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Industrial policy imitation: the perils of matching the US Inflation Reduction Act to attract battery plants

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Abstract: Implementation of the US IRA in 2022 significantly changed the practice of automotive-related industrial policy in the USA. We scrutinise its influence on a third country, Canada, where, in response to the IRA, more than CAD 42 billion has been committed to secure three battery plants with a value of CAD 19 billion. The purpose of our research is to determine if the incentive packages offered by the Canadian Government were truly necessary to secure the investments and if Canada can expect benefits comparable to those that similar support would engender in the USA, where the IRA was conceived. Based on our analysis, Canada's obligation to provide substantial incentives do not guarantee benefits on par with those of a core automotive country. Hence, as a semi-peripheral automotive nation, Canada's three new battery plants are unlikely to produce core country-like results, raising doubts about the effectiveness of Canada's strategy.

Keywords: industrial policy; automotive; battery plants; Inflation Reduction Act; IRA; Canada, USA.

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1 Introduction

It is well-established that industrial policy is back in favour as a tool to address challenges like declining manufacturing sectors, technological disruption, and geopolitical competition, a development that has been captured in academic literature (see Bailey et al., 2019; Irwin, 2023; Schneider, 2023), grey literature (see Bernstein, 2020; Kalish and Wolf, 2023; Siripurapu and Berman, 2021), and by the media (see Wherry, 2023; Friedman, 2023; Piotrowski, 2022). Although countries have long employed aspects of industrial policy, whether by providing subsidies, tax breaks, or loans, issuing targeted regulations, or providing other support to companies and sectors, there can be no question that industrial policy is experiencing a period of renewed visibility. Indeed, reliance on the tools of industrial policy is now expanding across the economic spectrum in both developing countries (e.g., the Make in India program, Indonesia's Commodity Downstreaming Policy, and Malaysia's Master Industrial Plan) and developed economies (e.g., the German Industrial Strategy 2030, Japan's New Capitalism Program, and South Korea's multi-pronged ambition to become the world's top producer of semiconductors). The much-discussed renaissance of industrial policy aside, the truth is that the concept of governments intervening in the economy to engender outcomes that would not occur in the absence of such intervention (Pack and Saggi, 2006) has never truly gone away.

The enduring relevance and deployment of industrial policy is particularly true in the global automotive industry, a state of affairs explored in a range of disciplines over a significant duration and in a wide geographic range. These include, for example, fields as diverse as business history (e.g., Anastakis, 2004, 2024; Mordue, 2007, 2019), geography (see Holmes, 2004, 2023; Klier and Rubenstein, 2022a, 2022b; Pavlínek, 2018, 2020, 2022), economics (Gereffi and Fernandez-Stark, 2016; Helper and Munasib, 2022) and political science (see Wolfe and Lemphers, 2023). The crucial discrepancy, however, is

that this research was based primarily on data accumulated when industrial policy measures were significantly less extensive and less expensive than recent measures.

Critical in that regard – and the focus of this research – is the US Inflation Reduction Act (IRA). Passed in 2022, aspects of the IRA have upended the most visible methods of automotive industrial policy: industrial subsidies. Before the IRA, the most generous of firm-specific industrial policy-related incentive packages tended to have a ceiling of 30% of the capital cost of a new project, generally no more than USD 1 billion (see Jacobs, 2024). However, the IRA's advanced manufacturing tax credit has had the effect of transforming standard practice. The IRA offers production incentives of up to USD 45 per kWh for the automotive industry for battery cell and module assembly. The effect: large-scale automotive industry capital investments that pre-2022 might have generated government investment incentives of several hundred million dollars now yield incentives comparable to pre-2022 levels plus US IRA production tax credits of several billion dollars more. As this paper will show, over the next few years, in return for their investments in battery plants, many firms will receive government incentives that exceed the capital costs of those plants.

Understandably, the IRA will profoundly affect the US automotive industry (Slowik et al., 2023). Additionally, jurisdictions outside of the USA are now also under pressure to enhance their own industrial policies to remain competitive with the IRA, implementing or considering the implementation of similar tax credits or incentives to attract investment in their own battery and electric vehicle (EV) industries (Bown, 2023; Kleimann et al., 2023). The purpose of this research is to contribute to that discussion via a case study of the effect of this policy on Canada's automotive industry, describing the financial incentives used by governments in Canada to attract battery manufacturing plants for EVs and assessing the effectiveness of those incentives.

Our work is based on two research questions. First, were governments in Canada obliged to match US IRA-type incentives to gain these investments? In answering that question, we demonstrate the outsized role played by industrial policy in the form of direct financial incentives. We also argue that other factors pointed to by Canadian policymakers as the rationale for selecting Canada as an investment location proved to be uncompelling. These factors encompassed assurances regarding Canada's reservoir of critical minerals, the caliber of its workforce, and the accessibility of environmentally sustainable electricity sources.

Answering our second research question is critical to non-US locations: can countries like Canada expect benefits comparable to those that similar support would engender in the USA, where the IRA was conceived? While we show that other countries can mimic US investment attraction policies, we argue that countries like Canada are unlikely to replicate the benefits. We answer this by drawing from research that classifies automotive countries into categories that include *core* automotive countries, which host global automaker headquarters, possess advanced research and development (R&D) capabilities, and have high production levels; *integrated peripheries*, which are characterised by affordable labour and experience growing vehicle production, but face challenges in attracting knowledge-intensive segments of the automotive value chain; and *semi-peripheries* (including Canada), which lack both homegrown domestic automakers and cost-efficient labour (see Pavlínek, 2018, 2020; Mordue and Sweeney, 2020).

In the following section we consider the literature that influenced our assessment of Canada's mimicking of US industrial policy. In Section 3, we consider the context for Canada's implementation of the US-inspired industrial policy: i.e., the post-2000 decline

of its automotive manufacturing industry. Section 4 explains the measures taken by Canada in the aftermath of the passage of the US IRA in 2022, focusing on its efforts to secure mandates for battery manufacturing. This section includes details of the direct costs it has agreed to incur. In Section 5, we discuss the implications of non-core automotive countries like Canada adopting industrial policy measures developed by and for members of the automotive core. A short conclusion follows in Section 6.

2 Industrial policy resurgence and its application across diverse automotive regions

It is well-established that authorities engage in inter-jurisdictional competition to secure investment. That said, the effects of those investments do not necessarily unfold uniformly. This is a consequence of inherent variabilities in industry-specific and economy-wide conditions accompanying different locations (see McKay and Grant, 1983; Greenstone and Moretti, 2003; Ferreira et al., 2005; Meckling and Nahm, 2019). The global automotive industry is not exempt from this phenomenon. Indeed, the activities associated with developing, distributing, and manufacturing vehicles occupy an outsized station within studies of the spatial distribution of production, investment, and employment. This has occurred because automotive investment is highly valued for its capacity to catalyse economic development in developed and less advanced nations (Katz and Darbishire, 2000; Sardy and Fetscherin, 2009).

Because of its impact, the global automotive industry is a focal point for the practical implementation and scholarly examination of industrial policy. Since the 1980s, case studies on the attraction of automotive investment have emphasised the role of industrial policy, in general, and financial incentives, in particular (Molot, 2005; Moran, 2005; Ma et al., 2019). The inference is that the combination of engaged policymakers and the deployment of generous incentive packages are instrumental. In these case studies, policymakers are understandably disposed to discuss the necessity and influential role their contributions played. Meanwhile, firms – the recipients of these industrial policy largesse – are reticent to dismiss the relevance of incentive packages (see Mordue, 2019, 2020; Jacobs, 2012). The result is a body of literature highlighting, and potentially overstating, the role of incentives in automotive investment location decisions for several decades.

