Circular Economy

DAIMLER *and the auto industry*

Goals

This presentation seeks to explore the following:

- Better understand the manufacturing, supply chain, and profitability model of the European automobile industry, using Daimler as an example
- Identify potential strategies that Daimler can pursue, in a shift towards an efficient closed-loop circular system
- Assess the applicability of such strategies for the entire auto industry, as well as other industries globally
- Assess the financial benefits of such strategies, quantifying them so that a business case can be made

About Daimler

Daimler is a leading German automobile manufacturer, most well-known as the maker of Mercedes Benz vehicles

- Headquarters: Stuttgart, Germany
- Industry: Automotive
- Publicly Traded: Frankfurt Stock Exchange: "DAI"
- Revenues: €130 billion (2014)
- Net Income: €7 billion
- No. of Employees: 280,000 (2014)

Major Brands/Businesses

- Mercedes-Benz, Mercedes AMG
- Smart
- Daimler Buses
- Daimler Trucks
- Daimler Financial Services

Mercedes-Benz

Why Daimler

Daimler is an example of a firm uniquely positioned to benefit from a closed-loop circular strategy.

- It is a prominent European vehicle manufacturer with global customers and manufacturing operations
- Its premium pricing and services represent a higher potential for gross margin improvements via a circular system
- Above-average Cost of Goods Sold component (78%) represents lucrative cost-saving opportunities
- Its European operations and corporate culture instill a strong focus on sustainability
- An assessment of Daimler could yield findings similarly applicable to its industry peers such as BMW, Volkswagen, and Audi

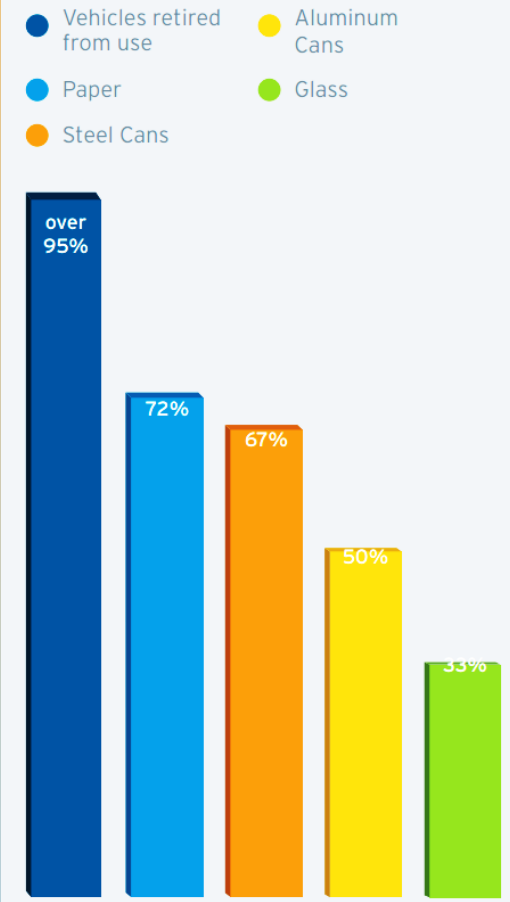
Current State – Auto industry sustainability

- Estimated average lifespan of a car: 13.5 years
- Each year, the steel industry recycles more than 18 million tons of steel from cars that are no longer fit for the road. This is equivalent to nearly 18 million new cars. Green house gas emissions are reduced by over 30 million metric tons per year
- Approximately 86% of a vehicle's material content is recycled, reused or used for energy recovery:
  - Manufacturers build new tires with 10% recycled tire rubber material
  - Recycled tire rubber is also used in brake pedals or floor mats
  - Metals such as steel or copper from old cars are melted down and reused for new consumer products, building construction, or put back into the production of new vehicles
  - Typically vehicles in North America are composed of approximately 20% post-consumer recycled material by weight. Everything from old carpet to blue jeans may end up in a new vehicle
  - Auto recyclers remove parts such as engines, transmissions, doors and bumpers for reuse in other vehicles
  - Other parts that can also be remanufactured include starters, alternators and water pumps. Batteries, catalytic converters, tires and some plastics are removed and their materials are recycled into new products
- Every ton of new steel made from scrap steel conserves: 2,500 lbs. of iron ore, 1,400 lbs. of coal, 120 lbs. of limestone
- In 2015, the European legally required recycling rate for end-of-life (ELV) vehicles, components and materials was raised to 85% reuse and recycling of materials and 95% overall recovery *

