintained by the CRA. NETFILE enables Canadian taxpayers to send their individual income tax and benefit returns directly to the CRA using a NETFILE-certified software product created by a private sector software company. EFILE enables approved tax preparation service providers to submit income tax and benefit returns online on behalf of their clients. During the 2018 tax filing season, 29.7 percent of individuals' income tax and benefit returns were filed using NETFILE. Another 57.6 percent of returns were filed using EFILE. More than 25 million individual returns were filed electronically in 2018—87.3 percent of all returns.

Essentially, the CRA provides an API that allows information to be shared with third-party software companies, moving into and out of CRA's systems. Private sector software firms use the API to create user-friendly tax filing solutions that improve service delivery for Canadians.

The NETFILE program is a huge success. By providing the necessary tools to software companies, the CRA enabled the creation of a competitive market that has resulted in a highly refined user experience across a variety of tax software products. Users of tax software enjoy the following benefits:

- They are less likely to miss applicable deductions and credits. Many products have prompts or other means of reminding users about their potential eligibility.
- They are less likely to make errors. Tax software performs necessary calculations automatically and, if permitted, can automatically fill in your verified personal information.
- They take less time to do their taxes.

Once completed, tax returns can be processed in a matter of seconds. Eligible Canadians receive their Express Notice of Assessment almost instantaneously. Canadians who set up direct deposit receive their tax refunds more quickly.

Each tax season, software companies compete for a fixed market share of tax returns that includes do-it-yourself consumers and professional tax preparers. This highly competitive market continues to drive investment in high-tech sector jobs, and the adoption of new electronic services by the CRA. Our discussions with the CRA revealed that, as more tax filers rely on software solutions, the CRA [benefits from fewer paper returns](#) and higher-quality tax filings. Electronic tax filings are higher quality because they are [less likely to contain errors](#) and, since they seldom require human intervention, are [generally faster to process](#).

Software companies making NETFILE-certified software regard NETFILE as an extraordinary accomplishment. The competitive market that the government enabled by creating opportunities for software developers to work in this space has resulted in diverse tax software products. Less competition would likely have meant higher prices and lower quality or less choice for Canadians.

Every software company we heard from emphasized that the Government of Canada should be actively seeking more opportunities to use this hybrid co-creation model to reduce government costs, improve quality of service, and create valuable opportunities for the private sector.

NETFILE's hybrid co-creation approach could be used to enhance other government services. When they are open and accessible, APIs create the opportunity for governments to support software development without relying on procurement or in-house government development. They do not require the government or a private company to define a single response to a digital service-delivery opportunity. Anyone can take

the information or functionality offered by an API and use it in their own software applications. Those software applications can then compete for market share, potentially on the basis of customer satisfaction. Nobody needs to define, in advance, the “right” or “best” solution.

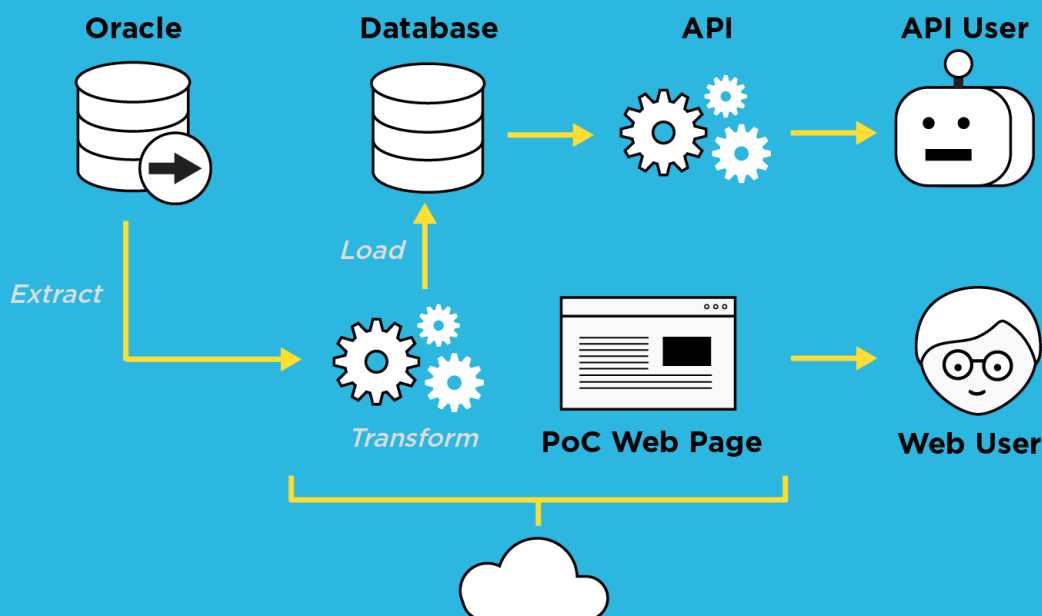
For the model to work, government needs to identify opportunities to collaborate with the public—and enable third parties to use government data to create new services or enhance existing ones for Canadians. Where can third parties help solve the pain points for Canadians trying to access government services?

Use APIs to overcome legacy system limitations

The enterprise architecture within many large organizations can resemble a technological “Frankenstein”—a range of legacy technologies cobbled together to work with modern systems. This is the result of continuous technology adoption alongside a dependence on legacy systems. It can be extremely difficult to move away from legacy systems within an enterprise architecture, and this creates complications and restrictions for IT modernization.

Rather than replace legacy systems or create custom code for point-to-point integration, organizations can create APIs that will bridge to the data in a legacy system. When APIs are managed responsibly, they protect the integrity of other systems, enable secure and governed access, deliver insight into how data is used and accelerate developer productivity. By allowing new systems easy access to the data in a legacy system, it becomes much easier to modernize the entire system and overcome the limitations imposed by legacy infrastructure.