A substantial body of research has also been dedicated to exploring the intricacies of the organisational and evolutionary dynamics inherent in the geographic dispersion of the design, development, and manufacturing of automobiles. Much of this work has leveraged and refined the concepts of global value chains (GVCs) and global production networks (GPNs). An important outcome of this is studies that classify nations engaged in automotive production based on their position within these value chains and production networks. Pioneering research in this regard was conducted by Sturgeon and Florida (2000), who categorised automotive-producing jurisdictions into three distinct groups, delineated by the motivations driving automakers' investments.

Since Sturgeon and Florida's work was originally published, significant restructuring of the global automotive industry has occurred. Indeed, the post-2000 period has given rise to original equipment manufacturers (OEMs) engaging in a thorough reorganisation of the geographic distribution of their value chain activities (see Brincks et al., 2018; Domanski et al., 2017; Lampón et al., 2016; Pavlínek, 2018, 2020; Sturgeon et al., 2009).

The predominant method of categorising the global automotive sector in more contemporary discourse continues to employ a three-tier framework, this time comprised of core, semi-periphery, and integrated periphery automotive countries (Mordue and Sweeney, 2020; Pavlínek, 2018, 2022). Core countries host the headquarters of major global automotive lead firms, namely, OEMs. Given that power dynamics within automotive GVCs typically revolve around OEMs, it is widely recognised that countries hosting the headquarters of these automotive lead firms gain significant advantages (Jacobides et al., 2015; Sturgeon et al., 2009; Sturgeon and Van Biesebroeck, 2011; Yeung, 2018). Such nations maintain substantial automotive production capacities and are privileged with access to the industry's most advanced forms of upgrading and a majority of the sector's highest-value products, processes, and functions (Lampón et al., 2016; Mordue and Sweeney, 2020; Pavlínek, 2018).

At the opposite end of the spectrum are nations constituting the automotive industry's integrated periphery. These countries are characterised by low-cost labour (Mordue and Sweeney, 2020) and primarily serve as manufacturing centres (Pavlínek, 2020; Sturgeon and Van Biesebroeck, 2011). They are typically in geographic proximity to core automotive-producing countries, provide production cost advantages, participate in regional trade agreements, and rely heavily on foreign sources of investment (Brincks et al., 2018; Humphrey et al., 2000; Pavlínek, 2018). The post-2000 proliferation of the automotive integrated periphery has, in part, been fuelled by former low-cost integrated peripheries losing competitiveness to alternative, even more cost-efficient, competitor locations (Adascalitei and Guga, 2020). This shift has been propelled by a confluence of factors, including inter-jurisdictional wage differentials (Domanski and Lung, 2009; Lung, 2004; Pavlínek, 2018) and the ability that automotive manufacturers have to rapidly diffuse production processes across nations and regions (Mordue and Sweeney, 2017).

The growth of both the number of countries constituting the low-cost automotive integrated periphery and the volume of vehicles those nations produce can also be attributed to waning production in automotive semi-periphery countries (Gerőcs et al., 2021; Gorachinova and Wolfe, 2023; Carey and Mordue, 2020), which are characterised by an absence of domestic OEM ownership (a defining feature of core nations), high-cost structures relative to integrated periphery countries, and a high degree of foreign ownership (Pavlínek, 2018; Mordue and Sweeney, 2020). As outlined by Mordue and Sweeney (2020), the automotive semi-periphery category comprises Canada, the UK, Austria, Belgium, Finland, Spain, and Sweden.

As described, automotive semi-periphery nations have encountered considerable challenges in attracting new manufacturing mandates, particularly during the post-2000 period (see Pavlinek, 2022; Mordue and Sener, 2022; Szalavetz and Sass, 2023). However, research exists supporting the argument that countries confronting the effects of reduced manufacturing competitiveness may lessen the effects of declining production by securing mandates for more advanced design and product development tasks (refer to Özatağan, 2011) and that a strategic shift of that nature is well-aligned with the inherent characteristics of countries belonging to the automotive semi-periphery (see Tanguay, 2018; Yates and Holmes, 2019). It is suggested that unlike the recurring and standardised labour-intensive manufacturing functions linked with automotive integrated periphery nations, R&D activities entail non-routine processes demanding the integration of technology and knowledge (Awate et al., 2014; Cantwell and Mudambi, 2005; Gereffi and Fernandez-Stark, 2016; Lederman and Maloney, 2003). Consequently, in the

post-2000 era, several automotive semi-periphery countries have adopted a range of policy measures to incentivise investment in knowledge-intensive domains (see Badillo et al., 2014; Lampón et al., 2016; Tanguay, 2018; Yates and Holmes, 2019).

Proponents of the shift to more knowledge-intensive mandates for the automotive semi-periphery suggest that doing so is facilitated by a range of factors: advancements in information and communication technology, the need to develop products that are more suitable to local contexts, the motivation to access new or underutilised workforces, efforts to access alternative or emerging innovation networks, the attraction of compelling R&D incentive schemes, and pressures imposed by local, regional, or national policymakers (refer to Atkinson, 2007; Castellani et al., 2013; Castellani and Lavoratori, 2017; Lewin et al., 2009; OECD, 2007a, 2007b; Von Zedwitz and Gassmann, 2002).

Despite the possibilities mentioned above, the outcomes of the internationalisation of automotive R&D have been modest (see Mordue and Sweeney, 2020; Lampón et al., 2016). Ultimately, the draw to a more internationalised approach to automotive R&D and other more knowledge-intensive mandates continues to be overwhelmed by firms' preference for integrating R&D activities within established innovation networks (Howells, 1990; Malecki, 2010; Siedschlag et al., 2013) and their conviction that R&D benefits from firm-level economies of scale (Athukorala and Kohpaiboon, 2010). Consequently, the enduring practice within the automotive sector of situating knowledge-based activities in close proximity to corporate headquarters remains steadfast (Casson et al., 2016; Malecki, 1985; Patel and Pavitt, 1995; Schmitz and Strambach, 2009; Sturgeon et al., 2008).

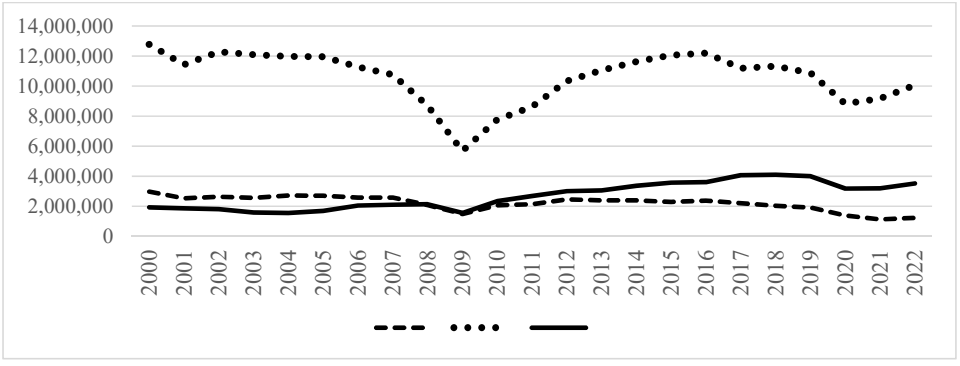
3 The post-2000 challenges facing the Canadian automotive manufacturing industry

During the post-2000 era a convergence of factors coalesced to stymy the development of Canada's automotive manufacturing industry. These include a combination of intensified global and regional competition and tepid responses by the industry to Canadian federal and provincial government industrial development tools.

The pinnacle of Canadian vehicle production occurred in 1999. After that, a period of decline ensued, followed by stagnation. Seven vehicle assembly plants closed their operations, with one later restarting. Only a single new greenfield site[1] was opened. The consequence of this has been a drop in vehicle production of almost 60%, from almost 3 million in 2000 to 1.2 million in 2022 (from data in Figure 1). On a global scale, Canada's position in 2000 as the world's fifth-largest vehicle producer evaporated. By 2022, it was the world's 15th largest producer of automobiles (OICA, 2024). Regionally, data from Figure 1 shows that in 2000, Canadian assembly plants produced 18.7% of all vehicles made in North America. By 2022, its factories made just 8.3%.