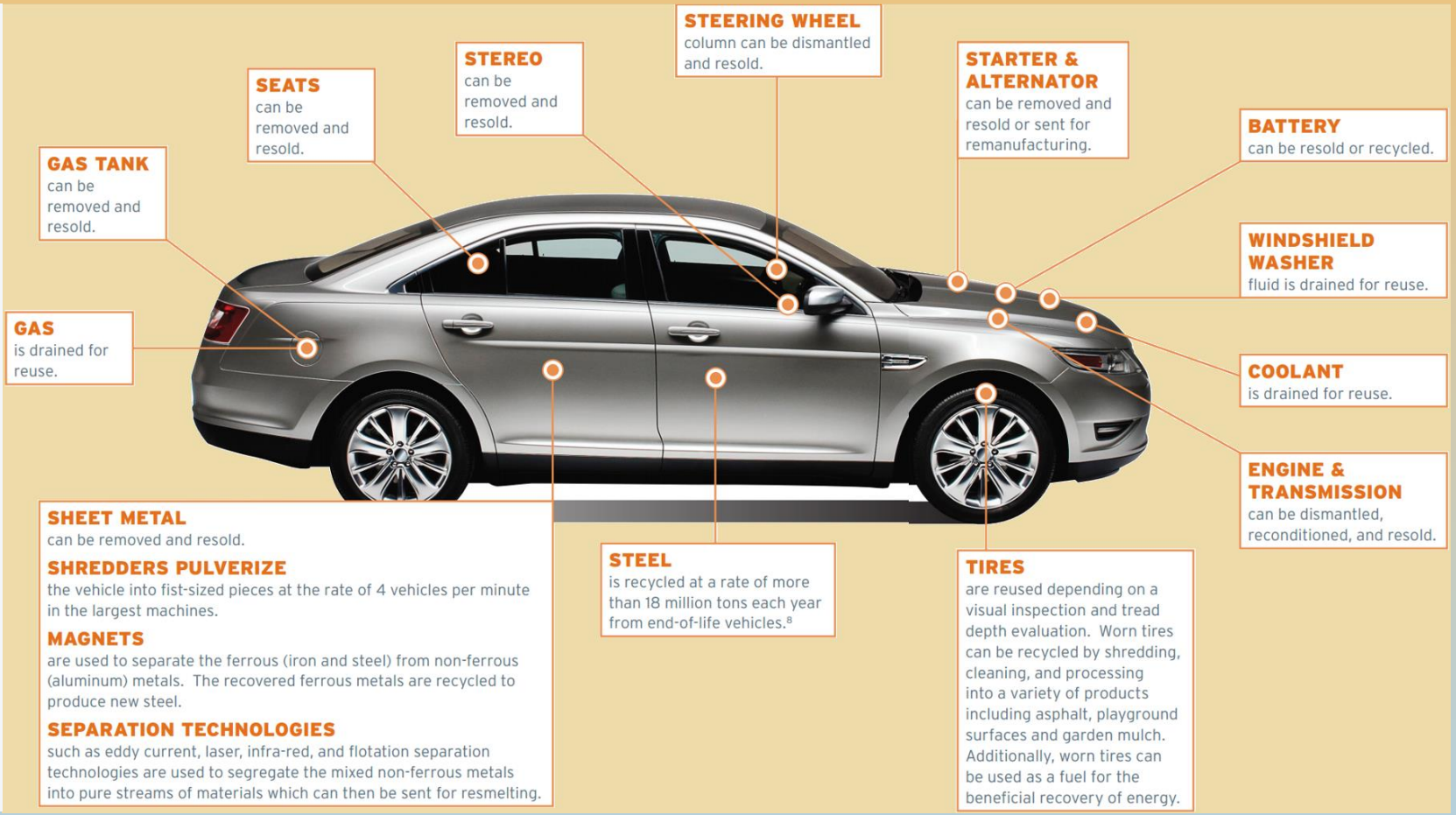
* BMW sustainable value report (2014)

