Tesla’s History:
Startup Experiences in the Automotive Industry

- The automotive industry hasn’t been kind to startups with new ideas. Ever since the “Big Bang” period of the automobile in the first few decades of the 20th Century, no company has successfully entered the industry and survived more than a few years. Some of the casualties:
  - Tucker Torpedo-1948 (Top Left): Industry visionary Preston Tucker designed a unique car (which included a “frunk”, or front trunk) and organized 2,000 dealers. The car didn’t sell and the company collapsed amidst legal woes.
  - The Dymaxion-1933 (Bottom): Buckminster Fuller designed the Dymaxion, an odd-looking three-wheeled people-mover which never gained traction in the marketplace.
  - Delorean DMC12-1981 (Top Right): Design legend John Delorean created the DeLorean, one of the most distinctive coupes ever built. But sales were flaccid and Delorean eventually turned to drug dealing (and prison) to unsuccessfully keep his car company afloat.
Tesla’s History: Strategic Vision and Values

- After covering Tesla Motors for more than a decade and observing its financial growth, process development and behavior traits, we feel that the most common misrepresentation of the company is that it is a luxury carmaker.

- Tesla’s goal always has been, and always will be, to bring the electric drivetrain to the masses. Thus the impending launch of the Model 3 is an extremely important moment for the company.

- Tesla also has a history of sacrificing near-term financial goals for long-term milestone achievement.

- Tesla under Elon Musk has shown a skill and deftness in brinksmanship in negotiations that has served the company very well in its dealings with suppliers, competitors and government agencies.
The successful launch of the Model S in 2012 transformed Tesla from a specialty sports car assembler to a full-scale mass manufacturer.

Cairn ERA expects sales of the Model S will dip in 2016 due to the cannibalization effect of the Model X. That will be followed by slower growth in the next few years until the Model S reaches its apogee of growth in 2023.

By 2020, Cairn ERA expects Tesla to have sold a cumulative total of 291,255 Model S units.
Model 3: Specifications Estimates

- Year Introduced: 2016
- Battery Pack Size: 65 KWH
- Battery Cells: 4,400
- Battery Modules: 12
- Voltage Level: 350
- Base Price: $35,000
- Zero to Sixty: 4.4
- Horsepower: 300-350
- Max Torque: ~300 lb. ft.
- Range: 225 miles
- Fastest Full Charge Time: One hour
Model 3: Unit Shipment Forecast

- Cairn ERA expects Tesla Motors to successfully launch the Model 3 in 2017, however unit shipments will only reach 12,200 in that year. By 2020, the company will have shipped 196,890 Model 3 cars.
- Cairn ERA expects the Model 3 to become a market leader in its segment (medium luxury sedans) by 2019.
- Overall growth in unit shipments will increase at a CAGR of 200.4% each year until 2020.
A fundamental part of Tesla’s overall strategy is the buildout of its Supercharger network. Superchargers are Tesla’s proprietary high-voltage DC chargers and function much like gas stations do for conventional cars. By providing a functional network of strategically placed Superchargers, Tesla can overcome the majority of the factors that cause range anxiety.

By 2016, Tesla had installed 3600 chargers in 611 stations throughout the world.

Cairn ERA expects Tesla to continue to build out its Supercharger network just to be able to handle the needs of Model S and Model X drivers. Once the Model 3 is introduced, Tesla will need to at least triple the amount of Superchargers in its network. And that assumes that Model 3 drivers will have to pay for their Supercharger sessions (which provide free energy to Model S and Model X drivers).
The Model 3 Battery:  
*Cell Components*

- Cathode: LiNi0.76Co0.14Al0.10O2 Cathode (NCA)
- Anode: Battery Grade Graphite mixed with Silicon
- Voltage Range: 3.6-4.0; 3.6 Nominal
- Capacity: Maintains 90% capacity after 3,000 full DoD cycles
- More nickel is used in the battery than lithium or cobalt
- Cobalt concentration is approximately one-third of that used in consumer electronics Li-ion batteries
- Battery is designed to be capable of high bursts of power (both in charge and discharge). It does, though, require relatively tight temperature parameters.

Panasonic’s 18650 cell used in the Model S
The Battery: Tesla’s Battery Demand 2013-2020

- Tesla’s demand for batteries has grown from 1.1 GWH’s in 2013 to 6 GWH’s in 2016. Almost all those batteries will go into the Model S and the Model X.
- By 2020, Cairn ERA predicts that Tesla will need 31 GWH’s of batteries. This will be for a combination of the three car models and Tesla Energy products (although automotive will dominate demand).
- All of the batteries produced for Tesla today are being manufactured in Japan by Panasonic. By 2020, all batteries produced for all products will be manufactured in the GigaFactory.
The majority of Tesla’s battery demand will be for automotive purposes. That will remain the case through 2025.

