

# DOCOL light steel

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A case study

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<b>Innovation:</b>	<b>Improved process technology and co-design with end users</b>
<b>Intervention:</b>	<b>DOCOL Steel</b>
Case Study by:	Duncan Kushnir, Lund University
Methodology:	5 interviews, extensive literature review (>30 peer reviewed papers)
<i>Case Study Overview</i>	
Sector(s):	Steel (and Automotive)
Value Chain Stage(s):	Manufacturing/Finishing
Type of Intervention:	Process Technology
Date & Duration:	1982 – Present
Location:	Sweden
Initiating Actors:	SSAB
Actor Constellation:	SSAB – producer Vehicle manufacturers – consumer / design and specification for steel Swedish Government – initial financier through guaranteeing a loan Associations (Jernkontoret, Worldsteel) - advocacy as well as knowledge and standards
Short Description of Intervention:	DOCOL steel is a range of steel grades produced specifically for automotive applications. The design objective for all DOCOL steels is to reduce the amount of steel needed for a given part while increasing overall vehicle strength. This is achieved through proprietary improvements in steel manufacturing which give superior material properties that are tuned specifically for individual applications through collaboration with the automotive manufacturers.
<i>Research Theme Summaries</i>	
1. Innovation History & Dynamics:	<p>After a parliamentary decision in 1977, NJA, Domnarvets Jernverk and Oxelösund were merged into a single company, SSAB, with the Swedish State as the owner. One possibility for upgrading Domnarvet was to try and produce extremely high grade steel. The brand of DOCOL steel and idea of targeting the automotive industry was conceived during the Iran oil crisis, first mentioned in the SSAB annual report in 1979 and protected as a brand name in 1980.</p> <p>Producing DOCOL steel required an entirely new process, and the Swedish government was an early supporter of the effort. At first DOCOL comprised only cold rolled steel products, but over time grew to include every type of steel. The turning point according to SSAB was formation of the ULSA consortium with other producers of AHSS and the 1995 ULSA case study on a future vision for how far high strength steels could go to reduce the weight of vehicles and the resulting benefits. Subsequently, there was an increased interest in using AHSS to lightweight vehicles, which has developed and refined more or less continuously to the situation of today.</p>
2. Governance Arrangements & Agents of Change:	<p>DOCOL steel has emerged as one of the six main product brands of SSAB and operates as its own division comprising an entire vertical. DOCOL teams have a one-to-one relationship with many major car manufacturers and customer parts producers.</p> <p>Legislatively, fuel economy standards now exist in most OECD countries, providing one source of constant pressure for lightweighting vehicles. A related institutional change is the spread of vehicle safety regulations, which place specific mechanical needs on certain parts that are not related to lightweighting. These needs for safety and crash resistance are considered by SSAB to now be the second major driver of automotive material design.</p> <p>DOCOL steel appears to follow the general governance model of most advanced steel production: develop the capacity to reliably produce better material qualities, then suggest and market applications, or listen to needs and engineer the appropriate material. The people spoken to at SSAB did not consider it materially different from other advanced steels they produce, simply focused on a specific need set of the automotive industry and thus attuned to their processes.</p>
3. Transformative Capacities:	DOCOL initiative has maintained a portfolio of the highest grade of steels available for at least thirty-five years. The transition from the first few cold rolled products to the offerings comprising every type of steel today and sold in increasing volumes into a global market is incontrovertible evidence that the initiative has indeed been successful in