Current State – Auto Industry

Recycling Rates, by Product



Components of a car that can be recycled



Vehicles are 95% recyclable*

Almost all components of a car can be recycled/resold/reused *

* Source: Automotive Recyclers Association

Current State – Daimler

- **What is Daimler's current business model?**
  - Daimler purchases parts from its suppliers, manufactures components, assembles vehicles, and sells these vehicles via dealers, to customers
  - Daimler owns some of these dealers (i.e. corporate stores), while others are independent
  - Daimler's dealers are mostly focused on selling new Mercedes Benz vehicles: ~ 80% new cars; 20% used cars
  - ~ 98% of Daimler's used vehicle sales are vehicles <5 years of age* (average vehicle lifespan: 13 years)
  - Daimler makes most of its income from new vehicle sales → However, new vehicles are expensive to manufacturer, and margins are low
  - Although 95% of Daimler's vehicle materials are recoverable, Daimler has not yet adopted a closed-loop circular strategy
- **What is Daimler's current manufacturing process?**
  - Daimler purchases most of its parts from its various German suppliers
    Major components such as engines and transmissions are then manufactured in house
  - Daimler's factories around the world then assemble these parts and components into complete vehicles
  - A subset of old components are "remanufactured" by Daimler for use in new vehicles. Remanufacturing involves building new components by repairing, refreshing, and modifying old components. Remanufactured parts are subject to the same standards that apply to new parts
  - Daimler's design teams work closely with remanufacturing experts in the early stages of the development process

* Based on research of Mercedes Benz USA and UK certified preowned websites

Current State – Daimler

- **What are the key raw materials used in Daimler's cars?**

Raw materials:	Steel and iron 56%	Other metals 18%	Plastics 12%	Other 10%	Rubber, 4%
Recoverability:	95%	95%	80%	80%	85%

- **Currently, to what extent are Daimler's materials or components recycled/refurbished/remanufactured?**
  - All Mercedes-Benz models are 85% recyclable and 95% recoverable *
    - Major components such as engines, transmissions, and axle housings
    - Mechanical components such as turbochargers, brake parts, and steering units
    - Components for diesel injection and after treatment
    - Electronic systems — including everything from navigation and control units to high-voltage batteries
  - 350 specialists for replacement engines (in Mannheim)
  - 2,100 employees are involved in remanufacturing activities around the world (U.S., Brazil, South Africa, and Japan)

* Daimler 2014 Annual Sustainability Report

Current State – Daimler

Daimler is currently able to remanufacture many key components of its Mercedes Benz vehicles*.
Remanufacturing saves energy and production costs, but requires careful planning during initial design.