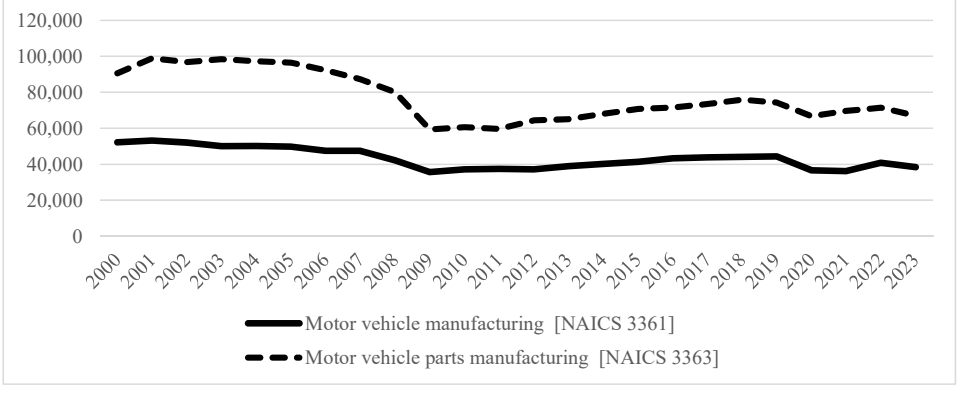
As Figure 2 shows, total employment in vehicle manufacturing and automotive parts manufacturing also declined, from 142,634 in 2000 to 105,362 in 2023. Most of the decline occurred between 2000 and 2009. After that, a period of relative stasis set in.

Figure 1 Vehicle production in Canada, the USA, and Mexico: 2000–2022



Source: (1) Production figures for 2000 from DesRosiers Automotive Yearbook, 2001 Edition, (2) Production figures for 2000–2015 from DesRosiers Automotive Yearbook, 2016 Edition, (3) Production figures for 2016–2022 from the International Organization of Motor Vehicle Manufacturers (OICA, 2024); the post-2000 period also witnessed an effect on employment

Figure 2 Automotive employment in Canada: 2000–2023



Source: Statistics Canada (2024a) and DesRosiers (2004)

The post-2000 struggles experienced by the Canadian automotive manufacturing industry can be attributed to a mix of factors. First, in 2001, a bilateral, automotive-specific trade agreement between Canada and the USA was invalidated by the World Trade Organization (WTO). That agreement, known as the Auto Pact[2], had been in place since 1965 and was deemed to favour US-owned automakers in Canada at the expense of Japanese-owned producers in Canada like Toyota and Honda. The Auto Pact's nullification resulted in the removal of preferential tariffs for Auto Pact member firms General Motors, Chrysler, and Ford. It also eliminated the requirement that those firms achieve production and value-added levels commensurate with sales (see Irish, 2004; Krikorian, 2012). The impact of the WTO ruling was almost immediate, with several Canadian assembly plants closing between 2002 and 2004.

A second reason for Canada's, post-2000 automotive decline was the inclusion of Mexico as an important actor in the North American automotive manufacturing milieu, an adjustment that occurred via the implementation of the 1994 North American Free Trade Agreement (NAFTA). Previously, the policy tools linking the North American automotive industry were restricted to Canada and the USA only, a result of the Auto Pact of 1965 and the Canada-US Free Trade Agreement of 1988. However, expanding the two-country partnership to three had an acute and disproportionate effect on Canada's automotive industry, a consequence of Mexico supplanting Canada as the continent's low-cost regional option. The effect of Mexico's entry was significant: by 2008, Mexico surpassed Canada in vehicle production; by 2017, it doubled Canada's production levels; by 2022, Mexico's assembly plants made almost three times as many vehicles as Canada's.

A third factor contributing to Canada's post-2000 decline is the diminished cost competitiveness of Canadian labour compared to the USA. Prior to the introduction of Voluntary Employee Beneficiary Associations (VEBAs) in the USA in 2007, Canada's automotive sector held a labour cost advantage over the USA due to Canada's publicly-funded healthcare (see Wells, 1997). VEBAs had the effect of shifting retiree healthcare obligations away from automakers, reducing the cost gap between Canada and the USA (Landon, 2008). Additionally, labour negotiations in the USA and Canada in 2007 and 2008, respectively, led to concessions by US autoworkers that were earlier and more impactful than those made by Canadian workers, the result of which was a further diminution of Canada's labour cost advantage over the USA (Stanford, 2010).

The fourth cause of Canada's deterioration is the consequence of a phenomenon Mordue and Sweeney (2017) labelled the commoditisation of automotive assembly', a term designed to capture the widespread, rapid adoption of advanced automotive manufacturing technologies and production practices by less advanced (and lower cost) economies like Mexico – practices previously exclusive to more advanced (and higher cost) industrial economies like Canada. The process of commoditisation, they claimed, has produced a convergence of capabilities and quality levels across jurisdictions, despite different wage structures. It has facilitated the post-2000 ascendancy of countries like Mexico as hubs for automotive manufacturing. Indeed, Mordue and Sweeney (2020) show that the effect of this has been disproportionately felt by countries comprising the automotive semi-periphery, including, but not restricted to, Canada.

In the face of these intra- and inter-regional disruptions, policymakers in Canada invoked a series of measures to reinforce the competitive condition of their automotive manufacturing base. First, actions were taken to secure automotive manufacturing mandates. Notably, in the case of Canada, rather than encouraging new or greenfield automotive manufacturing investments – a form of industrial policy that defined Canada's approach prior to 2000 (see Mordue, 2007, 2019) – the post-2000 period witnessed Canadian policymakers lower their aspirations: from attraction and expansion to mere retention and preservation. Thus, in Canada, after 2000, direct incentives were no longer restricted to new greenfield sites, but became commonplace for vehicle model changeovers, which occur every five to seven years. The effect was that most automotive assembly capital projects in Canada since the mid-2000s have been supported by government incentives of between 10% to 25% of the value of the investment (Mordue and Sweeney, 2017).

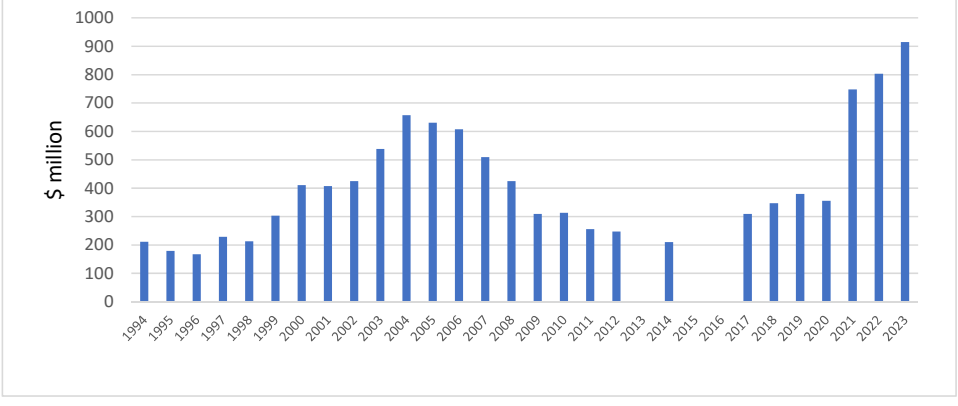
Mordue and Sweeney (2024) show that between 1980 and 2000, Canada and Ontario (the province where almost all of Canada's automotive manufacturing occurs) spent CAD

714 million on six automotive projects, five of which were new greenfield assembly plants. However, notwithstanding Canada's post-2000 drop in automotive output, between 2000 and 2021, 17 automotive assembly-related projects received incentive packages of CAD 100 million or more. The total value of those 17 incentive packages was CAD 3.9 billion. Beyond that, the governments of Ontario and Canada also extended bailouts to DaimlerChrysler and General Motors in 2009, which Milke (2015) estimates cost those two governments CAD 3.7 billion. Thus, between 2000 and 2021, automakers' Canadian operations received incentives totalling CAD 7.6 billion (Mordue and Sweeney, 2024).