The plan CDS developed in partnership with NRCan to make EnerGuide data available via an API, is a good example. When building the EnerGuide API, CDS chose a solution that separated their API from the legacy database; they used an extract-transform-load pipeline. Data is extracted from the legacy database, transformed into a standard format, and loaded into a separate database. By using this pipeline, the API can continue to run when the legacy database needs maintenance and when the legacy database is eventually replaced.



CDS'S DESIGN

Caption: The extract-transform-load pipeline provides data in a standardized format to a modern database that the EnerGuide API interacts with directly. Anyone can use the API to develop applications that require home energy rating data. NRCan can now use the API to build a web page that allows web users to easily search for home energy rating data, as CDS did with their proof of concept web page early in the project-development process.

Know your users, focus on their needs and build trust

A common theme that emerged in both case studies was the difficulty the CRA and CDS had identifying and understanding the users of the NETFILE program and the EnerGuide API.

In their [own reflections](#) on the EnerGuide API project, CDS highlighted the importance of co-locating with its partner, NRCan. CDS and NRCan took turns co-locating in one another's offices. Although co-locating was part of the build phase and accelerated that phase significantly, it is important to note that it was also an effective tool for conducting user research. CDS was quickly able to identify various problems, learn directly from NRCan, and tailor its capacity building to meet various challenges as they arose. It is true of any project that many questions do not arise until you roll up your sleeves and do the work.

A key lesson that CDS identified was the need to do more to understand the potential range of users for an API during the user-research phase of a project. Within government, development teams need to identify and communicate with the actual users of the data being opened up and services being created. To help conduct user research, NRCan provided CDS with a list of federal, provincial, territorial and municipal government contacts who were part of a working group on mandatory labelling and disclosure of building energy use. This working group had formed to develop a harmonized approach to supporting mandatory

labelling and disclosure related to home energy use with the goal of helping Canadians make more informed decisions when purchasing a home. This working group was a good first step to reaching those in various levels of government who directly use home energy data.

Focusing on the user is a first principle of high-quality service delivery. Designing with users is among the [standards set out by TBS](#). This user focus should be relentlessly pursued. That relentless pursuit was reflected in another of CDS's lessons from this project: "No design decision is too small for usability testing." To ensure the EnerGuide API could be used effectively, a proof of concept web page was built to allow users to interact with and test the tool. The insights from this testing were extremely valuable for informing the design.

Some of these insights were also reflected in the NETFILE example. According to software companies working with NETFILE, software design must always be informed by user testing.

Talking to users and identifying their needs is crucial for the successful design and deployment of APIs. Two-way interactions with third-party software developers who are API users are essential for information and feedback. By providing information about project goals, legal and technical limitations, and other details, relationships of trust can be established with developers while also empowering them to provide feedback that is as useful as possible.

Use APIs to support open data

Open data is an important element of the Government of Canada's [Open by Default Pilot](#), [4th Plan on the Open Government \(2018–2020\)](#) and [Strategic Plan for Information Management and Information Technology \(2017–2021\)](#). Public APIs can play an important role in realizing the goals of open government by making data publicly accessible in modern, structured, more readily usable ways.

Providing open data is not about simply releasing data. The data must be presented in ways that make it useful and beneficial to all Canadians. APIs offer innovators the ability to do this, as exemplified in the NETFILE and EnerGuide examples. In both cases, the aim was to create platforms so government data could be accessed and used by third parties and Canadian citizens. The open nature of APIs, as evidenced by the NETFILE example, also creates an environment for third parties to develop and maintain high-quality services that use open data. In some cases, there is no need for government to build services; third parties can do the work when the right data is made available. When shared externally, APIs can create entirely new marketplaces of online services.

By making APIs reusable and discoverable publicly—or even just within government—others can use APIs to address their own needs and adapt to changing needs. Ensuring that APIs are interoperable can also increase organizational efficiency when they are shared internally. In fact, TBS has updated its [Directive on](#)

[the Management of Information Technology](#) to require open standards and solutions by default as well as certain measures to enable interoperability.

CONCLUSION

The NETFILE and EnerGuide case studies illustrate the immense potential of APIs to help governments develop services that meet their end-users' needs. TBS is aware of this potential and [has put in place standards](#) as well as mandatory procedures for APIs in its [Directive on the Management of Information Technology](#) to promote their proper implementation. When combined with co-creation models, the deployment of APIs can also allow governments to create platforms that give rise to new private sector markets, free up government resources and increase the flexibility of government service delivery.

Through the two case studies, and a series of roundtable discussions, we identified four key criteria for successful deployment of APIs within government:

- 1. Know your users, focus on their needs and build trust.**

Fully understand who your user(s) are and their needs to ensure that the API(s) being developed can be of use to them.

- 2. Enable hybrid co-creation models alongside API deployment.**

Create an environment for external partners, such as the private sector, to develop a range of alternative service-delivery models.

- 3. Use APIs to overcome legacy system limitations.**

APIs can be used to create bridges between legacy and modern systems, overcoming the limits of legacy systems and helping to speed up their eventual retirement.

- 4. Use APIs to make government data more accessible.**

The use of APIs can be a more effective means of opening up structured data inside and outside of government.

The benefits of using APIs are clear and the private sector is already leading the way. There are some other good examples in government of API development, including Health Canada's open data API for federal recalls related to food, medical products, consumer products and vehicles. There may be numerous opportunities to expand the use of APIs as the government looks to open up government data and improve service delivery for Canadians.