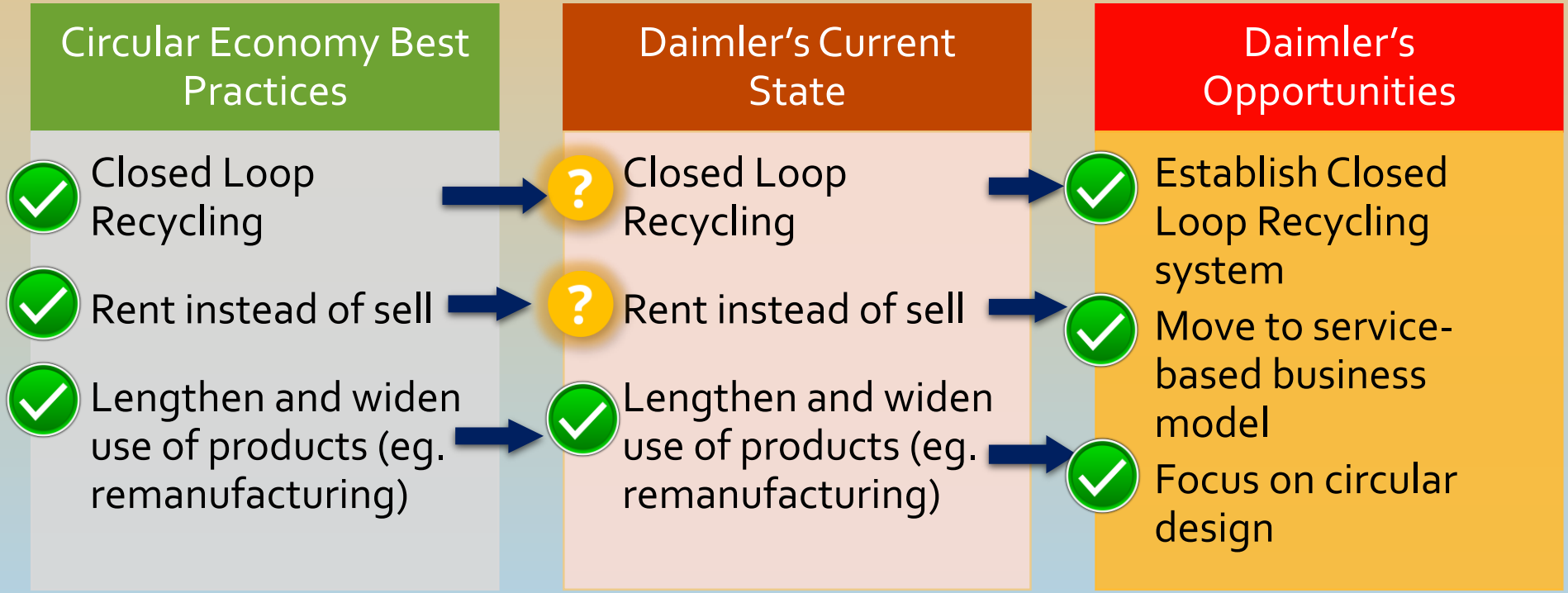
* Source: Daimler 2014 Annual Sustainability Report

Circular Strategy: Opportunities

Both Daimler and the auto industry already have a 95% recycling/recovery rate.

What more can be done? A lot.

- **Daimler can establish a closed loop recycling program, move to a service-based business model, and aim for higher remanufacturability rates**



Legend: Achieved Not Yet Achieved

Circular Strategy: Opportunities
1. Establish Closed Loop Recycling system

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- Daimler can establish a program that collects End of Life (ELV) vehicles directly from end customers. Materials from these ELVs will be directly recycled by Daimler's suppliers for use in Daimler's new vehicles.

Examples: The steel, aluminum, upholstery, and glass from an old Mercedes C-class vehicle can be recycled for use in a new C-class vehicle

Benefits:

- Reduces energy use by as much as 75%*.
- Ensures Mercedes doesn't lose track of most of these vehicles after 5 to 7 years. The useful life of a vehicle is 13 years.
- Efficient refurbishment and remanufacturing translates into a cost advantage for Daimler. Today, although 95% of a car's materials are recyclable, there are still many "gaps" in the circular loop
- Purer inputs (i.e. uncontaminated material) will result from this collection and redistribution efficiency*

* World Economic Forum: Towards the Circular Economy report, 2014

Circular Strategy: Opportunities
2. Move to service-based business model

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- Instead of just selling cars to customers, Daimler should establish a ***Long-term Lease ("LTL") program***. This program will be different from a traditional vehicle leasing arrangement.
  - In a traditional leasing arrangement, Daimler leases a vehicle to a customer for a fixed period (eg. 4 years), at the end of which the vehicle is returned and resold by Daimler (or independent dealer) to another customer as a used vehicle. Thereafter, Daimler has no association with the vehicle whatsoever.
- In the LTL program, Daimler charges customers a monthly fee for driving a Mercedes, instead of actually selling the Mercedes to the customer.
  - Daimler retains legal vehicle ownership, but in turn provides a lifetime warranty for the vehicle
  - During the lifetime of the vehicle (eg. 13 years), Daimler covers the warranty-eligible repairs and maintenance at no extra charge
  - Daimler will offer periodic upgrades to the engine, transmission, and vehicle cosmetics at an extra charge if the customer desires a periodic upgrade
  - At the end of the LTL period, the vehicle has also reached the end of its life. Daimler collects the vehicle and recycles/remanufactures its major components into a brand new car
  - The customer pays Daimler a flat monthly fee during this 10-year LTL period, for a worry-free driving experience.