Cairn ERA expects that Tesla’s automotive demand for batteries will grow from 1 GWH in 2013 to 58.4 GWH in 2025. Meanwhile, Tesla Energy’s growth in demand will rise from 65 MWH in 2016 to 11.1 GWH in 2025.
The GigaFactory: The Concept

- The GigaFactory is a key element in Tesla’s goal for long-term growth. By building a manufacturing eco-system in a single building, Tesla expects to be able to dramatically reduce the cost of the batteries it buys. Key facts:
  - Expected Building Completion Date: Mid-2018
  - Expected Full Capacity of all Lines: Early 2020
  - Manufacturing Capacity upon Completion: 35 GWH of cells; 50 GWH of Packs*
  - Battery Manufacturing Partner: Panasonic
  - Other Component Partners: To Be Determined
  - Cost of Construction:$5-8 billion
  - Employees at Full Capacity: 6,000

*Battery cell production is measured in energy capacity; The GigaFactory will be able to produce 50 GigaWattHours of battery packs in the course of one year of production.
The GigaFactory: Cost Savings

- Tesla commenced construction on its first GigaFactory in Sparks, Nevada in late 2014. As of March 2016, only one third of the planned structure of the GigaFactory has been built. Some assembly operations have already commenced in that finished structure.

- The goal of the GigaFactory is to manufacture dramatically cheaper batteries than traditional battery factories make. Tesla executives have officially stated that they expect GigaFactory batteries to be one third cheaper than the price-point of batteries that Tesla will be buying from other factories midway through 2016.

- In Cairn ERA’s opinion, the sources of this pricing decline are:
  - Scale of manufacturing operations
  - Supply chain contraction
  - Supplier profit margin contraction
The Ford F-150 assembly plant in Dearborn, MI is the largest manufacturing facility in the U.S. The above two pictures (on the left is an artist’s concept of what the Tesla GigaFactory will eventually look like; the picture on the right is of the Ford Dearborn factory) have been sized to scale. Additionally, the GigaFactory has four floors, while most of the Dearborn facility is a single floor.

Economies of scale, however, do not always ascend in a straight line. Most battery manufacturing experts feel that economies of scale diminish dramatically after a 1 GWH facility is built. Thus the sheer size of the building is not the only reason for the GigaFactory’s cost contraction impact.
The Gigafactory: The Journey of a Lithium Molecule

- A lithium molecule is extracted from a salt lake in Chile and then follows this route before a car customer drives off the lot powered by batteries using that lithium molecule.
  - Shipped from Chile to Alabama to be refined into battery grade Lithium Carbonate. 4,788 Miles.
  - Shipped from Alabama to Los Angeles Port and then to Japan for further refinement. 7,480 Miles.
  - Shipped to Korea for mixture into NCA slurry. 714 Miles.
  - Shipped to Shanghai. 537 Miles.
  - Multiple stops at various distribution warehouses in the Shenzhen/Shanghai area before being incorporated into a battery at a factory in Shenzhen. 200 Miles.
  - Battery is then shipped back to Los Angeles to be incorporated into car battery pack. 6,465 Miles.
- Total Miles: 20,184 Miles
The GigaFactory: Cost Savings

- Based on conversations with suppliers and competitors, Cairn ERA estimates that Tesla is paying Panasonic approximately $125 per KWH on a cell level for its NCA automotive cells.
- Due to the economic impacts of the GigaFactory, Cairn ERA predicts that pricing for the cells will reach $105 per KWH by 2020.
- After 2020, incremental gains in battery manufacturing cost will continue to be made, leading to a price of $90 per KWH by 2025.
### Competitive Landscape: BEV Offerings from Incumbents

<table>
<thead>
<tr>
<th>Model</th>
<th>Manufacturer</th>
<th>Range</th>
<th>Cost</th>
<th>2017 Global Unit Sales Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolt</td>
<td>General Motors</td>
<td>200</td>
<td>$35,000</td>
<td>13,248</td>
</tr>
<tr>
<td>Leaf 200</td>
<td>Nissan</td>
<td>200</td>
<td>$35,000</td>
<td>18,000</td>
</tr>
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<td>i3</td>
<td>BMW</td>
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<td>$42,000</td>
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<td>Zoe</td>
<td>Renault</td>
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<tr>
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<td>BYD</td>
<td>250</td>
<td>$31,000</td>
<td>86,500</td>
</tr>
<tr>
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<td>Hyundai</td>
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<td>Nissan</td>
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<tr>
<td>Model 3</td>
<td>Tesla</td>
<td>225</td>
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<td>12,200</td>
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</table>