The second response of Canadian policymakers to the post-2000 decline of its automotive manufacturing base was to prompt a transition towards a more knowledge-intensive profile for that industry. Indeed, the Canadian approach has been attempted by other countries holding similar profiles and experiencing comparable challenges, as a substantial part of the base of automotive manufacturing is under pressure from new sources of lower-cost competition (see Badillo et al., 2014; Lampón et al., 2016; Yates and Holmes, 2019).

The pivot that Canadian policymakers attempted was supported by a range of new policies and programs, including wage subsidies, grants, interest-free loans, and tax credits (see Ontario, 2024; Canada, 2024a). Subsequently, Canadian research-oriented announcements were made by automakers like Ford (2017), General Motors (Owram, 2016), and Chrysler/Fiat Chrysler/Stellantis (Automotive News Canada, 2016), as well as automotive suppliers like Linamar (Keenan, 2018), Magna (Chappell, 2018), and Blackberry QNX (Canada, 2019). Based on those announcements, researchers have tended to accept the narrative of a knowledge-based transition (see Bramwell et al., 2012; Katz-Rosene, 2018; Gorachinova and Wolfe, 2023).

Figure 3 In-house R&D expenditure for motor vehicles and motor vehicle parts (1994–2023): Canada (see online version for colours)



Note: Statistics Canada deemed data for 2013 to be too unreliable to be published. Data for 2015 and 2016 were suppressed to meet the confidentiality requirements of Canada's Statistics Act.

Source: (1) For the period 1994–2013 (Statistics Canada, 2024b), (2) for the period 2014–2023 (Statistics Canada, 2024c)

The reality, however, is that despite the announcements, for most of the post-2000 period, the knowledge-intensive narrative has not aligned with tangible results. The data in Figure 3 shows that average automotive R&D spending in Canada in the combined automotive assembly and parts sector dropped from CAD 525 million annually between 2001 and 2008 to CAD 265.2 million annually for the five years for which data is available between 2009 and 2014 (Statistics Canada, 2024b, 2024c). An indifferent response to policymakers' overtures was also demonstrated via an output analysis. For example, Mordue and Karmally (2020) and Mordue and Sweeney (2020) show a steady decline in the filing of Canadian-based automotive patents post-2000 in absolute terms and relative to the rest of the world. That said, Figure 3, shows a jump in automotive R&D expenditure in Canada starting in 2020. While research has not yet revealed the cause of the recent escalation, it is possible to conject that by 2020 the policy overtures described above combined with the mid-2010 decade intentions revealed by automakers and parts suppliers were beginning to yield results.

4 Canada's attraction of EV battery plants in the wake of the 2022 US IRA

In the late 2010s, following a nearly 20-year period of anaemic performance – declining production, stagnant employment, and mostly limited success gaining mandates for automotive R&D – Canadian policymakers entrusted with the task of propping up the country's automotive sector embarked on what would become a profound and costly realignment. Seeking to leverage the shift to electric mobility, they started to promote the country as a potential 'EV superpower' (see McClearn, 2023; Trescases, 2023), employing the slogan 'mines to mobility' to capture the country's range of capabilities across the EV supply chain (see Bains, 2020; Natural Resources Canada, 2021). The idea was that Canada was well-positioned to leverage reserves of critical minerals like lithium and cobalt, alongside its capabilities in automotive parts and vehicle manufacturing, to secure battery electric vehicle (BEV) investment, including in battery manufacturing.

During the early days of this transition (i.e., 2020–2022), Canada merely extended the industrial policy tools it had developed and deployed during the previous two decades. This meant that EV production incentives mirrored the pattern that had characterised the Canada-Ontario approach during the post-2000 period, albeit at levels more generous than previously. Therefore, as mandates for models propelled by traditional internal combustion engines (ICEs) came to their natural termination, the governments of Canada and Ontario took measures to replace them with BEVs. For example, in 2020, when Ford committed CAD 1.8 billion to re-tool its sole Canadian assembly plant to build BEVs, the governments of Canada and Ontario provided incentives valued at CAD 590 million (Ford, 2023; Noble, 2023). In January 2021, General Motors announced a CAD 1 billion investment to transform its CAMI assembly plant to build its commercial BrightDrop BEV (General Motors, 2024). That project was supported by a Canada-Ontario package of CAD 518 million (Karim, 2022). In 2022, Stellantis announced its intention to invest CAD 3.6 billion to retool their Windsor and Brampton Ontario assembly plants to build BEVs. The combined Canada-Ontario support for those projects was CAD 1 billion (Coppola, 2022).

4.1 March 2022: LG-Stellantis

Throughout this time, even though Canada and Ontario were securing mandates to assemble BEVs, they were less successful in attracting investment to build batteries. However, their fortunes appeared to change in March 2022 when an LG-Stellantis joint venture announced a CAD 5 billion 45 GWh battery plant in Windsor, Ontario. (Eventually, it was revealed that the plant's mandate would be to produce both battery cells and module assembly, the process of connecting individual battery cells together to form larger modules.) Incentives of CAD 1 billion were extended, 20% of the project's total cost (Friedman, 2023), with CAD 500 million coming from Canada's federal government and CAD 500 from the Government of Ontario (McKenzie-Sutter, 2023). The LG-Stellantis package was in keeping with previous industrial policy measures enacted in Canada. It was also more generous than typical US industrial policy practice at the time. For example, in 2019, SK Innovation received incentives of USD 300 million or 17.6% of the value of a USD 1.7 billion project from the State of Georgia for the first battery plant that the company placed in that state (Trubey, 2019). When General Motors unveiled plans to invest USD 7 billion for a battery plant and EV assembly operation in Michigan in 2022, the combination of local government and the State of Michigan incentives totalled USD 824 million (Hall and Noble, 2022), 11.8% of the project's cost. Ford's 2021 announcement that it would invest USD 11.4 billion to build EV assembly and battery plants in Tennessee and Kentucky was supported by incentives from the two states valued at USD 1.134 billion (see Klyce, 2021; Bremmer, 2021), 9.9% of the cost of those projects. In 2022, Stellantis and Samsung indicated they would spend USD 2.5 billion for a 23 GWh battery plant in Kokomo, Indiana. For that, state government incentives were USD 161.5 million (PR Newswire, 2022; Gerber, 2022), 6.5% of planned spending.

4.2 August 2022: Introduction of the US IRA

In August 2022 – just five months after the announcement of the LG-Stellantis battery plant in Windsor, Ontario – the US IRA was signed, fundamentally reshaping the competitive landscape underpinning automotive investment. As will be demonstrated, the impact of the IRA transcended US borders. Moreover, as will also be shown, the IRA shook battery plant decisions that had been made previously.

Among other items, the IRA provided companies with tax credits for domestic manufacturing of battery cells and modules (White House, 2023). For manufacturing located in the USA, it included USD 35 per kilowatt-hour (kWh) for battery cell production and another USD 10 per kWh for module assembly (Internal Revenue Service, 2023). Thus, the manufacturer of a 75 kWh battery pack (with which the top-selling Tesla Model 3 Long Range is equipped) could receive a tax credit of USD 3,375 for each battery pack: USD 2,625 ($35 per kWh) for battery cell manufacturing and USD 750 for the module assembly ($10 per kWh). The IRA also contained a sunset clause where those values would ratchet down to levels of 75%, 50%, 25%, and 0 in 2030, 2031, 2032, and 2033, respectively.

