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Evaluating California's Zero-Emission Vehicle (ZEV) Credits and Trading Mechanism and its Potential Suitability for China

INNOVATION CENTER FOR ENERGY AND TRANSPORTATION
iCET
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Executive Summary

Context

- Accounting for over 25% of GHG emissions and about 50% of city center air pollution, China's petroleum-based transportation system is growing at unprecedented rates and driving the global production and sales of automobiles. The rapid increase in China's vehicle fuel consumption is in stark contrast to the global fuel economy initiative goal of reducing petroleum consumption by 50%-80% by 2050. Meanwhile, air quality in China's major cities continues to deteriorate at alarming rates, posing major health risks and triggering social unrest.
- Although China has committed itself to ambitious energy consumption reduction policies and has already started incentivizing the commercial development of New Energy Vehicles (NEVs) and related infrastructure, it is clear that more aggressive, comprehensive, and innovative approaches are in need. Instead of solely incentivizing consumption through end-user subsidies, it is necessary that we also address the inventive structure that drives manufacturing in order to create diverse and attractive commuting alternatives. Through such an inclusive approach, socio-economic development could be decoupled from private mobility usage. Furthermore, multi-stakeholder engagement that is guided by (but not financially managed and dependent on) the government, is deeply needed to slow and eventually reverse the trend of worsening air pollution and high adaptation risks in Chinese growing cities.
- In recognition of the importance that market-based mechanisms play in the transition to a low-carbon economy, Chinese mega cities such as Shenzhen, Shanghai, and Beijing have launched carbon emissions trading schemes over the past year. These schemes, currently in their pilot stages, are projected to further test the grounds for innovative trading approaches and multidisciplinary participation aimed at increasing carbon efficiency and improving air quality.

Purpose and Methods

- The California ZEV-Credits scheme has been identified as a truly innovative program with high contribution value to support sub-national low-carbon development. Furthermore, the Californian ZEV-credits scheme has recently received the attention of national decision-makers (among which are NDRC, MOF, MIIT) as well as local planners (mainly local DRCs). *i*CET was invited to attend a cross-ministerial workshop aimed at introducing California's best practices for

advancing clean transportation, through which it gathered national-level feedback and ideas concerning a local program development.

- Many local governments such as those in Beijing and Shanghai are in search of new policy initiatives that will enable them to meet the recently announced city emission targets (Atmospheric Pollution Prevention Action Plan, 2013), advance their low-carbon development utilizing their pilot status and dedicated funds (National Low Carbon Pilot Cities, 2010) and promote the commercialization of new-energy vehicles (New Energy Vehicle Pilot Cities, 2009). Most of these cities have established emissions exchange platforms and are examining the potential contribution these platforms could make on cities' air-quality, emissions mitigation, sustainable development as well innovation and commercialization of green solutions. *i*CET has been in communication with cities that expressed interests as well as provided initial inputs on the suitability of a ZEV-credits type program to China.
- Through the single case study of global electric car leader Tesla Motors, this work has demonstrated the capacity building the ZEV credits program provided for small manufacturers in a fast evolving and highly dominated market place. As Tesla Motors is publically registered on the Nasdaq, records of the company's financial reporting and third party (e.g. J.P. Morgan) analyses were used in this study.

Study Outcomes

- The ZEV regulation builds on the program in place since 1990 and is designed to rapidly increase ZEV production to early commercial volumes, establishing a sustainable and growing market for these advanced technology vehicles. The current definition of ZEVs includes the four categories of vehicles which are entitled to different types of credits:
- While critics doubt the ZEV regulation contribution to California's emission reduction goals, CARB claims that in reality it has spurred significant commercial integration of mainly near-zero emissions vehicles. For instance, nearly 2 million Californians are driving partial zero and advanced technology partial zero emission vehicles (PZEV and AT PZEV) with near-zero tailpipe emissions and some 80% cleaner exhausts than the average 2002 model year car. In addition, gas-electric hybrid vehicles are also a success accounting for over 400,000 hybrids on California's roads.
- The advantage of California's ZEV approach lays in its integrated methodology for addressing both criteria pollution and GHG emissions, while allowing ZEV credits trading in a pre-defined market place. Through credits trading early stage zero and

near-zero emission vehicle companies are funded and all automakers are provided with an added incentive to develop ever-cleaner vehicles and related technologies. For example, Tesla Motors has earned revenue from the sale of ZEV credits of about $245M over 5.5 years (accounting for 27% of its profits to date), enabling it to reach market maturity in the cash-strapped new energy vehicle industry that have typically diminished PEV players elsewhere (e.g. Coda, Better Place etc.).

- In order to allow for its initial and increasingly expensive design, development, procurement, and sales Tesla relied on receiving pre-announced ZEV credits, sales of its electric power-train components, the financial market (since 2008), as well as pre-orders and down payments. The impact of changes in sales of regulatory credits were recognized as one of importance to the company at its development stages.
- In its 2012 financial discloser, Tesla recognized that the sharp increase of some 350% in gross revenues from car and credit sales was derived by ZEV credits. In the first quarter of 2013 Tesla reached profitability for the first time while credits accounted for 604% of its profit (and 87% of its gross margin). In Tesla's 2013 first half-year disclosure it recognized $119.4M in ZEV credits sales that have largely contributed to the company's gross margin growth.
- The revenue from credits in 2008 has enabled the company to engage in powertrain deliveries to mature and leading auto manufacturers, starting off from Daimler with actual shipments of batteries and chargers commencing early 2010, furthering to its ongoing commitments fulfillment to other manufacturers, and continuing with supporting its global expansion capacity. The credits could have enabled Tesla to meet the obligations of service agreement with leading automakers.
- ZEV credits' impact on Tesla's gross margin is significant, enabling the company to reach a whopping margin of 25% in the last quarter of 2013, overtaking Ford's 15.5% and General Motors' 12% gross profit margin. The ZEV credits accounted for up to 125% of the company's gross revenue over the past five years. As gross margin is often used by analysts from the financial market, the ZEV-credits arguably made important contribution to the company's stock valuation and subsequently influenced its liquidity.

Recommendations

- One clear shortfall of this program's scope lays in its neglect of low-emissions infrastructure and components players. While auto manufacturers can enjoy the fruit of the program during their seed period, other complementary players that have a significant influence on market demand and uptake are excluded from this

scheme. As evidence in recent years' financial instability of electric power train components producers, such as the bankruptcy of A123 Inc., and the integrated charge-switch network provider Better Place Inc., lack of support in the complete zero-emissions car ecosystem may result in delays of mass-market integration of zero-emissions vehicles.

- Another issue with the current California-grown ZEV credit scheme is the inability of a participating seed-company to expand geographically and internalize its market potential at every technological step. As evidenced in the case of Tesla, selling its first model the Roadster abroad has resulted in revenue slowdown. The utilization of potential profits for every technologically-intense product to the full extent is essential for breakthrough technology market shapers, as they are typically facing scarce demand and limited resources.
- For the case of China, the above described adverse effect of geographically confined ZEV credits program is even more complex. While large geographies within China are an important potential revenue streams for local manufacturers, local protectionism and a favorable institutional framework may hamper the expansion of a local ZEV credit scheme.
- The feasibility of a China-tailored ZEV credits type program should be more thoroughly investigated through in-depth qualitative research incorporating global experts (primarily active in the California ZEV credits program) and local stakeholders, among which local potential pilot-city government will pay key role. The scalability of such program, just like in the case of the US, is a process dependent upon various evolving factors – however a goal that should be aimed at once a pilot stage is proven to be effective in advancing local new energy transportation capacity building and air quality improvement.

1. Background

Recent studies indicate that China is on course to overtake the U.S. as the world's top oil importer in 2014. Oil imports to China are projected to surpass 6 million barrels a day, enabling China to meet 60% of its oil needs from foreign crude[1]. Not surprisingly, accounting for over 25% of GHG emissions, China's oil-fueled transportation is already leading global production and sales and is projected to increase roughly 5-7% annual during the next decade. These complementary trends are in stark contrast to the global goal of 50% reduction in petroleum use and GHGs emissions by 2050. Meanwhile, air quality in China's major cities continues to deteriorate at alarming rates.

Although China has committed to some of the most ambitious policies for reducing energy consumption and begun incentivizing the commercial development of new energy vehicles and related infrastructure, it is clear that more aggressive and innovative approaches are needed for slowing down and eventually reversing the trend of rapidly rising oil consumption rates and worsening air pollution in many Chinese mega cities such as Beijing and Shenzhen.

This report is aimed at introducing the California ZEV-Credits Program, a recent innovative scheme for incentivizing sustainable vehicle production and financing clean transportation technologies development through the transportation sector. The Program's success will be evaluated through a single case study of world's leading California-based electric vehicle manufacturer, Tesla Motors. This report will end with initial suggestions for policy-makers and related stakeholders on how a similar program could be evaluated and tailored for use in China.

[1] Organization of the Petroleum Exporting Countries report (2011).

2. Introduction of the ZEV scheme

2.1 California's role

The State of California, representing one of the most polluted states in the US with over 26 million cars on its roads accounting for nearly 40% of its GHG emissions, is continuously developing and implementing some of the world's most innovative programs for improving the state's air quality[2]. These stringent and complementary programs include zero as well as low-emission vehicles' development and market commercialization.

With the target of advancing sales of non or nearly non-polluting vehicles[3] (15.4% of projected sales estimated at 1.4M) and significantly increasing vehicles' fuel economy by 2025[4], California aims to achieve the following goals**:**

- New vehicles will emit 34% fewer global warming gases and 75% fewer smog-forming emissions, therefore addressing both global and local challenges.
- Environmentally superior cars will be available across the range of models (compacts, SUVs, pickups, minivans etc.), thus avoiding consumer compromise while shifting to greener vehicles.
- Consumer savings on fuel costs will average $6,000 over the life of the car. The savings are projected to be greater than the average $1,900 increase in vehicle price for ultra-clean, high-efficiency technology. Market conditions which independently promote the adoption of cleaner private transportation would hence be put in place allowing for mass adoption beyond the limited early-adoption.