- Despite the production of hundreds of thousands of plug-in electric vehicles, it is clear that the Model 3 will not face competitive pressures for current or planned models in the next few years. Its range, relatively low price point, feature set and performance specifications won’t be matched by any other EV model to be produced in the next five years.
Competitive Landscape: New Car Startups

<table>
<thead>
<tr>
<th></th>
<th>NextEV</th>
<th>Atieva</th>
<th>Dyson</th>
<th>Rimbac</th>
<th>Faraday Future</th>
<th>TechRules</th>
<th>Karma</th>
<th>Elio</th>
<th>Google</th>
<th>Apple</th>
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</thead>
<tbody>
<tr>
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<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No</td>
<td>No</td>
<td>?</td>
</tr>
</tbody>
</table>

- At least 10 new car startups are actively developing EV models for the global market (this does not count the dozens of relatively new car companies in China developing only for the Chinese market). Cairn ERA expects that only a handful of these companies will actually produce a production vehicle.
- While all of these companies represent potential competition for Tesla, that competition won’t be felt until 2020 at the earliest.
Competitive Landscape: Entry Level Luxury Sedan Market

- The Model 3 is designed to compete in the entry level luxury sedan market, which is dominated today by the BMW 3 series and the Mercedes C Class. In 2015, 1.25 million cars were sold into this segment of the market throughout the globe.

- If Tesla gains the same market share in three years in this segment that it accomplished with the Model S in the same time period (17.7%), then it would sell 216,384 Model S units in 2020.

Source: Edmunds, Manufacturers, Cairn ERA
Competitive Landscape: Global Automotive and PEV Sales Forecast

- Global auto sales are expected to grow from 72.2 million units in 2015 to 94.2 million units in 2025.

- PEV sales are expected to grow from 506,956 in 2015 to 16,167,089 units in 2025.

- Cairn ERA expects that by 2025, PEV’s will account for 17.2% of the overall vehicle market.
Key Takeaways

- Cairn ERA predicts that the Model 3 will be a very high-selling car, with 196,890 units shipped in 2020. Although this number is nearly 100,000 short of Tesla’s official guidance, we believe that such a result would be an extremely positive achievement for the company and will allow it to lay the foundation for further expansion into other model types over the coming ten years.

- In the coming years, Tesla will begin the transition from being a car manufacturer to being a car sharing platform. Although Cairn ERA expects that most of its cars by 2025 will still be individually sold, car sharing will become a significant factor in the company’s business model.

- The GigaFactory concept will essentially be proven valid by 2020, even though its production won’t reach Tesla’s stated goals of 50 GWH of pack production in the next four years. At least three more GigaFactories will be built by 2025.

- Tesla will pay be paying a little more than $100 per KWH for its battery cells in 2020. That number will drop to $93 by 2025.

- Tesla Energy will be a relatively small portion of Tesla’s overall business over the next ten years, primarily because of the lack of an existing market demand for the products. Cairn ERA expects that Tesla will ship more than 41 GWH’s of stationary storage battery packs cumulatively by 2025, however that will still be an extremely small part of the overall electricity industry.
Cairn ERA’s Key Predictions Regarding the Tesla Model 3 and Other Tesla Products

- Number of first 24 hours of sight-unseen reservations to be announced on Thursday night: 30,000+
- Number of Model 3 reservations in first week: 90,000+
- Number of Model 3 reservations by June 2017: 250,000+
- Model 3 Unit Sales in 2017: 12,200
- Model 3 Unit Sales in 2020: 196,890
- Tesla’s Overall Battery Demand in 2020: 26 GWH’s
- Tesla Energy Battery Demand in 2020: 1 GWH
- Number of 7 KWH PowerWall shipments in 2020: 18,044
- Number of 100 KWH PowerPack shipments in 2020: 22,001
- Number of New Models Launched by 2025 after the Launch of the Model 3: 5 (pickup truck, Model 3 Crossover, economy car, specialized truck)
- GigaFactory cell manufacturing output in 2020: 25 GWH’s
The full report on which this presentation is based is available for purchase for $499 through our distributor: Shmuel DeLeon Energy Inc. (www.sdle.co.il). The report includes:

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Cairn Energy Research Advisors is a research and consulting firm with a focus on energy storage. We provide strategic insight and data that allows our clients to thrive in the dynamic global energy marketplace.

We are based in Boulder, CO and work with clients in Asia, Europe, the Middle East and North America.

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