The effect of the IRA was immediate and significant. For context, had the March 2022 announcement of the 45 GWh Windsor Ontario LG-Stellantis plant with a 2024 start of production (Stellantis, 2023a) been located across the border in Michigan, the

IRA would have provided total production incentives, as calculated in the following steps:

Step a Determine how many kWh constitute a 45 GWh factory:

1 GWh = 1,000,000 kWh

So, 45 GWh = 45,000,000 kWh

Step b Establish how many 75 kWh batteries can be produced each year in a factory with a capacity of 45 GWh, by dividing the factory's annual capacity in kWh by 75 kWh:

45,000,000 kWh / 75 kWh = 600,000

Therefore, a factory with a capacity of 45 GWh could produce approximately 600,000 75 kWh batteries at full capacity.

Step c Determine maximum potential annual IRA production incentives for a battery plant of 45 GWh or 600,000 units of 75 kWh batteries operating at capacity. Note i: The LG-Stellantis plant will produce both battery cells and modules. As such, IRA incentive values of USD 45/kWh would have applied (USD 35/kWh for the battery cells and USD 10/kWh for module assembly.) Note 2: For this and subsequent calculations, we assume one USD = CAD 1.35, a level within 2% of the average Bank of Canada exchange rate in March 2024. We also use this rate to convert CAD to USD in subsequent calculations.

600,000 batteries × USD 3,375 per battery = USD 2,025,000,000 (or CAD 2,733,750,000)

Step d Calculate the total 'potential' and 'anticipated' value of IRA production incentives over the period 2025–2033, the period during which the IRA is scheduled to be in effect. The year-by-year results are contained in Table 1. While Stellantis originally projected a mid-2024 start of production (see Stellantis, 2023a), for the purposes of our calculation, we assume full production will occur in 2025. 'Potential' value assumes that the plant will operate at 100% capacity utilisation, a rate that is unlikely to be achieved. For this reason, we also calculate an 'anticipated' value. Estimates of current and future battery plant utilisation rates range between 70% and 80% (see Kang, 2023; Dempsey and White, 2023; Benchmark Source, 2023; Moores, 2019). Our estimate of 'anticipated' capacity utilisation is 75%.

Therefore, as shown in Table 1, had the LG-Stellantis battery plant in Windsor, Ontario – initially announced in March 2022 – been delayed by five months, the joint venture could have entertained 'potential' production incentives available in the USA totalling USD 13.16 billion/CAD 17.77 billion and 'anticipated' incentives of USD 9.87 billion/CAD 13.33 billion.

4.3 April 2023: Volkswagen

By early 2023, the implications of the IRA had been absorbed by the automotive/battery manufacturing community. At the time, Volkswagen was scouting locations for their first battery plant in North America. Eventually, Volkswagen settled on St. Thomas, Ontario,

Canada, as the location for a CAD 7 billion battery plant. At 90 GWh capacity (Volkswagen, 2023; Ontario, 2023b), the plant's battery cell manufacturing operation would be twice as large as what LG-Stellantis had slated for Windsor. The start of production was pegged at 2027 (Ontario, 2023b). To earn that investment, the Government of Canada committed to "providing Volkswagen with production support to match the IRA's Advanced Manufacturing Production Credit" (Ontario, 2023b). That meant that because the Volkswagen plant would manufacture battery cells only, IRA-style incentives would be USD 35/kWh.

Eventually, the Government of Canada indicated that Canada's commitment would result in incentives that they estimated to be between CAD 8 billion and CAD 13.2 billion (Ontario 2023b). Later, Canada's independent Parliamentary Budget Office (PBO) set the value of Canada's package at CAD 16.3 billion, consisting of CAD 12.8 billion in IRA-like production support and a CAD 700 million grant from the Strategic Innovation Fund[3] (Parliamentary Budget Office, 2023). The PBO also suggested that tax adjustments of CAD 2.8 billion would be needed to ensure Volkswagen achieved after-tax equivalency with that available under the IRA, a component Canada's Finance Minister subsequently acknowledged (Mallees, 2023). The CAD 2.8 billion tax equivalency provision was included because, rather than dealing with the production incentives via non-taxable tax credits like the US IRA, Canada dealt with them as contributions, which Canadian tax authorities have deemed subject to tax. That meant that once companies like Volkswagen demonstrated they had manufactured the battery cells and/or modules, the government would provide direct financial contributions, in Volkswagen's case, at the rate of USD 35/kWh. Beyond that, the Province of Ontario also committed CAD 500 million to the project (Parliamentary Budget Office, 2023; Ontario, 2023b).

Table 1 contains two estimates of the value of the Volkswagen package: a 'potential' value based on an assumption that the plant achieves a utilisation rate of 100% the other an 'anticipated' value, which assumes the plant utilisation rate will be 75% (see above). Both assumptions result in estimates that exceed the evaluation of the incentive package's total cost provided by the Government of Canada. Only the estimate based on a plant utilisation rate of 100% results in an estimate that is higher than that provided by the PBO.

To establish the value of the production incentive portion of the Volkswagen package, we assume the following: a 2028 start of production, not 2027 as announced (to allow for delays and to give time to ramp up production); 90 GWh of capacity, equivalent to production of 1.2 million 75 kWh batteries annually at 100% utilisation (the rate we use to calculate 'potential' production incentives). For reasons described earlier, we also calculate 'anticipated' production incentives. For that, we assume the plant will operate at 75% utilisation. Module assembly will not occur in Volkswagen, only battery cell production (therefore, production incentives will be USD 35/kWh). Incentives per battery will be USD 2,625 (calculated on the basis of each battery being 75 kWh × USD 35) and available at levels and for periods stipulated by the IRA (a ratcheting down occurs starting in 2030). The Volkswagen agreement contains no cap on IRA-style production incentives.

Therefore, as Table 1 shows, we estimate that the 'potential' value of the IRA-like production incentive portion of the Volkswagen deal is USD 11.24 billion/CAD 15.17 billion. The 'anticipated' value is USD 8.43 billion/CAD 11.38 billion.

Table 1 Potential and anticipated IRA-style production incentives: LG-Stellantis, Volkswagen, and Northvolt

Year	IRA step-down formula	*LG-Stellantis*				*Volkswagen*				*Northvolt*			
		Potential production incentives		*Anticipated production incentives*		*Potential production incentives*		*Anticipated production incentives*		*Potential production incentives*		*Anticipated production incentives*	
		(100% utilisation of capacity)	*(100% utilisation of capacity)*	*(75% utilisation of capacity)*	*(75% utilisation of capacity)*	*(100% utilisation of capacity)*	*(100% utilisation of capacity)*	*(75% utilisation of capacity)*	*(75% utilisation of capacity)*	*(100% utilisation of capacity)*	*(100% utilisation of capacity)*	*(75% utilisation of capacity)*	*(75% utilisation of capacity)*
		USD (million)	*CAD (million)*	*USD (million)*	*CAD (million)*	*USD (million)*	*CAD (million)*	*USD (million)*	*CAD (million)*	*USD (million)*	*CAD (million)*	*USD (million)*	*CAD (million)*
2025	100%	2,227,500	3,007,125	1,670,625	2,255,344	-	-	-	-	-	-	-	-
2026	100%	2,227,500	3,007,125	1,670,625	2,255,344	-	-	-	-	-	-	-	-
2027	100%	2,227,500	3,007,125	1,670,625	2,255,344	-	-	-	-	1,050,000	1,417,500	787,500	1,063,125
2028	100%	2,227,500	3,007,125	1,670,625	2,255,344	3,210,000	4,333,500	2,407,500	3,250,125	1,050,000	1,417,500	787,500	1,063,125
2029	100%	2,227,500	3,007,125	1,670,625	2,255,344	3,210,000	4,333,500	2,407,500	3,250,125	1,050,000	1,417,500	787,500	1,063,125
2030	75%	2,227,500	3,007,125	1,670,625	1,692,508	2,407,500	3,250,125	1,805,625	2,437,594	787,500	1,063,125	590,625	797,344
2031	50%	1,670,625	2,255,344	1,252,969	1,127,672	1,605,000	2,166,750	1,203,750	1,625,063	525,000	708,750	393,750	531,563
2032	25%	1,113,750	1,503,563	835,313	563,836	802,500	1,083,375	601,875	812,531	262,500	354,375	196,875	265,781
Total		16,149,375	21,801,657	14,660,736	14,660,736	11,235,000	15,167,250	8,426,250	11,375,438	4,725,000	6,378,750	3,543,750	4,784,063