In January 2012, California adopted a new Advanced Clean Cars program to further refine the path for its above stated goals, which is composed of four separate, yet related schemes: GHG standards for cars and light truck; Clean Fuels Outlet; Reducing Smog-Forming Emissions; and Zero Emissions Vehicle (ZEV) Regulation. The latter two are unique to California, of which the ZEV regulation has also been successfully adopted by 10 other US states[5] collectively representing about 30% of the US vehicle market[6].

[2] Source: CARB ZEV tutorial.
[3] PHEV, EV and Hydrogen Fuel-cell vehicles.
[4] Large volume manufacturers selling at least 20k vehicles in California, would have to introduce Zero Emissions Vehicles that would account for at least 15.4% of their fleets.
[5] Arizona, Connecticut, Maine, Maryland, Massachusetts, New-Jersey, New-Mexico, New-York, Oregon, Rohde Islands and Vermont.
[6] http://www.mass.gov/eea/agencies/massdep/news/releases/governors-initiative-to-put-3-3-m-zevs-on-road-by-2025.html

Figure 2. 1: An outline of ZEV requirements' adjustments per vehicle model in brief*

Model year	1998	2001	2003	2009	2012	2015	2018
ZEV fleet portion requirement	2%	5%	10%	11%	12%	14%	16%
*** This table is a simplification of a dynamic and complex requirements measurement method and is meant for providing an illustration only.**							

Moreover, the ZEV strategy has taken into account market factors and economic impacts throughout the process of its formation starting in 1990. Its success has become evident in recent years through the number of clean vehicles adopted and the financial stability of innovative clean technology companies. The ZEV program will therefore be at the focus of this work, while the case of Tesla Motors will attempt to exemplify its advantages and robustness.

2.2 The ZEV program outline

In order to achieve 80% reduction in GHG emissions from 1990 levels by 2050, The Zero Emission Vehicle (ZEV) regulation was first adopted as early as 1990 as part of the Low Emission Vehicle Program set by the California Air Resources Board (CARB). At the core of this regulation, is the utilization of industry players' resources for advancing market development and integration of low and zero emission vehicles (plug-in hybrid and hydrogen fuel cell cars).

The ZEV regulation is a credit scheme mandating a portion of car manufacturers' vehicles sold in a state during each model year to be zero emission vehicles. It allows for a manufacturer to earn credits, referred to as ZEV credits, if it produces and delivers for sale zero emissions vehicles, including passenger cars, light-duty trucks and medium-duty vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any or all possible operational modes and conditions[7]. A manufacturer with a surplus of credits may sell its excess credits to other manufacturers who can then apply these credits in order to comply with the regulatory requirements, including making up for deficits.

The ZEV regulation builds on the program in place since 1990 and is designed to rapidly increase ZEV production to early commercial volumes, establishing a

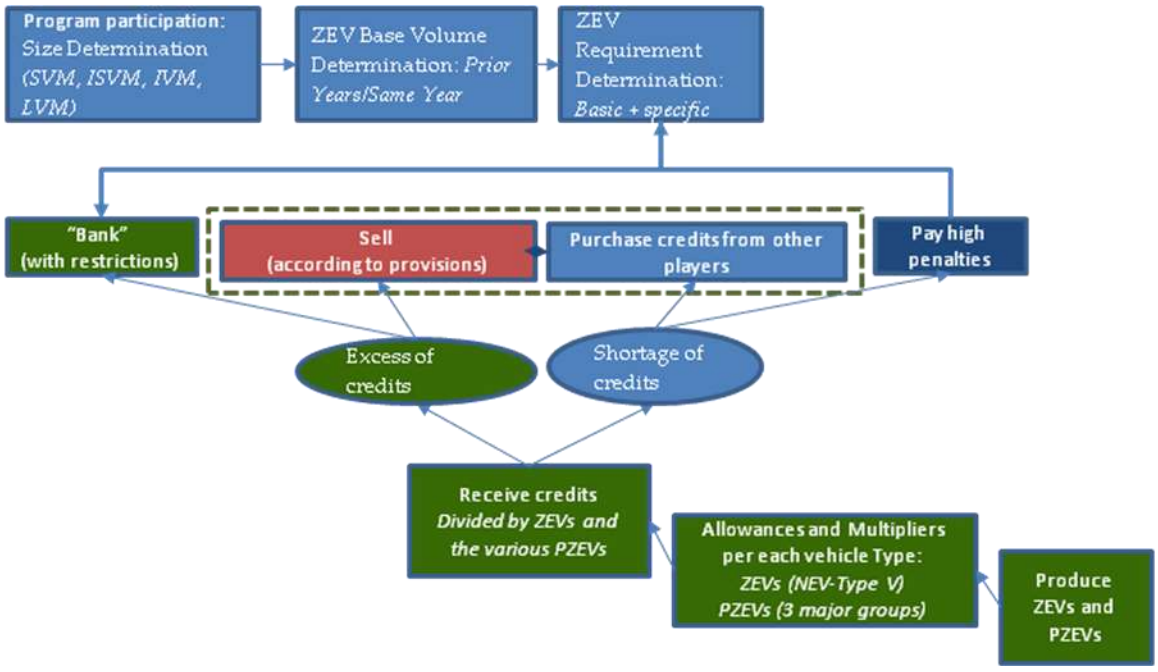
[7] "Zero Emissions Vehicle Standards for 2009 through 2017 Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" (1962.1).

sustainable and growing market for these advanced technology vehicles. The ZEV program implementation is built upon eleven major steps, as detailed in **Figure 2.2** and illustrated in **Figure 2.3**.

Figure 2. 2: Detailed steps of the California ZEV-credits regulation

Step	Description
Step 1	Size Determination
Step 2	ZEV Base Volume Determination
Step 3	Requirement Determination
Step 4	Allowances
Step 5	Applicable Multiplier Determination
Step 6	Total Credit Calculation
Step 7	Rules on Credit Use
Step 8	Special Provisions
Step 9	Travel Provision
Step 10	Demonstration of Compliance
Step 11	Penalties

Figure 2. 3: ZEV credits program illustration



The ZEV credits regulation does not require all vehicle manufacturers (VM) to comply, and compliance requirements vary between different volume manufacturers. Typically, large volume manufacturers face stricter ZEV production and credits obligations. The threshold for compliance is determined by the company size, which is

evaluated on the basis of average vehicle sales in the previous three consecutive years. Sales of passenger vehicles, light duty trucks (LDTs) and Medium duty vehicle (MDVs) are all included in sales calculations. The threshold is detailed in **Figure 2.4**.

Figure 2. 4: Company subjection to the ZEV regulation

Company type*	Company sales**	Compliance requirement
Small vehicle manufacturer (SVM)	= or < 4,500	Not subject****
Independent Small vehicle manufacturer (ISVM)	< 10,000	Not subject
Intermediate vehicle manufacturer (IVM)	= or > 4501 and = or <60,000	Subject to regulation, but can meet all with PZEVs
Large vehicle manufacturer (LVM)	> 60,000	Subject to regulation,

* Company size is determined by company sales in the previous three consecutive years.
** Passenger vehicles, light duty trucks (LDTs) and Medium duty vehicle (MDVs) are all included in sales calculation.

In the case where fluctuating sales volumes change vehicle manufacturer's categorization downwards, the new compliance requirement applies in the following model year (MY). In the case sales shift (or majority ownership agreement) that changes vehicle manufacturer categorization upwards, there is a grace period to the adequate shift in compliance requirement. **Figure 2.5** describes these shifts in categorization and compliance requirements.

Figure 2. 5: Company subjection to the ZEV regulation

Size shift direction	Previous company type	New company type	Compliance requirement
Increase	SVM	→ IVM	5 years lead time
	IVM	→ LVM	5 years lead time
Decrease	IVM	→SVM	Following MY
	LVM	→IVM	Following MY
Majority ownership agreement*	IVM+IVM	→LVM	3 years lead time

* In one manufacturer has 50% or greater ownership in another manufacturer, their sales are aggregated for determining size.

Unlike the production-size based evaluation, and as outlined in **Figure 2.4**, a separate production volume assessment determines each manufacturer's ZEV base requirement. This assessment is taking into account average PCs and LDTs (including light duty truck produced as of 2003, namely LDT1, and prior to 2003, namely LDT2) delivered over a period specified in one of two optional calculation methods. The first optional method is a "Prior Years" method which is based on an average of the previous

4th, 5th, and 6th model year from model year in which the manufacturer is complying (for example, for the 2013 MY, manufacturers would use their 2007-2009 sales average). The second optional method, "Same Year" method, is based on a projection of sales for the model year in which the manufacturer is complying. Manufacturers are free to choose and switch between these methods every year.

PCs and LDT1s are calculated simply according to sales while as of 2009 LDT2s deliveries are phased in by multiplying the relevant period delivery numbers with a fixed multiplier for each ZEV credit requirement year (51% for 2009, 68% for 2010, 85% for 2011, and finally 100% as of 2012).

All vehicle manufacturers that are required to comply with the ZEV regulation are required to have ZEV-defined portion of their annually determined ZEB-based volume (described in section 2.4.2) as detailed in **Figure 6**. The required portion is comprised of a single or combination of ZEV-credit types, while they must meet a minimum of ZEVs ("gold" category) before moving to other ZEV categories, as defined in **Figure 7**. Most manufacturers choose to combine credit types (keeping the required minimum for each) as it is a cost-effective way for complying with the ZEV regulation. Large Volume Manufacturers (LVMs) have two paths for meeting their ZEV requirement: primary path and alternative path, which add more restrictions and provisions on top of the basic ZEV requirements. Small Volume Manufacturers (SMVs) or independent Low Volume Manufacturers (independent LVMs), on the other hand, are not required to meet the percentage of ZEV requirement however can earn and market credits for ZEVs, TZEVs, AT PZEVs or PZEVs it produces and delivers for sale in California.

Figure 2. 6: Minimum ZEV requirements per vehicle year model

Model Year (MY)	**1998-200**	**2001-2002**	**2003-2008**	**2009-2011**	**2012-2014**	**2015-2017**	**2018+****
ZEV fleet portion requirement	2%	5%	10%	11%	12%	14%	16%

* To be officially confirmed at a later date.

** On top of the below stated basic percentage obligation further minimum and maximum requirements for various types of manufacturers apply.