Circular Strategy: Opportunities
2. Move to service-based business model (Cont'd)

Example of a service-based business model:

- Customer signs up for a LTL for a new 2016 Mercedes C-class sedan. From the customer's perspective, it is as if he has leased the vehicle indefinitely, with all expenses covered.
- He pays US$450 per month for the life of the vehicle* (estimated at 13 years).
  In comparison, a traditional 3-year lease currently costs US$550 a month.
- In return, Mercedes covers all scheduled maintenance and warranty-eligible repairs for the entire duration.
- Customer returns the vehicle at the end of vehicle life, but also has the option to return it prior to that, at a time-weighted penalty. Customer can also transfer the LTL obligation to another person for a nominal fee.

Benefits to customers:

- Customer enjoys unlimited driving mileage and very few restrictions, similar to owning the vehicle
- Customer no longer needs to worry about expensive out-of-warranty repairs after 4 years (when traditional warranties expire). This will save the customer money in the long run.
- Monthly payments under the LTL are stable and predictable, and lower than any other financing method (traditional lease, or financing). LTL monthly payments are also tax-deductible as a business expense.
- Customer avoids having to unnecessarily switch cars every 3 or 4 years because his/her lease term has 'expired'.
- Customer does not need to worry about "selling" the vehicle when it gets old and is in need of repairs. Mercedes will repair the vehicle for free, and recycle it when it reaches the end of its useful life.
- Regular maintenance and upgrades to the vehicle helps prolong its useful life.
- Customer can make non-warranty-nullifying modifications to the vehicle, or incur cosmetic damages to the vehicle without being fined by Mercedes Benz. (This is in contrast to a traditional leasing programs.)

* Life of vehicle (in years) will be estimated by Mercedes Benz at inception. Typically, 13 years or 200,000 miles of mileage, whichever is reached earlier.

Circular Strategy: Opportunities
2. Move to service-based business model (Cont'd)

Benefits to Daimler:

- Shifts towards a service-based business model as opposed to a manufacturing one
  - Service-based businesses typically enjoy higher margins, greater differentiation potential, as well as improved customer loyalty
  - Service revenue is regular, stable, and predictable. This leads to less income volatility and improved corporate valuations (hence higher stock price).
- Daimler can reduce vehicle production costs while retaining market share and increasing profitability per vehicle (because vehicles are no longer unnecessarily discarded by customers)
- The stability and predictability of the all-encompassing monthly payment will attract new customers
- By servicing and engaging the customer over a much longer horizon (eg. 13 years), stronger customer relationships will be built, and customer loyalty will be improved
- Daimler will be able to manufacture new vehicles much more efficiently and cost-effectively by recycling parts from existing vehicles
- By manufacturing fewer new vehicles and augmenting the profitability of existing ones, Daimler will significantly reduce inventory storage costs, raw material costs*, as well as manufacturing labor costs*
- Daimler will increase brand recognition as an innovative, sustainable, and environmentally-friendly company, thereby improving brand loyalty and equity

* Cost of Sales represent 78% of Daimler's total expenses. Direct labor costs are expensive. In Daimler's US plant (in Alabama), the average worker hourly wage is US$65.