Source: Elaborated by the authors

Table 2 Potential and anticipated incentives: by firm and combined

By firm	*LG-Stellantis (CAD billion)*		*Volkswagen (CAD billion)*		*Northvolt (CAD billion)*	
	Potential (100% capacity utilisation)	*Anticipated (75% capacity utilisation)*	*Potential (100% capacity utilisation)*	*Anticipated (75% capacity utilisation)*	*Potential (100 capacity utilisation)*	*Anticipated (75% capacity utilisation)*
Capital incentives: Canada	0.5	0.5	0.7	0.7	1.34	1.34
Capital incentives: province (Ontario or Quebec)	0.5	0.5	0.5	0.5	1.37	1.37
Production incentives	15 (capped)	14.66	15.17	11.38	4.6 (capped)	4.6 (capped)
Tax adjustment	3.28	3.21	3.32	2.49	1.0	1.0
Total incentives, by firm	19.28	18.87	19.69	15.07	8.31	8.31
Planned investment	5	7	7			
Ratio: incentives to investment	3.86:1	3.77:1	2.81:1	2.15:1	1.19:1	1.19:1
Combined						
Total potential incentives for three plants (at 100% capacity utilisation)			CAD 47.28 billion			
Total anticipated incentives for three plants (at 75% capacity utilisation)			CAD 42.25 billion			
Total planned investment for three plants			CAD 19			
Combined ratio for three plants: incentives to investment			2:49:1 (at 100% capacity utilisation), 2.14:1 (at 75% capacity utilisation)			

Source: Elaborated by the authors

In Table 2, we combine data from Table 1 (on production incentives) with other facets of each incentive package. That means, in addition to production incentives, we also tally capital incentives from the governments of Canada, Ontario, and Quebec, as well as the 'potential' and 'anticipated' costs of providing after-tax equivalency with the USA on the production incentives (MacDonald, 2023). For the after-tax equivalency portion, we use the formula provided by the PBO. In the case of Volkswagen, the PBO estimated the value of its after-tax equivalency provision at CAD 2.8 billion (based on the PBO's estimate of federal production support of CAD 12.8 billion, an effective rate of 21.87%). Table 2 shows that our estimate of the 'potential' after-tax equivalency of the Volkswagen production incentives is CAD 3.32 billion ('potential' production incentives of CAD 15.17 billion × 21.87%). The 'anticipated' cost of providing after-tax equivalency is CAD 2.49 billion.

Table 2 shows that Canada's total support to Volkswagen could be as high as CAD 19.69 billion/USD 14.58 billion, consisting of the federal government's Strategic Innovation Fund incentive of CAD 700 million, an Ontario government commitment of CAD 500 million, 'potential' IRA-style contributions of CAD 15.17 billion, and a corresponding 'potential' tax adjustment of CAD 3.32 billion. Should the plant achieve an 'anticipated' utilisation rate of 75%, the total value of its incentives will be CAD 15.07 billion/US 11.16 billion.

4.4 May–July 2023: LG-Stellantis … again

As the implications of the US IRA were unfolding and as information about the Ontario Volkswagen plant was revealed, LG-Stellantis developed significant misgivings about their Windsor investment, the cause of which was recognition that they had missed the windfall the IRA represented. Instead of multi-billion-dollar IRA-type incentives, LG-Stellantis' March 2022 announcement had yielded a joint Canada-Ontario package of just CAD 1 billion: adequate in the context of March 2022, derisory a few months later. Behind the scenes, LG-Stellantis and Canadian government actors started re-negotiating Canadian government support. However, a way to get the government of Ontario back to the table as well as satisfy LG-Stellantis was slow to emerge (see MacCharles et al., 2023; Radwanski and Stone, 2023). Eventually, the effects of the deadlock boiled over. On May 15, 2023 – a month after details of the Volkswagen incentive package were revealed – LG-Stellantis suspended construction at the Windsor site, threatening to move the project to Michigan where IRA incentives were guaranteed (see Shakil and Scherer, 2023).

The stand-off dragged on for seven weeks. Early on, the Government of Canada expressed a willingness to match US IRA incentives (Stone, 2023). However, unlike the USA, where the federal government was the sole source of production incentives for battery cells and module assembly, the approach in Canada was to fund automotive incentives jointly between the federal and provincial (i.e., Ontario) governments on an equal or near equal basis (the April 2023 Volkswagen incentive package representing an exception). Ontario, however, was reluctant to go any further than the CAD 500 million they had pledged in March 2022 (MacCharles et al., 2023). As the stalemate continued, the CEOs of LG and Stellantis elevated the temperature, issuing a joint statement declaring: "In the event our agreement is not promptly executed, we will be forced to make difficult decisions regarding this project and other respective investments in Canada" (MacCharles et al., 2023), the implication being that absence of a local battery

plant would compromise not only the Windsor battery plant, but Stellantis' other Canadian facilities including their Brampton and Windsor Ontario assembly plants.

Eventually, following a flurry of discussions elevated to the Deputy Prime Minister of Canada and the Premier of Ontario, a deal was struck between Canada and Ontario (see Cochrane, 2023; Jones, 2023; Radwanski and Stone, 2023). The original agreement (announced in March 2022), which included support of CAD 500 million from each level of government, would persist. Beyond that, it was announced that LG-Stellantis would also receive IRA-type production subsidies capped at CAD 15 billion, approximately one-third coming from the province and the rest from the Government of Canada (Cochrane, 2023). Construction resumed immediately (Campbell, 2023).

Table 2 captures the re-negotiated deal's components. Table 2 also incorporates LG-Stellantis' subsequent decision to expand the plants' production from 45 GWh to 49.5 GWh (Stellantis, 2023b). Beyond the original CAD 1 billion support from Canada-Ontario and the July 2023 addition of IRA-style production incentives capped at CAD 15 billion, our estimate of total incentives also includes provisions to provide LG-Stellantis with US after-tax equivalency, an incentive that Table 2 shows we value at a maximum of CAD 3.28 billion (LG-Stellantis production incentives capped at CAD 15 billion × 21.87% – the rate established by the PBO and captured above).

Table 2 shows that with a value between CAD 18.87 billion ('anticipated' value) and CAD 19.28 billion ('potential' value), the LG-Stellantis package, including production incentives, tax equivalency, and capital support, is almost as rich as the 'potential' package extended to Volkswagen and more generous than that plant's 'anticipated' value. This is despite LG-Stellantis' battery cell capacity being barely half that of the Volkswagen facility in St. Thomas. However, the LG-Stellantis plant will start production earlier than Volkswagen and, therefore, generate production subsidies for a longer period (see Table 1). In addition to battery cells, it will also assemble modules. As such, it will qualify for production incentives of USD 45/kWh (not USD 35/ kWh, as is the case for Volkswagen).

4.5 September 2023: Northvolt

In September 2023, Swedish-based battery manufacturer Northvolt announced a CAD 7 billion 30 GWh capacity plant in McMasterville, Quebec. To support construction, the government of Quebec committed CAD 1.37 billion and the federal government offered CAD 1.34 billion (Prime Minister of Canada, 2023). The start of production was slated for 2026 (Ewing, 2023). The company would also be eligible for IRA-type production incentives, and the federal and Quebec governments would adopt the same two-thirds-one-third allocation Canada and Ontario arrived at for the renegotiated deal with LG-Stellantis. Also, like the LG-Stellantis re-negotiated deal, production incentives would be capped, this time at CAD 4.6 billion (Jonas, 2023), lower than either 'potential' or 'anticipated' capacity utilisation.