Figure 2. 7: ZEV credits categories and minimum annual requirement per ZEVs

EV vehicle type	ZEV credits category	Annual min requirement of ZEV base volume*	
		Base Path	New Path
Pure Electric Vehicles (ZEVs)	**Gold, up to seven credits**	**0.79%**	**0.93%-3%**
Enhanced Advanced Technology Vehicles with Partial Zero-Emissions Rating (Enhanced AT PZEVs)	Silver +	2.21%	2.07%
Advanced Technology Vehicles with Partial Zero-Emissions Rating (AT PZEVs)	Silver	3%	2%
Partial Zero-Emissions Rating Vehicles (PZEVS)	Bronze	6%	6%

Note: (i) A manufacturer must fulfill its ZEV (gold) requirement, but may fulfill the rest of its requirement with lower levels (for each a minimum must be met before shifting toward a lower level); the above table is updated with 2012-2014 data. (ii) On top of the below stated basic percentage obligation further minimum and maximum requirements for various types of manufacturers apply.

In order to obtain a ZEV category credit ("Gold", pure electric vehicle), there are specified minimum sales figures for each ZEV category type, detailed in **Figure 2.8**. Typically, ZEVs earn 1 credit for delivery into California and earn additional credits when placed in service. The ZEV requirement is currently based on the annual NMGO (None-Methane Organic Gas) production report for the appropriate model year (California Government)[8].

All other credits, which can collectively be defined as PZEVs, can earn a base allowance of credits and additional credits. There are three types of additional credits, all based on the vehicle characteristics (range, pollutants, fuel type etc.) which can be measured either through standard testing procedures or on the basis of a credible third party evaluation and proof. Credit allowance further changes along implementation years, and is typically divided into model year groups (2009-2011, 2012-2014, 2015-2017).

Therefore, the total credit calculation is determined upon vehicle segmentation

[8] http://www.arb.ca.gov/msprog/levprog/cleandoc/clean_nmogtps_final.pdf

(generally outlined in **Figures 2.6** and **2.7**), specific vehicle tier in the case of ZEVs (**Figure 2.8**), and specific allowance in the case of PZEVs (generally described in **Figure 2.9**).

Figure 2. 8: ZEVs type vehicles and ZEVs credits earned per vehicle type

	Definition: *UDDS ZEV Range (miles)*	*Fast refueling (FR) capabilities*	Credit per vehicle 2009-2011	Credit per vehicle 2012-2017	Credit per vehicle 2018+*
Type V	≥ 300 miles range	285 miles in ≤ 15 min	7	2012-2014: 7 2015-2017: 9	3
Type IV	≥ 200 miles range	190 miles in ≤ 15 min	5	5	3
Type III	≥ 100 miles range	95 miles in ≤ 10 min	4	4	3
	≥ 200 miles range	N/A			
Type IIx	≥ 100 miles range	N/A	N/A	3	3
Type II			3		
Type I.5x	≥ 75, <100 miles range	N/A	N/A	2.5	2.5
Type I.5			2.5		
Type I	≥ 50, <75 miles range	N/A	2	2	2
Type 0	< 50	N/A	1	1	1
NEV	No minimum	N/A	0.3	0.3	0.3

* ZEVs earn 1 credit for delivery into California and earn additional credits when placed in service.

** Estimations.

Figure 2. 9: Illustration of credits calculation per vehicle type

Vehicle segmentation	Basic credits allowance	+ Additional credits allowance*	X Multiplier**
Pure Electric Vehicles (ZEVs)	Ranges 0-7 (See **Figure 7**)***	N/A	1.25 (excluding NEVs and Type 0)
Enhanced Advanced Technology Vehicles with Partial Zero-Emissions Rating (Enhanced AT PZEVs)	0.2	+ Zero Emission VMT (1.39 or 1.5) +Adv. Comp. (Ranges between 0.15-0.95) + Low Fuel Cycle (0.3)	1.25 (PHEVs)
Advanced Technology	0.2	+ Adv. Comp. (Ranges	N/A

Vehicles with Partial Zero-Emissions Rating (AT PZEVs)			between 0.15-0.95) + Low Fuel Cycle (0.3)	
Partial Zero-Emissions Rating Vehicles (PZEVS)	0.2		N/A	N/A
Formula:	***(***	***X + Y***	***)***	**** Z = Credits***

* See section 2.2.4 for additional credits allowances determination

** Excluded from this table are: (i) multiplier for ZEVs and > 10 mile zero emission VMT allowance PZEVs

*** ZEVs receive 1 credit upon delivery in CA and additional when placed in service.

The general rules governing the ZEV credits program are as follows: all credits produced in excess of a manufacturer's requirements may be "banked" for future use; credits are earned from all types of vehicles; credits may be traded or sold to any other party (while the price per credit is not reported); traded credits can be used the same way credits are earned from vehicles placed; there is a cap for PZEVs credits meant for fulfillment of the total ZEV regulatory requirement as illustrated in **Figure 2.10**.

Figure 2. 10: PZEV credits cap restriction in fulfillment of ZEV credits requirement

PZEV Type	Period	Restriction	% out of the company's credit-base requirement
PZEVs	2009-2011	55%	6% (out of 11%)
	2012-2014	50%	6% (out of 12%)
AT PZEVs	2009-2011	72.5%	8.5% (out of 11%)
	2009-2011 Alternative Path	100%	
	2009-2011	75%	9% (out of 12%)
Enhanced AT PZEVs	2012-2014	93.4%	11.21% (out of 12%)

Carry forward provisions exist for allowing the utilization of credits from vehicles from model year 2005, with specific more stringent restrictions on LVMs. Neighborhood electric vehicles from model year 2001 through 2005 may also qualify as forward looking credits, with specific provisions. Advanced demonstration vehicles (placed for two years, where 50% of the time in California) may also earn credits, and so do vehicles placed in projects with innovative transportation systems, such as shared-use and intelligent technologies, and technologies with linkage to transit, as illustrated in **Figure 2.11**.

Figure 2. 11: Transportation systems credits

2009-2011	Shared-Use / Intelligence	Link to Transit	Limit
PZEV	2	1	<1/50th of AT PZEV Requirement
AT PZEV	4	2	<1/20th of AT PZEV Requirement
Enhanced AT PZEV	4	2	<1/10th of Enhanced AT PZEV Requirement
ZEV	6	3	<1/10th of ZEV Requirement
2012+			
Enhanced AT PZEV	1	1	
ZEV	2	1	

According to agreements signed between California and states that are following its ZEV credits program path, in pursuant to section 177 of the Federal Clean Air Act (42 U.S.C Sec. 7507), credits can be transferred or sold within a geographical geography with no premium if done within the West Region Pool or the East Region Pool. For transferring or selling credits between these two pools, a premium of 30% exists. These credits exclude NEVs and Type 0, and confine Type I, I.5, and II ZEVs to years 2009-2014 and Type III, IV and V ZEVs between the years 2009 and 2017. For 2010 through 2017 model years, ZEVs placed outside of California are multiplied by the ratio of the manufacturer sales in California.

Demonstration of compliance requires each manufacturer to disclose to the public the production and ZEV credits earned per vehicle for model year 2009, and annual credits balances as of model year 2010. If a manufacturer demonstrates non-compliance, it has an additional two years to make up a ZEV deficit. Penalties apply as for the 3rd year, and are specified in the Health and Safety Code (HSC 43211) as follows: $5,000 penalty per vehicle or credit not produced, where 1 ZEV credit equals either Type 0 ZEV (default ZEV) or 1 vehicle. For instance, if a vehicle manufacturer is 500 credits short to fulfill its regulatory requirement, and does not make up the deficit within two years of grace, it will pay a penalty of $2.5 million.

3. Tesla Motors Inc.: Case Study

Tesla Motors Inc. (hereafter "Tesla"), a California-based innovative electric vehicles and electric power-train components designer and manufacturer established in 2003, is one of very few global PEV companies that are on the course of reaching market maturity and financial sufficiency.

As a public company since 2008 and registered on the Nasdaq stock exchange (*TSLA*), Tesla offers transparency in its financial and operational information. The case of Tesla is therefore a unique Californian PEV story that could be learnt from, offering traceable financial records and elaborative strategic planning through which the ZEV scheme's market influence could be assessed.

Since the financial data publically released by Tesla typically doesn't make a distinction between the federal (national) GHG credit scheme and the California-grown ZEV credit scheme, this analysis assumes a majority of ZEV credits and treats the publically declared general credit figures as representative of the ZEV credits scheme credits. As of 2013 annual financial report filed in February 2014, Tesla started reporting the total revenues from ZEV credits specifically, however doesn't specify from what geographies. Furthermore, as credit inventories are reported by CARB not by the fiscal calendar year but rather between the period of October 1 and September 30 of each year, a monthly average is used for tracing Tesla's periodic earnings from ZEV credits.

3.1 Company introduction

Tesla Motors Inc. was incorporated in 2003 in California by several entrepreneurs. Elon Musk, an inventor and investor, joined Tesla's Board of Directors as its Chairman in 2004, was very involved in the companies' production and operations, and became the companies' CEO in early 2008. The company, in its quest to accelerate the shift to electric vehicles, designs, develops, manufactures and sells high-performance fully electric vehicles and advanced electric vehicle powertrain components.

Tesla Motors is unique as it is the only stand-alone global electric vehicle manufacturer, the company that introduced the first commercially certified EV in the US, and manufacturer of the world's highest range EV (of 425 km) on the new EPA 5-cycle test. Tesla Motors is considered an EV market leader. In 2007, General Motors' Vice Chairman Robert Lutz claimed that the Tesla Roadster inspired him to push GM to develop the Chevrolet Volt, a plug-in hybrid sedan[9]. On 2009 Germany's Daimler AG

[9] http://www.newsweek.com/bob-lutz-man-who-revived-electric-car-94987

maker of Mercedes-Benz, acquired an equity stake of less than 10% of Tesla (for a reported US$50 million) and in 2010 Tesla signed a strategic partnership with Toyota which purchased US$50 million in Tesla common stock. These automaker engagements exemplify the company's robust positioning in the vehicle market.

Tesla Motors was registered on the Nasdaq stock exchange (*TSLA*) as soon as 2010, on the same year it started selling the its first vehicle, raising as much as $265 million. This IPO was the second American auto manufacturer IPO on the NASDAQ exchange since Ford's 1956 IPO. Its public filings are providing insight over the company's strategic planning, its predictions and periodical outcomes. The company has raised another $415 million in seven funding rounds between 2004 and 2010.