	<p>generating the skills, knowledge and resources required to implement the product.</p> <p>Decarbonisation was not an explicit focus until later in DOCOL's history, although it is a natural consequence of improving transport energy efficiency. In many ways, this vision is still the one permeating DOCOL and the application of advanced steels in general. "A stronger, lighter, more sustainable world". At first the vision was about resources and the environment in general, but by their first environmental report (2008) it was also linked to climate change.</p> <p>DOCOL proved to SSAB (through sales and demand) that steels specifically targeted at applications in order to use less but higher quality steel was a viable business model. DOCOL was one of the product groups that survived SSAB's reorganization and served as a template on how to market green steel for 'greener applications' that permeates the company today.</p>
4. Assessment & Evaluation:	<p>DOCOL steel is more emission efficient than the global average for steel, but this is mostly due to the unusually pure iron ore in Sweden and the low carbon electricity supply.</p> <p>Many case studies exist documenting the impact of DOCOL steels in reducing the weight of individual components. There are also LCA studies showing the impacts of adopting lighter vehicle frames. DOCOL has without a doubt been successful in replacing steel components with lighter and stronger ones, in many verifiable case studies. There is thus evidence, that with each application, cars are lighter than they would have been and emissions lower than would otherwise have been the case. Yet the case cannot be made that overall emissions have decreased as average vehicle size has increased.</p> <p>SSAB monitors specifically sales volume, but for each grade and application these figures are directly correlated to weight reduction and can be extrapolated to marginal change in fuels consumption. SSAB also does case specific LCA work.</p>
5. Uptake & Consequences:	<p>The increasing sales figures of DOCOL steel directly demonstrate that the initiative is scaling up. The observable increase in AHSS as a percentage of vehicle chassis over time is also direct evidence that the concept of lightweighting is embedded in vehicle design.</p> <p>DOCOL steel has become a major economic pillar for SSAB, and SSAB is largely competitive in the automotive steel market because of premium quality and high standards of assurance. Taking on AHSS in automotive applications early has undoubtedly contributed to this competitive stance. Evidence for the impact is that SSAB, and the Swedish steel industry as a whole are competitive, where many national industries are struggling.</p>
<i>Conclusion &amp; Outlook</i>	
Key Learnings:	<p><i>Key insights from this case regarding ...</i></p> <p><i>Overall decarbonisation:</i> DOCOL steel is more emission efficient than the global average for steel, but this is mostly due to the unusually pure iron ore in Sweden and the low-carbon electricity supply. The overall decarbonisation of the steel sector and the automotive sector are dependent on radical changes in input fuels. Advanced steel has played a huge role in reducing component weight in vehicles, but this contribution has been eaten up by larger vehicles with more accessory systems. Advanced steels may have an important role in EV battery safety.</p> <p><i>Drivers and barriers:</i> Steel and automotive actors are very risk averse. The major barriers are in getting a new steel grade listed as acceptable for use. Ironically, vehicle safety regulation is seen as at least as important a driver as low carbon. Constant innovation in process is considered BAU in the sectors. Steel is very capital intensive.</p> <p><i>Instruments to overcome them:</i> Government guarantees of bonds for the initial equipment was decisive in launching the innovation. Government help in legitimizing new technologies and in creating niches is important. Again, safety regulations were a major driver for DOCOL. In new markets, e.g. SE Asia and India, ability to pay is very constrained, and this is a dominant factor slowing expansion.</p> <p><i>Role of policy:</i> Policy needs at least two tracks in these industries. The first is helping finance capital expenditures for radical innovations such as HYBRIT or EV adoption. The second is to help create acceptability and smooth the process of adoption for new steel grades. SSAB sees future regulations on crash safety for EVs as a major driver for growth in DOCOL. Other efforts include harmonizing and expanding vehicle regulations and standards beyond the OECD.</p> <p><i>Lessons for future innovations:</i> In the steel and automotive sectors, things take decades to change. Demanding higher standards in related fields (e.g. safety) can help.</p>
Open Questions &	How far can steel and lightweighting be taken in vehicles and why is average weight not

Further Research Requirements:	decreasing? Is new policy needed to make vehicles absolutely lighter? What is the role of advanced steels in accelerating adoption of alternative fuels in the automotive industry? How can policy help create more markets for 'green' steel? Can steelmaking be decarbonised (e.g. HYBRIT)?
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**REINVENT** focuses on plastics, steel, paper and meat & dairy – industrial sectors that are key to our daily lives, but where low-carbon transitions are still relatively unexplored.

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### **PARTICIPANTS & FUNDING**

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