To estimate the value of the Northvolt incentive package, we assume the following: a 2027 start of production, not 2026 as announced (to allow for delays and to give time to ramp up production); 30 GWh of capacity, equivalent to 'potential' production of 400,000 75 kWh batteries annually at 100% plant utilisation, and 'anticipated' production of 300,000. Module assembly will not occur in McMasterville, only battery cell production (therefore, production incentives will be USD 35/kWh); incentives per battery will be USD 2,625 (calculated on the basis of each battery being 75 kWh × USD 35).

Incentives will be available at levels and for periods stipulated by the IRA (a ratcheting down occurs starting in 2030). As described, production incentives will be capped at CAD 4.6 billion.

Therefore, as Table 1 shows, had no cap on production incentives been established, the 'potential' value of Northvolt's IRA-like production incentives would have been USD 4.73 billion/CAD 6.38 billion. Even if Northvolt reached the 'anticipated' plant utilisation rate of 75%, its output would have also exceeded the CAD 4.6 billion cap.

Table 2 shows that we estimate the total value of the Northvolt package to be CAD 8.31 billion/USD 6.16 billion, regardless of whether the plant achieves a 'potential' or 'anticipated' production capacity of 100% or 75%, respectively. That value consists of IRA-type production incentives of CAD 4.60 billion, provision for US tax equivalency of CAD 1.0 billion (CAD 4.6 billion × 21.87%), Government of Quebec support of CAD 1.37 billion, and Government of Canada support of CAD 1.34 billion.

5 The consequences of non-core automotive countries adopting industrial policy measures developed by and for the automotive core

Together, the three battery plants Canada secured over the period 2022–2023 have a value of CAD 19 billion and a total capacity of 169.5 GWh, equivalent to about 2.26 million typical 75 kWh batteries in plants when operating at a utilisation rate of 100%. In return for those investments, as Table 2 shows, we estimate that, depending on the volume of batteries the plants ultimately reach, the combination of government-funded measures to provide those plants with:

a support for construction

b ongoing production incentives comparable to those provided by the US IRA

c tax equivalency with the USA related to the production incentives will cost governments in Canada between CAD 42.25 billion/USD 31.29 and CAD 47.28 billion/USD 35.02 billion.

Returning to our original research questions:

5.1 Were governments in Canada obliged to match US IRA-type incentives to gain these investments?

In short, the answer is yes. Earlier, we suggested that existing literature tends to overstate the role of incentives on a firm's investment decisions, a consequence of the inclination of policymakers to justify and promote their involvement along with the reluctance of firms to publicly question or critique the value of the benefit they received. However, literature probing the effect of financial incentives has, until now, not considered incentives of the magnitude contemplated in this research. Even recent research about investment incentives, in general, and automotive investment incentives, in particular, has been done through a lens that considered investment incentives are significant when they approached USD 1 billion, no more than 30% of the cost of a typical automotive assembly plant (see Jacobs, 2024). As has been demonstrated, the IRA unleashed industrial policy measures on an entirely different scale. Table 2 shows that the US IRA

caused Canadian policymakers to extend direct financial incentives amounting to between 119% and 386% of the value of the firm's intended capital expenditure.

We suggest that had Canada not mimicked the US IRA, the three battery plants it secured over 2022–2023 would have been located in the USA. For example, as we have explained, in May 2023, LG-Stellantis stopped construction of their Windsor, Ontario joint venture, signalling an intention to relocate to the USA if Canada-Ontario did not renegotiate (Shakil and Scherer, 2023). At the time, LG-Stellantis' commitment to the project was limited to the sunk costs associated with land purchase, site preparation, and early-stage construction; investments they were willing to abandon in favour of IRA incentives across the border that were much larger than anything they had spent – or would spend – completing construction of their Windsor operation.

Similarly, it is unlikely that Volkswagen would have placed a battery plant in St. Thomas, Ontario if IRA-like incentives were not made available. After all, Volkswagen's North American assembly plants – the destination for the battery cells the St. Thomas plant will manufacture – are located in Tennessee and South Carolina, more than 1,000 kilometres away. Before the IRA, North American battery plants tended to be located geographically proximate to their final assembly plant customers. For example, Hyundai and LG are building a 30 GWh battery plant adjacent to an assembly plant that will produce Hyundai, Genesis, and Kia EVs (Hyundai, 2022); Tesla's battery factory in Nevada is five hours from the company's assembly plant in Fremont, California; the BlueOval City complex Ford is constructing in Tennessee will include an EV assembly plant and a battery plant on a single site (Ford, 2021).

Meanwhile, Canadian policymakers have downplayed the role of incentives. For example, Ontario's Minister of Economic Development, Vic Fedeli, explained. "They got tax credits, so it's not cash that's going out, it's tax credits. You have no money going out ... It's not as if you are writing them a cheque to them" (TVO, 2024). Fedeli's explanation is misleading. A tax credit is an amount that taxpayers can subtract, dollar for dollar, from income tax owed. The IRA's production tax credits do not limit tax credits to zero taxes due. Moreover, the agreements the Government of Canada negotiated with LG-Stellantis, Volkswagen, and Northvolt were that they receive their production incentives (equal to USD 35–45/kWh) in the form of a direct 'contribution'.

To avoid a discussion of incentives, Canadian policymakers have pointed to other attributes Canada, Ontario, and Quebec offer battery manufacturers. For example, when the original LG-Stellantis and Volkswagen investments were announced in March 2022 and April 2023, respectively, government press releases did not mention incentives. Instead, Minister Fedeli pointed to other attributes. "With a highly skilled workforce, clean energy, an abundance of critical minerals, access to markets, and a flourishing automotive and battery sector, we are an attractive investment destination with everything companies need to grow" (Ontario, 2023a).

Dissecting aspects of Minister Fedelli's pronouncement, in Ontario's highly skilled workforce, automakers have access to the highest calibre segments of the available workforce, regardless of location. Relative to the local employment market, they typically provide better pay, assuring access to employees with above-average skills (Irvine, 2014; Mordue and Sweeney, 2024). Thus, inter-jurisdictional differences in typical worker education or skills have minimal effect on automotive manufacturing investment attraction.

On the availability of clean energy, in Ontario, the amount of electricity generated by non-renewable sources accounted for just 10.4% of electricity used in 2022 (IESO,

2024). By comparison, in 2023, 60% of US utility-scale electricity was generated by fossil fuels (US Energy Information Administration, 2023), a trend repeated in key battery-producing states like Kentucky, Tennessee, and Michigan. Thus, even though those engaged in the process of investment attraction in Canada find the message of clean energy attractive – and automotive actors are unlikely to (at least publicly) disagree – previous location decisions by battery manufacturers suggest that the availability of electricity generated from sources other than coal, gas, and oil is irrelevant. This includes battery plant location decisions by Volkswagen in Europe and Stellantis and its partners in the USA. Among the three firms with battery plants under construction in Canada, only Northvolt (2022) has exhibited practices consistent with prioritising the availability of clean electricity, in line with its expressed intention of reaching and maintaining 100% fossil-free energy.