Tesla Motors expended to markets outside of the US in 2010, commencing sales in Europe and Asia in 2012, and started selling its vehicle in China in early 2014. The company has over 5,800 employees and operates in 116 locations including North America, Europe and Asia.

3.2 Market penetration: challenges and strategy

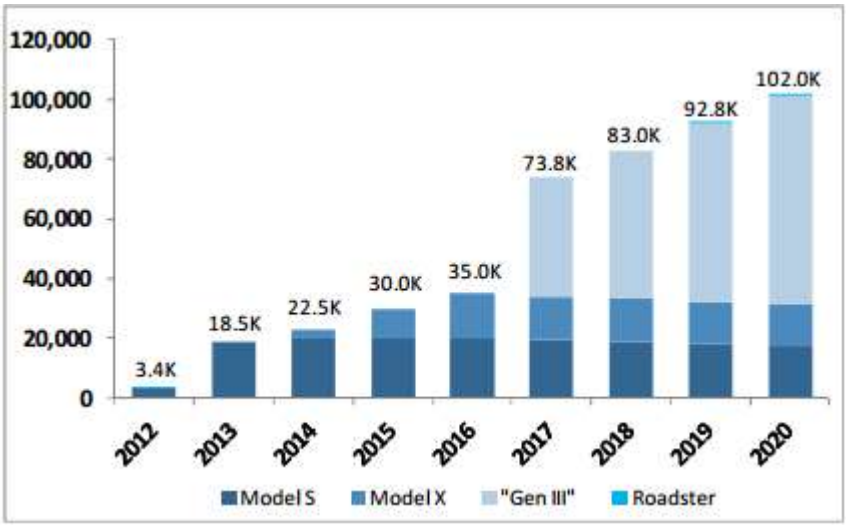
Being an entirely new auto manufacturer in a well established capital-intensive and very competitive industry, Tesla had to create a strategy that enables it to carefully reach economies of scale. Such a strategy required cost-effective development with minimum expenses and as little waste. This means secured demand and slow development that will improve alongside consumer experience feedback and upstream production improves (e.g. battery).

Tesla Motors penetrated the vehicle market and became considered as a leader in the pure electric vehicle (PEV) market utilizing the following unique business strategy: Tesla targeted premium car consumers in its first phase, then enabled vehicle leasing options to a wider variety of consumers, and finally announced it would introduce models for the mass market. This enabled limited high-quality production that gears up as company credibility and market positioning strengthens.

In order to internalize its strategy, Tesla started off by introducing a single premium sports-car model, the Roadster, available at the market price of $128,500 (before tax reliefs). This relatively high selling price has narrowed the spectrum of potential buyers' to mainly vehicle collectors and early adopters from high socio-economic status, reaching a moderate total production volume of 2,500 after nearly 4 years. The second vehicle, Model S, had picked with sales of about 25,000 within just 18 months since its

market introduction in mid-2012. Model S sales volume comprised about 70% of all plug-in sales[10], and was made available for the approximate price of $82,000 (and over $55,000 after tax relief). Model X, a crossover model adapted from the platform of its predecessor Model S, is expected to become available in 2015, addressing consumers of other taste and preferences. A Gen III electric car is planned to be developed and sold at lower cost, estimated at around $30,000[11], and higher volumes in the coming years.

Figure 3.1: JPM TSLA Vehicle Production Volume Forecast (2012E-2020E)



Source: J.P.Morgan, 18 December 2012, Tesla Motors, North America Equity Research, p.8

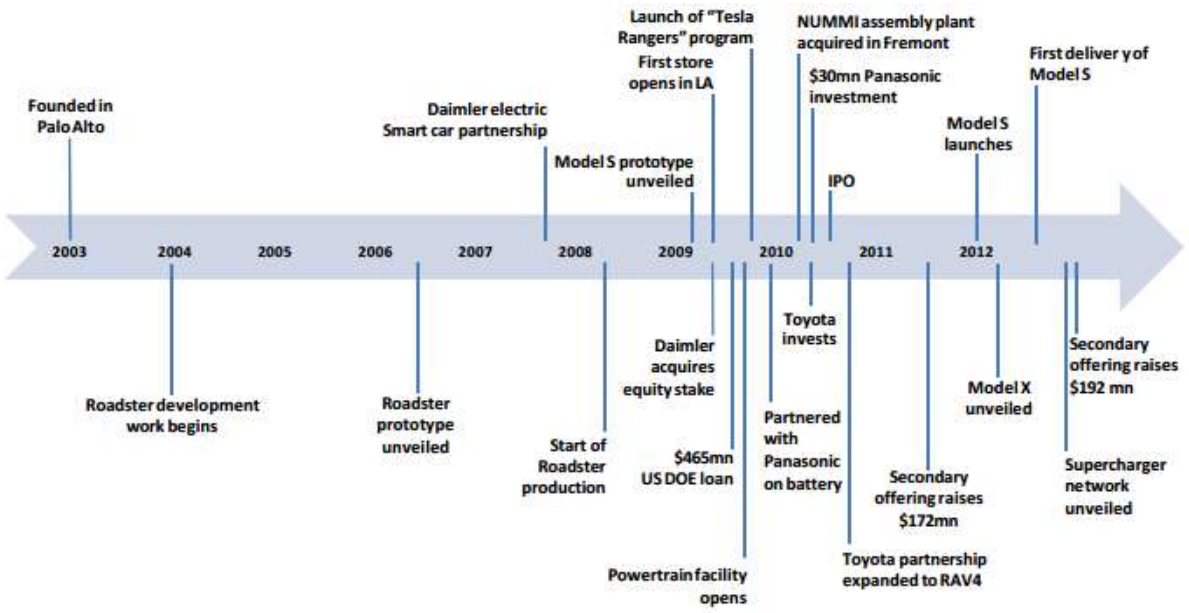
The development cost and associated risks were reduced by focusing on a single model at first, which was improved twice in each of the following years. Marketing expenses were minimal and so were costumer service efforts. On the risks front, by providing electric powertrain services and components to the well established conservative auto manufacturers (e.g. Daimler AG, Toyota) Tesla was able to secure stable income channels, gain market credibility based on which consumers and investors' trust was built (as well as other stakeholders' trust, such as suppliers and analysts) and impact the electrification of the auto market.

Influencing the vehicle market and leading auto electrification is recognized as key factors in paving a path towards market stability should a standardize system develop around electric vehicle and powertrain components, creating economies of scale that will in turn further accelerate market demand. In 2009 GM's former Vice Chairman Robert Lutz was quoted in the *The New Yorker*: "All the geniuses here at General Motors

[10] Based on estimations provided the Electric Drive Transportation Association (EDTA): http://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952
[11] http://onpoint.wbur.org/2009/09/25/teslas-elon-musk-on-a-sub-30000-electric-car

kept saying lithium-ion technology is 10 years away, and Toyota agreed with us – and boom, along comes Tesla. So I said, 'How come some tiny little California startup, run by guys who know nothing about the car business, can do this, and we can't?' That was the crowbar that helped break up the log jam."[12]

Figure 3.2: Tesla major developments timeline (2003-2012)



Source: J.P.Morgan, 18 December 2012, Tesla Motors, North America Equity Research, p.7

After the introduction of the vehicle, Tesla started developing its supporting infrastructure solutions (e.g. battery private/public charging and battery switch) and software solutions (e.g. range predictions and in-car updates). The company has also developed a unique and independent sales method that required further resources and multiple risks, catering for its ambition to lead the new vehicle market, avoid direct competition in other sedan vehicles' (e.g. Audi, BMW, Lexus and Mercedes) sales channels, and maintain close connection to its consumers. These efforts resulted in negative gross revenue margins over the second half of 2012.

In order to allow for its expensive design, development, procurement, and sales, Tesla relied on receiving pre-announced ZEV credits, sales of its electric power-train components, the financial market (since 2008), as well as pre-orders and down payments. In its 2012 financial filing report it stated that its revenues and gross margins would be impacted by the following factors: Models S sales at the projected price, commodity-related costs, planned cost reductions, and selling regulatory credits to other

[12] http://www.newyorker.com/reporting/2009/08/24/090824fa_fact_friend

vehicle manufacturers. The report emphasizes that any inability to sell credits may result in financial losses in the short term.

3.3 Introduction to ZEV contribution to Tesla's market stabilization

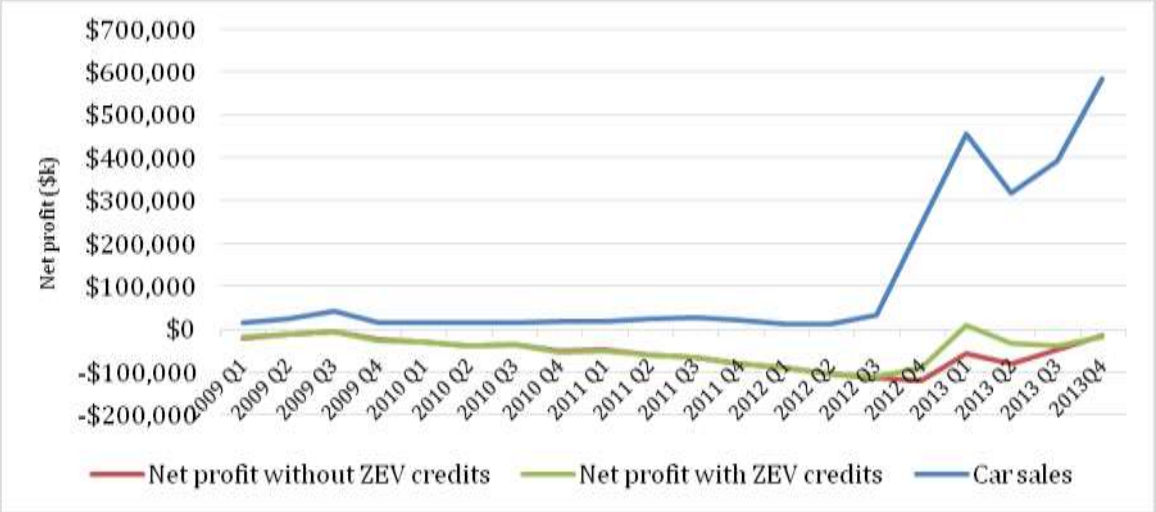
As a manufacturer solely of zero-emission vehicles (Pure Electric Vehicles), Tesla was able to earn ZEV credits for each of its sold vehicles (sold in the US) and was qualified for selling these credits to other manufacturers. It has therefore entered into agreements with auto manufacturers as early as 2008 when its first vehicles were sold and its first credits were earned, and enjoys a guaranteed income from selling ZEV credits at a pre-determined price. Tesla's revenue divide by vehicle and options sales, powertrain components and related sales, and ZEV (including federal GHG sales) revenues for the last 6 years of annual financial reporting are shown in **Figure 3.3**.