Circular Strategy: Opportunities
3. Focus on Circular Design

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- Remanufacturing is preferable to recycling because it builds upon an already-manufactured component, as opposed to creating it from raw materials. Remanufacturing components avoids having to repurchase raw materials from suppliers (thereby avoiding incremental costs)
- Although Daimler is already able to remanufacture many of its vehicle's components, there is still room for improvement*

Opportunities for improving circular design:

- Ensure that the materials used are suitable for a closed loop manufacturing system (avoid materials that degrade significantly post-recycling)
- Invest in R&D to further improve on the recyclability of engines, specifically the following*:
  - Removal of magnets from the old engines
  - Repair and subsequent reuse of electric motors or their components
  - Recycling of magnet materials and rare earth metals
- Leverage 3D printing technologies when producing smaller-batch niche components that benefit from additive manufacturing. This can save up to 90% of raw materials

* Daimler highlighted some areas of potential improvement in its Annual Sustainability Report 2014

Circular Strategy: Financial Benefits

- The customer's monthly payment under the Long-term Lease model is actually 40% lower. This is attractive for cashflow conscious customers.
- Although the payment term is longer, the customer enjoys a hassle-free lifetime warranty on the vehicle

- Net income per vehicle has actually more than doubled for Daimler. "Selling" 1 car under this new model equals selling 1.17 cars under the old model.
- Net income margin has also increased significantly by 71%

Compare Daimler's profitability in selling a new vehicle to a US customer

2016 Mercedes Benz C300 | Retail Price: US$42,000

Financing Interest Rate: 2.99%

	Current business model (Finance Purchase)	New business model (Long-term Lease)	% Increase
Revenue			
Customer's monthly payment	754	450	-40%
Length of payment period	5 years	13 years	260%
Total Revenue	48,279	61,281 *	27%
Expenses			
COGS + SG&A expenses**	44,163	44,163	
Additional warranty expenses		8,600 ***	
Earnings before income tax (EBIT)	4,116	8,519	107%
Income Tax	1,303	2,414	85%
Net Income	2,814	6,104	117%
EBIT margin	8.5%	13.9%	63%
Net income margin	**5.8%**	**10.0%**	**71%**

* According to FASB, the vehicle's "selling price" under the sales-type lease = present value of the lease payments

** Based on Daimler's EBIT margin in its 2015 annual report

*** Estimated based on Mercedes Benz's published extended warranty premiums for every 3 additional years

Circular Strategy: Financial Benefits Forecasted Impact

Income

- Net income is expected to increase 9X by the year 2020 (compared to 2015)
- Revenue, however, only needs to increase by 2X, as cost of sales per unit is gradually reduced

Profit Margins

- Net profit margin is expected to increase by 4X (compared to 2015)
- Gross profit margin is expected to double

Stock Price

- EPS is expected to increase 9X by the year 2020
- Stock price (based on a historical average P/E ratio) is expected to increase 9X to $689 per share

Circular Strategy: Considerations

In adopting a circular strategy, the following issues should likely be considered. They will affect both the feasibility and results of strategy implementation

Feasibility of technological improvements

- Improving remanufacturability requires technological improvements and/or redesigning of certain components.
- This may proof to be capital intensive in the short run with financial benefits only visible after 3 to 5 years
- Not all components can be economically remanufactured. There will be limitations.

Long-term revenue streams

- Adopting the "rent instead of buy" model requires companies to give up large cashflows in the short-run in exchange for steady revenue streams in the long-run. The company must be ready for such a long-term view.
- Adopting the "rent instead of buy" model requires companies to focus more on customer service as opposed to just quality manufacturing

Competitive pressures

- The first-mover has an advantage if adopting circular strategies early. As competitors gradually all enter the space, margins will collectively suffer.
- Circular strategies help promote longevity of the firm's products. However, excessive longevity will hurt annual sales. Therefore, firms will need to balance between sustainability and sales growth.

Conclusions

Daimler stands to greatly profit from a Circular strategy

- Daimler has already made numerous strides in sustainability, however it can do more.
- Specifically, it can:
  (1) Establish Closed-Loop Recycling system
  (2) Move to service-based business model
  (3) Focus on circular design
- Net income and stock price can grow by as much as 9X in 5 years