On an abundance of critical minerals, first, in Canada, with few exceptions, those minerals are still in the ground and in very remote, jurisdictionally complex, locations (Kerr, 2023; Saint, 2023). Second, the transition from 'known reserve' to 'operating mine' will take at least a decade (Resource World, 2017). Third, Canada's reserves and production of the most important critical minerals for battery manufacturing are insignificant. For example, with just 2.1% of global cobalt reserves and less than 1% of 2022 global production, Canada's position is minor compared to the Democratic Republic of Congo, Australia, and others (US Geological Survey, 2024). At 3.3% of global reserves and 1.9% of global production (US Geological Survey, 2024), Canada's narrative surrounding lithium is similarly suspect. As well, its production and reserves of manganese (0.2% and 2%, respectively) insignificant (US Geological Survey, 2024). Fourth, the connection that Canadian policymakers have made between the availability of critical minerals and the subsequent establishment of manufacturing operations in a specific area or jurisdiction is questionable. International trade regulations restrict the enforcement of mandates that require advanced processing of minerals within regions possessing the primary resources. Moreover, Canada has a long track record of exercising careful diplomacy, ensuring its trade practices are aligned with global expectations (see Hart, 1998; Pomfret, 2000; Krikorian, 2012). This means that the use of slogans like 'mines to mobility' by governments or assertions made by Minister Fedeli and others about Canada's offer of critical minerals should be viewed with skepticism. Hence, despite the narratives about the availability of high-quality personnel in Canada, green energy, and critical minerals, and despite policymakers' preference for downplaying the size and role of incentives, it is unlikely that the battery plants located in Canada over the period 2022–2023 would have ended up there had Canada not matched US IRA-style incentive packages.

Consequently, the answer to the question: *Were US IRA-type incentives necessary for Canada to gain these investments?* Is 'yes.'

5.2 Can Canada expect benefits comparable to those that similar support would engender in the USA, where the IRA was conceived?

To answer this question, we draw from the core-semi-periphery-integrated periphery framework captured by Mordue and Sweeney (2020). Their research and the literature upon which it is based (see also Brincks et al., 2018; Humphrey et al., 2000; Pavlínek, 2018, 2020, 2022; Lampón et al., 2016) give prominence to the fact that countries like Canada, which the framework categorises as a 'semi-periphery,' hold an ambiguous

source of power and competitiveness in so far as automotive industry value chains are concerned.

The framework demonstrates that semi-peripheries like Canada are different from core automotive countries. The basis of the competitiveness of core countries comes from their hosting home-grown automakers, a feature that causes them to retain mandates for vehicle production, as well as gain higher value and more knowledge-intensive mandates. In North America, that role belongs to the USA. In comparison, the foundation for the competitiveness of 'integrated periphery' countries is their offer of low-cost labour, a position that in North America is occupied by Mexico. While the offer of low-cost labour by Mexico and other integrated peripheries does allow them to gain large and expanding mandates for automotive parts and vehicle production, the industry's most knowledge-intensive functions are largely absent.

Canada's longstanding practice of incentivising automotive manufacturing confirms it is not prepared to cede all manufacturing mandates to low-cost integrated peripheries like Mexico or to core countries like the USA. As we have established, for North America's semi-periphery, Canada, to maintain a key feature of both core and integrated periphery automotive nations – i.e., large-scale manufacturing operations like assembly plants or battery manufacturing – considerable incentives are necessary, a practice the US IRA has escalated. Moreover, Canada's adoption of the most prominent and costliest feature of the US IRA (the incentivisation of battery cell manufacturing and battery assembly as well as provisions to extend US tax equivalent treatment) demonstrates its steadfastness in that regard.

Beyond production, statements provided by Canadian policymakers suggest that its objectives are more expansive; that rather than maintaining attributes consistent with its status as a member of the automotive semi-periphery, it holds aspirations more in line with those of the automotive core, such those captured in statements about becoming an 'EV superpower' or building a Canadian EV supply chain from 'mines to mobility.' As described, however, the temptation to conflate the capability to perform more sophisticated, knowledge-intensive tasks with actually achieving them is a common trap for policymakers and researchers (see Özatağan, 2011; Awate et al., 2014; Cantwell and Mudambi, 2005; Gereffi and Fernandez-Stark, 2016; Lederman and Maloney, 2003). Consequently, during the post-2000 era, it has been common for countries in the automotive semi-periphery to enact measures to establish more knowledge-intensive profiles for their automotive industries. This has occurred in Europe (see Badillo et al., 2014; Lampón et al., 2016) as well as in Canada (Tanguay, 2018; Yates and Holmes, 2019).

Thus, Canada's decision to deploy key aspects of the US IRA should be considered a costly measure to merely extend its longstanding rank within the global automotive hierarchy. Mimicking a US policy will not yield the same results that US policymakers anticipate when offering similar support to US-based global lead firms. In the USA, the support offered to homegrown automakers bolsters that country's more comprehensive and robust automotive value chain. Canada, a semi-periphery, has more limited mandates. Its expenditure of at least CAD 42.25 billion for three battery plants will not support its 'graduation' to the status of core. Unlike core automotive countries (e.g., the USA, Japan, Germany, China, or Korea), Canada does not play host to a homegrown

automaker. Similarly, no major battery producers (e.g., Panasonic, CATL, BYD, LG, Samsung) will be headquartered in Canada, as a result of that country's adoption of a key and costly feature of the US IRA.

Canada has hosted foreign-owned OEM assembly plants for decades, which build the vehicles they are instructed to build in quantities directed by headquarters, employing research, engineering, and design protocols established in locations outside Canada's borders. Despite the presence of those foreign-owned OEM assembly plants, with approximately 0.5% of global automotive-related patents and a history of modest spending on automotive R&D (see Mordue and Sweeney, 2020; Mordue and Karmally, 2020), Canada, like other automotive semi-peripheries, has been unable to alter its profile. The introduction of foreign-owned battery makers is unlikely to generate a different result.

Consequently, the answer to the question: *Can Canada expect benefits comparable to those that similar support would engender in the USA, where the IRA was conceived?* Is 'no.'

6 Conclusions

Over the course of 18 months in 2022 and 2023, governments in Canada embarked on a CAD 42 billion-plus exercise to sustain and, according to Canadian governments, transform its automotive industry. By mimicking a key and costly feature of the US IRA, Canada gained three foreign-owned greenfield battery plants. This paper has demonstrated that government funds were necessary to secure these investments. We have also demonstrated that several other attributes that Canadian policymakers point to as reasons for choosing Canada were less persuasive. This list includes items like Canada's promise of critical minerals, the quality of its workforce, and its availability of green electricity. Ultimately, we conclude that those three firms committed to Canada primarily because Canada was willing to replicate incentive packages at levels on offer in the USA.

While Canada was able to mimic a US policy and secure investments, our research has revealed that Canada will not replicate the benefits that similarly constituted policy levers applied in the USA might be expected to deliver there. Drawing from the core-semi-periphery-integrated periphery framework utilised to categorise automotive economies we demonstrate that the emergence of a more knowledge-intensive profile for the Canadian automotive industry – one that includes features like elevated levels of R&D, mandates for the design of vehicles and key components, or a bigger role in supply chain management – is an improbable outcome of these investments. In short, unlike the USA, Canada's expenditure of at least CAD 42 billion to attract three battery plants worth CAD 19 billion will yield just that: three battery plants worth CAD 19 billion and little more.

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Notes

1 A greenfield site is basically an undeveloped piece of land, one that has never had buildings on it or been used for industry (see https://dictionary.cambridge.org/dictionary/english/greenfield-site#google_vignette).

2 The Auto Pact was established in 1965. To benefit from the duty-free movement of vehicles and parts across the Canada-US border, The Auto Pact required automakers to achieve a 1:1 production-to-sales ratio and required a minimum 50% North American content for both parts and vehicles. Along with the terms of the treaty, the Government of Canada also required General Motors, Ford, and Chrysler to conduct minimum levels of value added in Canada, a level they set as a ratio of Canadian value added to sales in Canada of 60%.

3 The Strategic Innovation Fund is a program offered by the Government of Canada. It provides financial support to a wide range of industries, including advanced manufacturing, digital technology, clean technology, and bio-sciences. Companies can apply for funding to support research and development projects, scale-up initiatives, and other activities that promote innovation and growth in key sectors of the Canadian economy (see Canada, 2024a, 2024b).