Figure 3.3: Tesla's 2008-2013 annual ZEV credits n the context of revenues and cost

	2008	2009	2010	2011	2012	2013
Total Revenue ($k)	$14,742	$111,943	$116,744	$204,242	$413,256	$2,013,496
Total cost of revenue ($k)	$15,883	$102,408	$86,013	$142,647	$383,189	$1,557,234
Gross profit ($k)	-$1,141	$9,535	$30,731	$61,595	$30,067	$456,262
Credits revenues ($k)	$3,500	$8,200	$2,800	$2,700	$40,500	$194,400
Detailed Breakdown						
Auto sales revenues ($k)	$11,242	$103,355	$72,659	$99,008	$313,844	$1,758,284
Powertrain sales revenues ($k)	$0	$388	$21,619	$46,860	$31,355	$45,102
ZEV Credits revenues ($k)	$3,500	$8,200	$2,800	$2,700	$32,400	$129,800
Other credits revenues ($K)	$0	$0	$0	$0	$8,100	$64,600
Development services revenues ($k)	$0	$0	$19,666	$55,674	$27,557	$15,710
Automotive sales costs ($k)	$15,883	$102,408	$79,982	$115,482	$371,658	$1,543,878
Development services costs ($k)	$0	$0	$6,031	$27,165	$11,531	$13,356
Net profit ($k)	**-$82,782**	**-$55,740**	**-$154,328**	**-$254,411**	**-$396,213**	**-$74,014**

In its 2012 financial disclosure, Tesla recognized that the sharp increase of some 350% in gross revenues from car and credit sales was derived by ZEV credits. **Figure 3.4** exemplifies the strong connection between Tesla's credits allowances internalized in the first half of 2013 and its shift from net loss to net profitability.

Figure 3.4: ZEV Credits Drove Tesla's Net Profitability



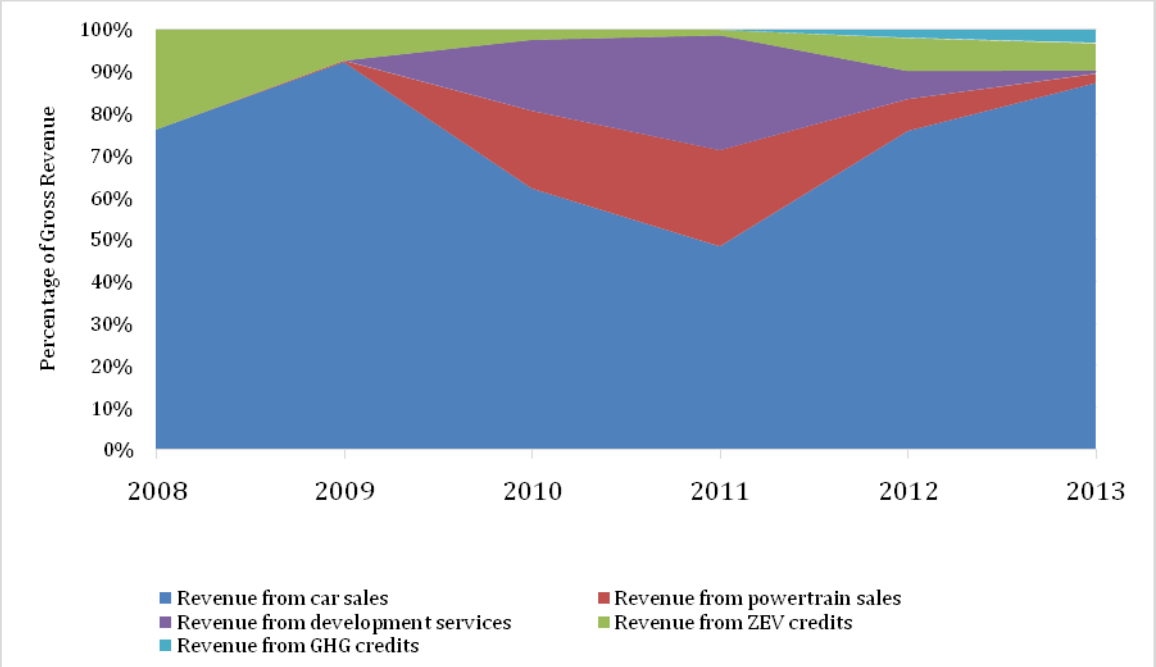
3.4 ZEV credits' role in Tesla's product development

Since credits are agreed upon in the beginning of the physical year, they play a crucial role in Tesla's development – the company can rely on this income stream when rolling out its research, marketing and other development activities, without which it may be "stuck" with limited and "outdated" products which in turn, as Tesla recognizes, would diminish its competitive edge and market penetration efforts (Tesla Motors, Inc., 2013)[13].

Figure 3.5 illustrates the portion of ZEV credits out of the total annual revenue sources of Tesla over the past five years. Vehicles ordered in 2007 have only been delivered as of February 2008 therefore no credits were internalized in 2007. As the sale of credits was negotiated and agreed upon throughout 2007, in 2008 already $3.5 million ware transferred to the company from its ZEV-credits trading partners. The total value of credits represented close to 25% of the company's total revenue and 307% of the company gross profit for that year.

[13] Tesla Motors Inc. 2012 Annual Financial Disclosure, p.27.

Figure 3.5: ZEV Credits Drove Tesla's Net Profitability



The revenue from credits in 2008 has enabled the company to engage in powertrain deliveries to mature and leading auto manufacturers, commencing in 2010 with shipments of batteries and chargers as part of Daimler's Smart for Two and A-class program. A more detailed analysis shows that this first batch of credit value internalized by Tesla could have covered the cost of about 350 battery packs of 60 kWh (assuming the battery cost is of about $200 per kWh or $10,000 a pack upon large volume supply).

The following year, Tesla received $8.2 million for the sale of its ZEV credits. This time, the total value of credits represented only 86% of the company's 2009 gross profit. This could imply that the company has internalized the value of anticipated credits throughout the year via product enhancement towards the shift to commercial production of the Tesla's second awaiting product, Model S. Alternatively, the total value of the company's 2009 earned credits could have covered 136% of the following year's (2010) development services costs, amounting to over $6 million. Therefore, the credits could have enabled Tesla to meet the obligations of service agreement with leading automakers.

In 2011 the production of the Roadster had ceased, making its way to commercial production of Model S, which is rated better thanks to its advanced features and higher score on the ZEV credits application. Tesla's new 85 kWh version of the Tesla Model S (hereafter refers to as S85) was reclassified from a Type III zero-emissions vehicle to a

Type V on October 12th 2012 due to its battery swap capacity[14]. The reclassification increased the number of ZEV credits Tesla got per each S85 vehicle from 4 to 7, as detailed in **Figure 3.6**.

Figure 3.6: Tesla's vehicles eligibility for ZEV credits

Vehicle	Features	Type	Credits	Dated	Comments
Roadster		Type III	4	2008	If Range: > or = to 100 miles (160km) than – Refueling: Must be capable of replacing 95 miles (UDDS ZEV range) in ⩽ 10 minutes per section 1962.1(d)(5)(B) ◎ If Range: > or = 200 miles (320km) than – Refueling: N/A
Model S 60 kWh battery pack	208miles (EPA 5-cycle) /230miles (est.), optional supercharging	Type III	4	June 15, 2012	
Model S 85 kWh version	265miles (EPA 5-cycle) /300miles (est.), supercharging included, battery switch included	Type V	7	October 12, 2012	Range: > or = to 300 miles (480km); Refueling: Must be capable of replacing 285 miles (UDDS ZEV range) in ⩽ 15 minutes per section 1962.1(d)(5)(B)
Model S 85 kWh version Performance	265miles (EPA 5-cycle) /230miles (est.), supercharging included				
Model X 60 kWh battery pack		Type V	7	Est.	
Model X 85 kWh version		Type V	7	Est.	

Tesla's technology improvements in its second vehicle model allowed it to gain more credits for such car sold in the ZEV geographies while expanding its other non-switchable battery Model S models elsewhere without harming the total amount of credits in gained per quarter. In other words, new innovation was rewarded allowing for the company to expand its market outreach without compromising on its potential gains within the ZEV-credits scheme geography.

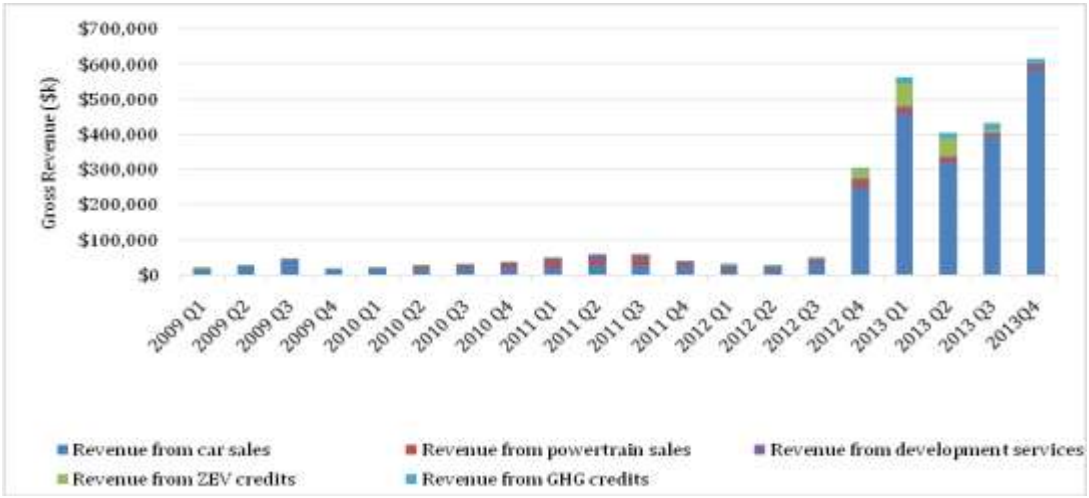
[14] http://www.arb.ca.gov/msprog/onroad/cert/pcldtmdv/2012/tesla_pc_a3740006r2_0_z_e.pdf

Therefore, although limited remaining stock of the legendary Roadster was dedicated to markets outside of the US with no entitlement for ZEV credits, 2012 marked an annual growth increase in revenues all across the company's resource components – vehicle and options sales, components and related sales, as well as credits. These revenue sources increased as Tesla started delivering its Model S sedan in the US, as planned[15]. Not only Tesla has reached a more diverse and mature production line, it has also been able to stay financially viable thanks to its Model S sales in the geographical boundaries of the ZEV-credits scheme.