The Auto industry stands to greatly profit from a Circular Economy

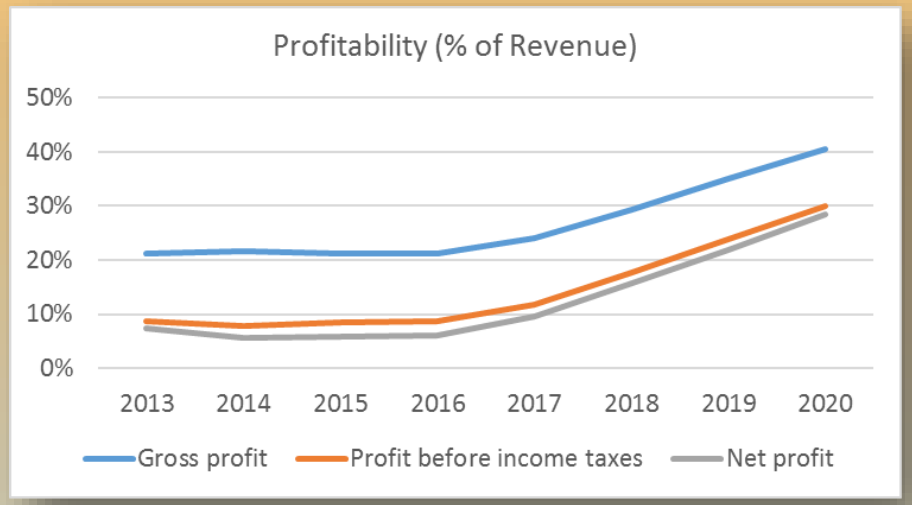
- Daimler is currently on equal footing with its European automotive peers in terms of sustainability
- Circular strategies that apply to Daimler can similarly apply to its peers (eg. BMW, VW)
- If the entire industry adopts efficient circular economy strategies, overall costs and waste levels will be drastically reduced

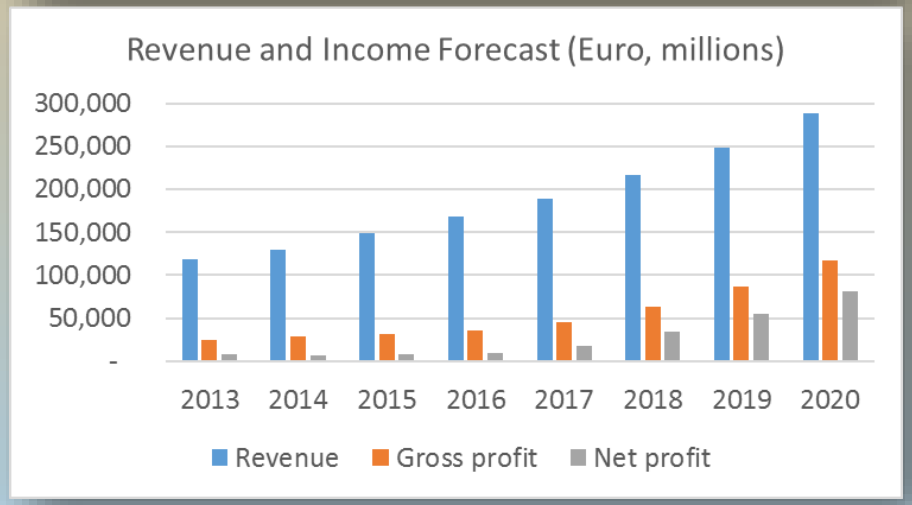
There is a compelling business case for adopting a Circular strategy

- Full adoption of the circular strategy not only conserves resources, but also reduces business expenses dramatically
- This significantly increases firms' net margins, returns, and stock prices

Appendices

Appendix A: Forecasted profitability margins





	Common Size (as % of Revenue)							
	2013	**2014**	**2015**	2016	2017	2018	2019	2020
Revenue	100%	100%	100%	100%	100%	100%	100%	100%
Cost of sales	79%	78%	79%	79%	76%	71%	65%	59%
Gross profit	**21%**	**22%**	**21%**	**21%**	**24%**	**29%**	**35%**	**41%**
Selling expenses	9%	9%	8%	8%	7%	7%	6%	6%
General administrative expenses	3%	3%	2%	2%	2%	2%	2%	2%
Research and non-capitalized development costs	4%	3%	3%	3%	3%	3%	3%	3%
Other operating income	1%	1%	1%	1%	1%	1%	1%	1%
Other operating expense	0%	1%	0%	0%	0%	0%	0%	0%
Profit/loss on equity method investments, net	3%	1%	0%	0%	0%	0%	0%	0%
Other financial income/expense, net	0%	0%	0%	0%	0%	0%	0%	0%
Interest income	0%	0%	0%	0%	0%	0%	0%	0%
Interest expense	1%	1%	0%	0%	0%	0%	0%	0%
Profit before income taxes	**9%**	**8%**	**9%**	**9%**	**12%**	**18%**	**24%**	**30%**
Income taxes								
Net profit	**7%**	**6%**	**6%**	**6%**	**10%**	**16%**	**22%**	**28%**