3.5 ZEV credits' role in Tesla's market expansion

Not surprisingly, Tesla seems to have been influenced year after year by the target markets of its annual car sales via loss of credits. For instance, Tesla states that its 2010 market loss is linked to its entrance to "higher average selling prices outside of the US"[16]. There is a clear advantage, created by the ZEV scheme, in selling vehicles within the scheme's geographical boundaries. However, for a premium product, geographical restriction creates a limited annual consumer growth potential. This contentment may explain the sharp increase in sales from the fourth quarter of 2012 as the Model S became available, and a further sales increase with less ZEV credits income already in the third quarter of 2013, as demonstrated in **Figure 3.7**.

Figure 3.7: Tesla Motor's Gross Revenue Trend and Sources

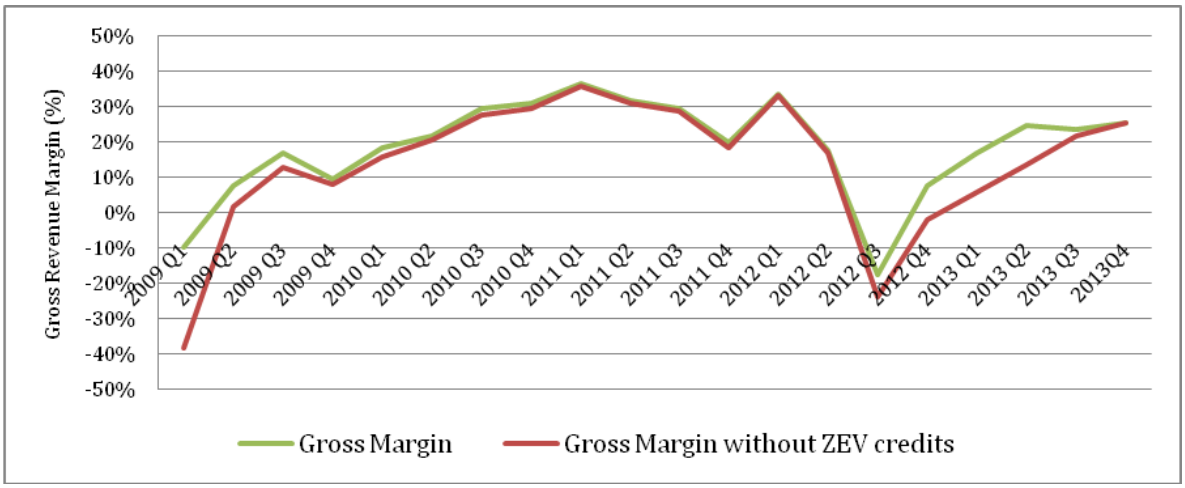


Tesla's income from the ZEV credits in 2008 and 2009 allowed it to expand abroad while increasing its gross margin. In 2010 the company started selling abroad, and in

[15] Tesla Motors Inc. 2012 Annual Financial Disclosure, p.7.
[16] Tesla Motors Inc. 2010 Annual Financial Disclosure, p.91.

late 2011 it had shut down its Roadster production and targeted the global market for its remaining stock sales. However, between 2010 and 2011, as Tesla expanded outside of the US (mainly EU and Asia), it received less credits per vehicle sold and experienced unchanged and decreased margin, as illustrated in **Figure 3.8**.

Figure 3.8: The ZEV Credits Impact on Tesla's Gross Margin



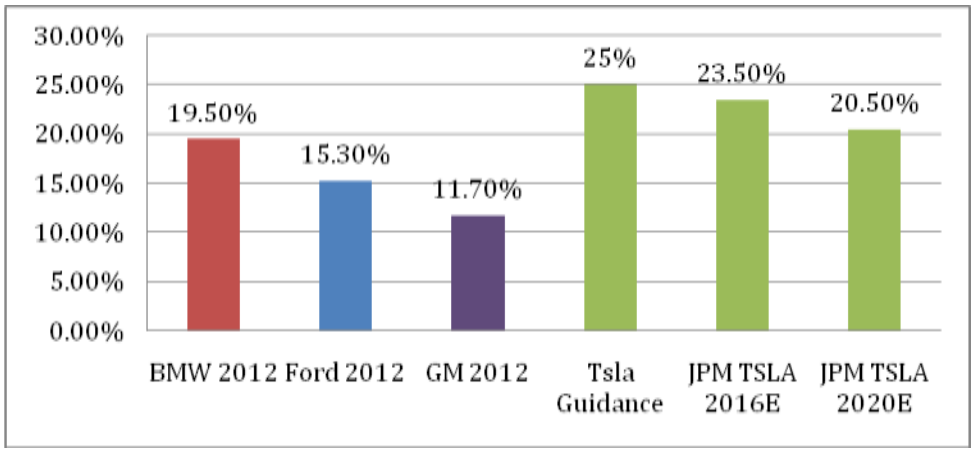
Tesla's $40.5 million revenues from credits in 2012, the largest to that date, could have covered 27% and 14% of the company's general expenses beyond its automotive and development services for 2012 and 2014, respectively. This secondary cost stream, excluded from its direct gross margin, is assumed to include its marketing and business development efforts outside the US. Therefore, Tesla's 2012 credit revenues could have contributed much to the company's ability to expand globally and reach sales in highly cost-driven markets such as Asia. Even the company's relatively low revenues from credits in 2011, amounting $2.8 million, could have covered for over five years of rent cost of the company's office and showroom in Beijing (assuming Tesla's 737 sqm located in the capital's CBD is rented at a modest cost of 12RMB/sqm/day).

3.6 ZEV credits' role in Tesla's financial market robustness

As illustrated in **Figure 3.8**, the ZEV credits impact on Tesla's gross margin is significant, enabling the company to reach a whopping margin of 25% in the last quarter of 2013, overtaking Ford's 15.5% and General Motors' 12% gross profit margin. The ZEV credits accounted for up to 125% of the company's gross revenue over the past five years specifically in relation to the automotive market, and projected to continue as illustrated in **Figure 3.9**. As gross margin is often used by analysts from the financial market, the ZEV-credits arguably made an important contribution to the company's stock valuation

and subsequently influenced its liquidity (as discussed in previous product development and market expansion sections).

Figure 3.9: TSLA Gross Margins vs. Automaker Peers



Source: J.P.Morgan, 18 December 2012, Tesla Motors, North America Equity Research, p.22

As further illustrated in Figure 3.8, the company registered on the NASDAQ under the symbol TSLA, has a market capitalization of nearly $25 billion, slightly less than half of General Motors Co's (GM.N) $57.7 billion market cap[17] (and nearly 100 times its initial IPO funding round). Tesla's weekly stock sales were relatively high in early 2010 despite the decline in vehicle sales, and have picked up again in 2013 as its first year half ZEV credits sky-rocketed $119 million, accounting for 77% and 386% of its gross and net profit, respectively. JP Morgan stated in its Tesla 2013 fourth quarter evaluation brief that "4Q execution was strong, lending credence to management outlook for higher 2014 gross margin exit run-rate. TSLA met its long-standing 25% 4Q13 gross margin guidance (widely not believed prior to 3Q earnings), reporting 25.2% excluding ZEV credits"[18]. Furthermore, Tesla was the top performer on the Nasdaq100 index in 2013[19].

In congestion to the company's statement of zero ZEV credits anticipation for the last annual quarter, and despite the fact it had projected solid sales of its Model S vehicles throughout the year end, the company stock have fallen after October 2013. In November news over a fire in a Tesla vehicle had also influenced the company's stock. Later on, as the annual filing was published, the stock went up again, this time on the premise that the company had reached market maturity and gained significant revenues despite the decrease in ZEV credits towards the year end.

[17] Based on February 2014 data, see also: http://www.reuters.com/article/2014/02/19/us-tesla-results-idUSBREA1I23D20140219
[18] J.P.Morgan, "Tesla Motors: Q4", North America Equity Research (20 February 2014)
[19] http://www.cnbc.com/id/101192173

Figure 3.10: The ZEV Credits Impact on Tesla's Gross Margin

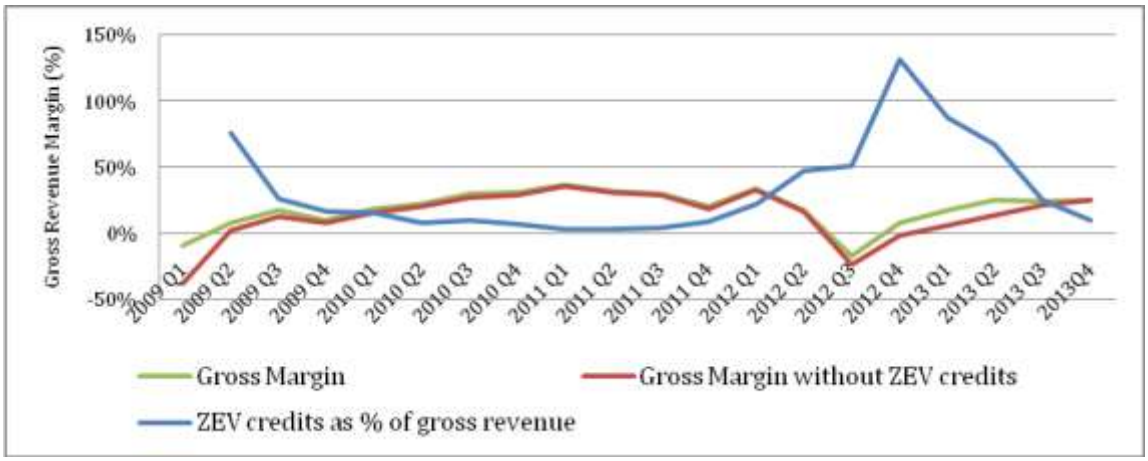
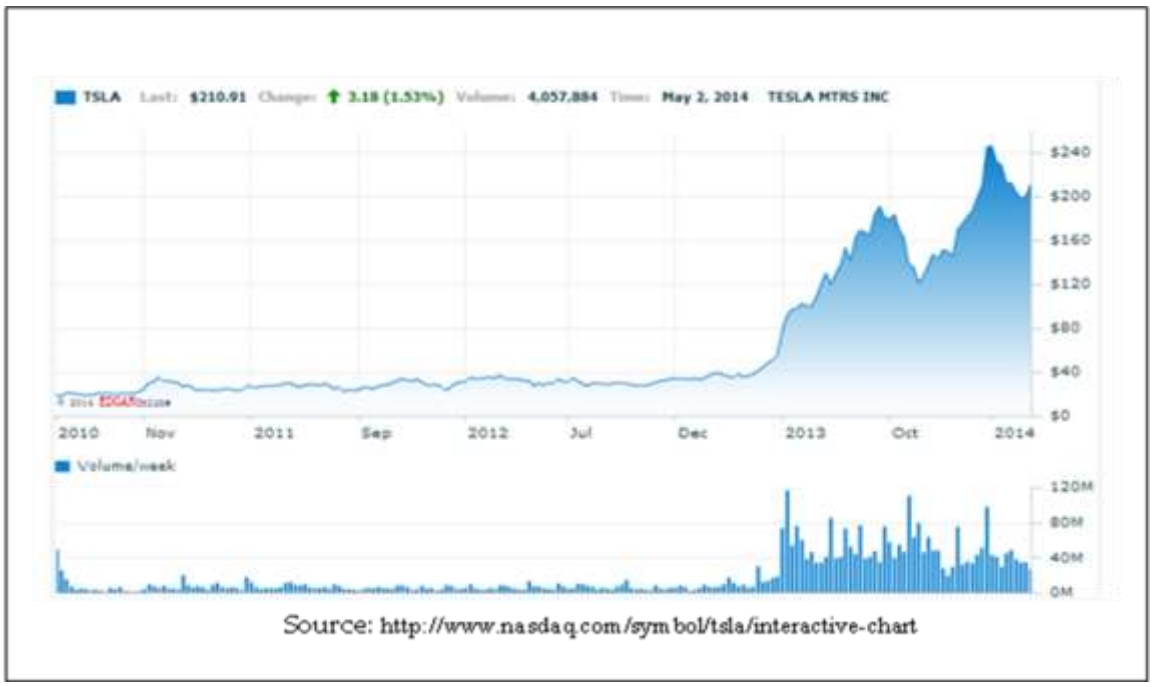


Figure 3.11: Tesla's Stock Value and Weekly Volume over 5 Years



Not surprisingly, there is a heated debate among auto industry experts and investors over whether Tesla's sky-high valuation is justified, and how dependent the company is on government credits (ZEV, GHG, CAFE). However, as credits have shrunk toward the end of 2014 and gross margin grew; many analysts recommended the company's stock[20].

[20] http://www.forbes.com/sites/markrogowsky/2014/02/20/bear-clawed-how-tesla-keeps-crushing-the-naysayers/

3.7 ZEV credits' future current and role in Tesla's business development

In the first quarter of 2013, Tesla reached profitability for the first time while credits accounted for 604% of its profit (and 87% of its gross margin) as exemplified in **Figure 3.12**. In Tesla's 2013 first half-year disclosure, it recognized $119.4M in ZEV credits sales that have largely contributed to the company's gross margin growth. These credits have become available as Tesla's new model S sales in the eligible areas have ramped up to over 5k per quarter. Tesla projected it will meet the pre-planned production capacity of over 20k vehicles in 2013[21] and have delivered over 25,000 Model S vehicles by the end of 2013 in North America and Europe[22].

Figure 3.12: 2013 quarterly ZEV credits as part of revenues and profits

Indicator	2013 Q1	2013 Q2	2013 Q3	2014 Q4	Accumulated
Car sales ($k)	$456,733	$320,620	$395,454	$585,477	**$1,758,284**
Powertrain sales ($k)	$14,420	$13,265	$8,192	$9,225	**$45,102**
Development services ($k)	$6,589	$3,604	$1,150	$4,367	**$15,710**
ZEV Credits ($k)	$67,900	$51,500	$10,400	$0	**$129,800**
Other Credits ($k)	$16,150	$16,150	$16,150	$16,150	**$64,600**
Total Revenue ($k)	$561,792	$405,139	$431,346	$615,219	**$2,013,496**
Automotive sales ($k)	$461,818	$303,599	$324,883	$453,578	**$1,543,878**
Development services ($k)	$3,654	$1,057	$3,595	$5,050	**$13,356**
Total cost of Revenue	$465,472	$304,656	$328,478	$458,628	**$1,557,234**
Gross profit	$96,320	$100,483	$102,868	$156,591	**$456,262**
Gross margin (%)	17%	25%	24%	25%	**23%**
Revenue growth (%)	83%	28%	6%	43%	**40%**
Profit growth (%)	113%	371%	26%	58%	**113%**
Credits/Total Revenue (%)	12%	13%	2%	0%	**7%**
Credits/Revenue from car sales (%)	15%	16%	3%	0%	**7%**
Credits/Gross profit (%)	87%	67%	26%	10%	**48%**
Net profit	$11,248	-$30,502	-$38,496	-$16,264	**-$74,014**
Credits/Net profit (%)	604%	169%	27%	0%	**-100%**

[21] Tesla Motors Inc. 2013 3rd Quarter Financial Disclosure, p.23.
[22] Tesla Motors Inc. 2014 Annual Financial Disclosure, p.4.

Tesla has also repeatedly stated in its 2013 quarterly reports that should its current and future models (e.g. Tesla model S and model X) fail to be eligible for saleable credits due to regulatory adjustments, or due to its expenditure in sales outside the regulatory scheme boundaries, its revenues and margins will be negatively impacted and "may negatively impact our ability to reach or maintain profitability in the short term"[23]. In its annual report, Tesla stated that 'over 90% of ZEV credit sales were recognized during the first half of 2013'. The company also stated to 'expect the contribution of ZEV credit revenue to remain low in the future relative to our automotive sales as we continue to grow our sales outside the United States'[24]. However the company has also stressed that it has reached a stage in which its business model no longer relies on these credits, a contentment that is well demonstrated in the above **Figure 3.12**.

Tesla's future revenues from ZEV credits sales will depend not only on the number of credits it sells but also on their market value fluctuations, which is determined through negotiations between the company and its credits' buyers and therefore dependent upon tensions in the credit market supply and demand. As new geographies enter the ZEV-credits program, Tesla's revenues from car sales outside California and within the US will grow as so may its bargaining power. As the regulation evolves and introduces more stringent requirements for eligibility, Tesla's pool of credits, which led the chart in recent years, may shrink in the absence of adequate innovation.

3.8 ZEV credits' value in the case of Tesla

The value of credits is not publically disclosed and determined according to market forces and negotiated between the buyer and sells of credits. This section attempts to hint at possible past and future values of Tesla's ZEV credits, however the below figures suggested below are not officially approved and may not reflect the real market value of credits.

In 2010 Tesla disclosed selling credits to Honda for 491 vehicles sold in 2009 and 2010 for $11M. This implies that Tesla internalized an average of about $22k for each vehicle sold during that year in ZEV credits, which represents about 35% of vehicle price to consumer after federal tax relief. In Tesla's first quarterly report of 2011 the company disclosed that 521 of its vehicles sold were granted credits that were purchased by Honda. It also stated that its ZEV-credits revenues were $600,000. If no other credits were issued and sold during that period, a raw estimate of about $1,500-3,500 was provided per vehicle credit.

[23] Tesla Motors Inc. 2012 Annual Financial Disclosure, p.31.
[24] Tesla Motors Inc. 2013 Annual Financial Disclosure, p.68.

As of its second quarter filling of 2011 Tesla began reporting its revenues from credits on a quarterly basis rather than on an annual basis, however mentioned it had entered a third contract with another company for selling its 2012 Model S ZEV-credits excesses. As of 2012 the company also started reporting revenues from GHG credits without any specifications. In 2013 the company resumed more detailed ZEV credits financial filing, however the value of credits is not fixed nor stated directly by any party of the agreement of government authorities.

At the last quarter of 2013 Tesla has kept an inventory of 276 ZEV-credits that can be internalized by the end of CARB inventory year ending October 1st 2014, along with vehicle sales from October 1st 2013 to that date. Assuming Tesla's Model S sales in the ZEV-credits geography areas will remain the same (about 4k per quarter) and the estimated market value per credit will remain around $3.5k ($5k is the penalty ballpark), market analysts suggest Tesla may be able to enjoy revenues of over $90 million from ZEV credits per quarter[25].

3.9 Concluding remarks on the ZEV-Credits role in Tesla's development

Tesla's story, exemplified in its transparent financial reports, showcases the dependency of a new clean transportation technological manufacturer in the ZEV scheme at its early stages. It also showcases the amount of fees that should have been injected into such a business entity either privately of through the government in an absence of such market mechanism.

[25] http://wattsupwiththat.com/2014/03/12/analysis-tesla-may-have-made-over-100-million-off-the-carb-enabled-battery-swap-scheme/

4. Conclusions

While China's need for sustainable city planning increases along with its rapid urbanization rates, Chinese decision-makers are examining various options for reducing transportation emissions and direct market development. Global programs are also being evaluated, and are playing important roles as they present case studies and success stories. As this report points out, the ZEV credits program is a well-demonstrated regulatory framework capable of accelerating innovations primarily through market sources.