Appendix B: Disclosure of key forecast assumptions

Assumption	Annual Growth Rates					Rationale
	2016	2017	2018	2019	2020	
Revenue	12%	13%	14%	15%	16%	Revenue grew by 12% per year over the past 2 years. Assuming circular strategies are adopted, revenue can be expected to grow by 16% in 2020
Cost of Sales	12%	9%	6%	6%	6%	Cost of Sales traditionally grew in line with revenue growth rates. However, by adopting a closed-loop circular strategy, Daimler can likely curtail the growth in Cost of Sales. This is anticipated to materialize by 2018, following heavy R&D investments that bring about stronger remanufacturing capabilities.
Selling expenses	10%	5%	5%	5%	5%	Selling expenses will increase in the short-run (in 2016) as additional bonuses will be used to motivate the salesforce to push the new "business model". However, once customers accept and adjust to the new model, sales incentives can be normalized again.
General administrative expenses	6%	9%	10%	11%	12%	As cost of sales decrease, general administrative expenses will increase. This reflects the additional resources needed to administer the large number of long-term-lease vehicles now under Daimler's management and warranty.
R&D Costs	16%	16%	16%	16%	16%	Daimler is expected to invest significantly in R&D, to improve component remanufacturability and recyclability. Such investments will start paying off in the medium term.

Appendix C: Daimler Pro-forma income statement and EPS

	2013	2014	2015	2016	2017	2018	2019	2020
Revenue	117,982	129,872	149,467	167,904	189,731	216,294	248,738	288,536
Cost of sales	- 92,855	- 101,688	- 117,670	- 132,147	- 144,040	- 152,683	- 161,843	- 171,554
Gross profit	25,127	28,184	31,797	35,757	45,691	63,611	86,894	116,982
Selling expenses	- 11,050	- 11,534	- 12,147	- 13,362	- 14,030	- 14,731	- 15,468	- 16,241
General administrative expenses	- 3,188	- 3,329	- 3,710	- 3,940	- 4,294	- 4,724	- 5,243	- 5,872
R&D costs	- 4,205	- 4,532	- 4,760	- 5,541	- 6,450	- 7,482	- 8,679	- 10,067
Other operating income	1,530	1,759	2,114	2,114	2,156	2,199	2,243	2,288
Other operating expense	- 399	- 1,160	- 555	- 555	- 566	- 577	- 589	- 601
Profit/loss on equity method investment	3,345	897	464	464	473	483	492	502
Other financial income/expense, net	- 349	458	- 27	- 27	- 28	- 28	- 29	- 29
Interest income	212	145	170	170	173	177	180	184
Interest expense	- 884	- 715	- 602	- 602	- 614	- 626	- 639	- 652
Profit before income taxes	10,139	10,173	12,744	14,479	22,513	38,302	59,164	86,494
Income taxes	- 1,419	- 2,883	- 4,033	- 4,343	- 4,429	- 4,518	- 4,608	- 4,701
Net profit	8,720	7,290	8,711	10,136	18,083	33,784	54,556	81,793
Profit (non-controlling interests)	1,878	328	287	334	596	1,113	1,797	2,695
Profit attributable to shareholders	6,842	6,962	8,424	9,802	17,488	32,671	52,758	79,098
EPS Basic	6.4	6.5	7.9	9.2	16.3	30.5	49.3	73.9
Stock Price (yearly average)	50	65	80	85	152	284	459	689
P/E ratio	7.8	10.0	10.2	10.2	10.2	10.2	10.2	10.2