The ZEV credits program has proven to deliver ground-breaking results, however these results may be the result of California's unique characteristics (such as its role as an innovation hub, its comprehensive regulatory framework, the amount of early-adopters is houses etc.). In order to assess the program's suitability for the case of China, local market conditions and the robustness of its institutional framework should be examined. Furthermore, a multi-stakeholders collaboration led by dedicated pilot city planners is needed to enable in-depth understanding of the forces that may enable the fruits of a China-tailored program, as well as assist in designing such a program.

As the worlds' larger GHG emitter, and home to 16 of world's 20 most air-polluted cities[26], China is aggressively promoting Energy Vehicle (NEV) demonstration project aimed at showcasing and assessing a variety of climate mitigation measurements. In particular, its 2008 "10 cities 1000 vehicles" of new PEV technologies integration was quickly followed by the gradual formation of 25 pilot cities which are meant to exemplify commercially scalable PEV projects under governmental support. These schemes have not only prepared the participating cities for NEV incorporation in city planning etc., but have also set the direction for further energy saving and new energy vehicles' institutional framework development. An appropriate city or cities for taking on the task of assessing and designing a ZEV credit type program should be selected carefully to ensure market readiness, institutional feasibility, government proactive collaboration, and potential linkage to broader areas and sectors.

While critics doubt the ZEV regulation has contributed to California's emission reduction goals, CARB claims that in reality it has spurred significant commercial integration of mainly near-zero emissions vehicles[27]. For instance, nearly 2 million Californians are driving partial zero and advanced technology partial zero emission vehicles (PZEV and AT PZEV) with near-zero tailpipe emissions and some 80% cleaner

[26] According to WB report (as soon as 2006).
[27] http://www.arb.ca.gov/msprog/zevprog/zevregs/zevregs.htm

exhausts than the average 2002 model year car. In addition, gas-electric hybrid vehicles are a success, accounting for over 400,000 hybrids on California's roads. Lastly, and as can be inferred from the number of zero emission vehicles on the roads, all vehicle manufacturers in California have been and are currently in compliance with the program. Notwithstanding, the program should be scrutinized through in-depth interviews with planners and participants for drawing effective and implementable lessons.

The central goal and advantage of California's ZEV approach lays in its integrated methodology for addressing both criteria pollution (and GHG emissions), while allowing ZEV credits trading in a pre-defined market place. Through credits trading, early stage zero and near-zero emission vehicle companies are funded and all automakers are provided with an added incentive to develop ever-cleaner vehicles and related technologies. For example, Tesla Motors has earned revenue from the sale of ZEV credits of about $245M over 5.5 years, enabling it to reach market maturity in an overwhelmingly resources-consuming new energy vehicle industry that have typically diminished PEV players elsewhere (e.g. Coda).

One clear shortfall of this program's scope lays in its neglect of low-emissions infrastructure and components players. While auto manufacturers can enjoy the fruit of the program during their seed period, other complementary players that have a significant influence on market demand and uptake are excluded from this scheme. As evidenced in recent years' financial instability of electric power train components producers, such as the bankruptcy of A123 Inc. battery manufacturer [28] and the integrated charge-switch network provider Better Place Inc.[29], lack of support in the complete zero-emissions car ecosystem may result in delays of mass-market integration of zero-emissions vehicles.

Another issue with the current California-grown ZEV credit scheme is the inability of a participating seed-company to expand geographically and internalize its market potential at every technological step. As evidenced in the case of Tesla, selling its first model the Roadster abroad has resulted in a slowdown of revenue. The utilization of potential profits for every technologically-intense product is essential for breakthrough technology market shapers, as they are typically facing scarce demand and limited resources.

[28] A123 applied bankruptcy in October 2012 and was eventually purchased by China's Wangxiang.
[29] Better Place was actively engaged in complete charging and switch infrastructure and battery management systems for supporting mass-demand for electric vehicles and filed for bankruptcy in May 2013. Its CA office have attempted to receive local government support.

In the case of China, the above described adverse effect of geographically confined ZEV credits program is even more complex. While large geographies within China are an important potential revenue streams for local manufacturers, local protectionism and a favorable institutional framework may hamper the expansion of a local ZEV credit scheme. Furthermore, the goal of enhancing local manufacturing by decision-makers may enable credit schemes expansion to imported vehicles, therefore interfering with consumer preferences. However, the expansion of a ZEV credit scheme is crucial for real and robust financial backing of seed companies that cannot attract financial market cash flow injections, which is the case for most home-grown seed companies in China.

*i*CET plans to work with key stakeholders to identify the key barriers for implementing a ZEV credits type program in a pilot city (or cities) in China, and recommend measures to overcome these barriers. Furthermore, *i*CET plans to work in collaboration with local stakeholders and city planners toward the design of a China-tailored ZEV credits type program.

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Appendix :

Tesla Moors' Annually Reported Financial Status							
	2007	2008	2009	2010	2011	2012	2013
Gross revenue revenue margin (%)	88%	-8%	9%	26%	30%	7%	23%
Gross margin without ZEV credits (%)	88%	-41%	1%	25%	29%	-3%	14%
Simple Breakdown							
Total Revenue ($M)	$73	$14,742	$111,943	$116,744	$204,242	$413,256	$2,013,496
Total cost of revenue ($M)	$9	$15,883	$102,408	$86,013	$142,647	$383,189	$1,557,234
Gross profit ($M)	$64	-$1,141	$9,535	$30,731	$61,595	$30,067	$456,262
Credits revenues ($M)	$0	$3,500	$8,200	$2,800	$2,700	$40,500	$194,400
Detailed Breakdown							
Auto sales revenues ($M)	$73	$11,242	$103,355	$72,659	$99,008	$313,844	$1,758,284
Powertrain sales revenues ($M)	$0	$0	$388	$21,619	$46,860	$31,355	$45,102
ZEV Credits revenues ($M)	$0	$3,500	$8,200	$2,800	$2,700	$32,400	$129,800
Other credits revenues ($M)	$0	$0	$0	$0	$0	$8,100	$64,600
Development services revenues ($M)	$0	$0	$0	$19,666	$55,674	$27,557	$15,710
Automotive sales costs ($M)	$9	$15,883	$102,408	$79,982	$115,482	$371,658	$1,543,878
Development services costs ($M)	$0	$0	$0	$6,031	$27,165	$11,531	$13,356
Other data							
Net profit ($M)	-$78,157	-$82,782	-$55,740	-$154,328	-$254,411	-$396,213	-$74,014
Net profit without ZEV credits ($M)							
ZEV credits % / Gross profit	0%	-307%	86%	9%	4%	135%	43%
ZEV credits % / Net profit	0%	-4%	-15%	-2%	-1%	-8%	-175%
Net porfit margin	6%	-33%	177%	65%	56%	-81%	

Tesla Motors Quarterly Reported Financial Status																				
	2009 Q1	200 9 Q2	200 9 Q3	2009 Q4	2010 Q1	2010 Q2	201 0 Q3	201 0 Q4	2011 Q1	201 1 Q2	2011 Q3	201 1 Q4	2012 Q1	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q3	2013 Q4
Gross revenue revenue margin (%)	-10%	8%	17%	10%	19%	22%	30%	31%	37%	32%	30%	20%	34%	18%	-17%	8%	17%	25%	24%	25%
Gross margin without ZEV credits (%)	-38%	2%	13%	8%	16%	21%	28%	30%	36%	31%	29%	18%	33%	17%	-24%	-2%	6%	14%	22%	25%
Simple Breakdown																				
Total Revenue ($M)	$21	$27	$46	$19	$21	$28	$31	$36	$49	$58	$58	$39	$30	$27	$50	$306	$562	$405	$431	$615
Total cost of revenue ($M)	$23	$25	$38	$17	$17	$22	$22	$25	$31	$40	$40	$32	$20	$22	$59	$282	$465	$305	$328	$459
Gross profit ($M)	-$2	$2	$8	$2	$4	$6	$9	$11	$18	$19	$17	$8	$10	$5	-$9	$24	$96	$100	$103	$157
Credits revenues ($M)	$4	$2	$2	$0	$1	$1	$1	$1	$1	$1	$1	$1	$2	$2	$5	$31	$84	$68	$27	$16
Detailed Breakdown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto sales revenues ($M)	$17	$25	$44	$18	$17	$19	$17	$19	$20	$27	$28	$25	$16	$14	$35	$249	$457	$321	$395	$585
Powertrain sales revenues ($M)	$0	$0	$0	$0	$2	$5	$5	$9	$13	$11	$15	$7	$1	$6	$10	$14	$14	$13	$8	$9
ZEV Credits revenues ($M)	$4	$2	$2	$0	$1	$1	$1	$1	$1	$1	$1	$1	$0	$0	$3	$29	$68	$52	$10	$0
Other credits revenues ($M)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2	$2	$2	$2	$16	$16	$16	$16
Development services revenues ($M)	$0	$0	$0	$0	$0	$4	$8	$7	$15	$19	$14	$7	$11	$5	$0	$12	$7	$4	$1	$4
Automotive sales costs ($M)	$23	$25	$38	$17	$17	$20	$19	$23	$27	$31	$33	$25	$14	$20	$59	$279	$462	$304	$325	$454
Development services costs ($M)	$0	$0	$0	$0	$0	$2	$2	$2	$4	$9	$8	$6	$6	$2	$0	$4	$4	$1	$4	$5
Other data	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net profit ($M)	-$16	-$11	-$5	-$24	-$30	-$39	-$35	-$51	-$49	-$59	-$65	-$81	-$90	-$106	-$111	-$90	$11	-$31	-$38	-$16
Net profit without ZEV credits ($M)	-$20	-$12	-$7	-$25	-$30	-$39	-$36	-$52	-$50	-$60	-$66	-$82	-$90	-$106	-$113	-$119	-$57	-$82	-$49	-$16
ZEV credits % / Gross profit		76%	26%	17%	16%	8%	10%	7%	3%	4%	4%	9%	22%	48%	52%	132 %	87%	67%	26%	10%
ZEV credits % / Net profit		15%	43%	1%	2%	1%	3%	2%	1%	1%	1%	1%	0%	0%	2%	33%	604%	169%	27%	0%
Net profit margin		- 32%	- 58%	425 %	22%	30%	-9%	47%	-5%	20%	10%	25%	10%	18%	5%	-19%	-113%	-371%	26%	-58%