FCEV Supplying Project
For A New Phase of Changwon
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City of Changwon

Overview

- **Location**: Southeast area
- **Area**: 747.67㎢
- **Key Industry**: Mechanic
- **Key Features**
  - Capital of Gyeongnam Province
  - 1st Planned City (modeled after Canberra)
- **Population**: 1.05m (9th)
- **Climate**: Temperate

**Major Events**
- Jinhae Naval Port Festival (April 1~April 10)
- K-Pop Festival (September)
- 2018 ISSF World Shooting Championship

**Local Professional Sports Teams**
- Gyeongnam FC (Soccer)
- Changwon LG Sakers (Basketball)
- NC Dinos (Baseball)
Life in Changwon

- City Plaza
- Yongji Lake
- Kpop World Festival
- Yeojwacheon Stream
- International Shooting Range
- Gyeongnam FC
- LG Sakers
- NC Dinos
I. Air Pollution
II. GHG Emission
III. PM10, PM2.5 Emission from Diesel Vehicles
IV. Achieving Sustainable Development Goal
V. Need for Development of A Major New Industries
Public Bike - NUBIJA

- The 1st Public Bike in South Korea (Currently over 20 cities running)
- Establishment: 2008 (20 Terminals & 500 Nubija bikes)
- Terminals & Bikes: 269 terminals and 6,121 Nubija bikes (As of April 2018)
- Bike Lane: 103.3km (Longest in South Korea)
- Budget: Installation $48,000/terminal  Maintenance $4.8m/yr

<table>
<thead>
<tr>
<th></th>
<th>Changwon</th>
<th>Miami, FL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period</td>
<td>Fee</td>
</tr>
<tr>
<td>Membership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td>$28</td>
<td>30min.</td>
</tr>
<tr>
<td>6 months</td>
<td>$17</td>
<td>1h</td>
</tr>
<tr>
<td>1 month</td>
<td>$3.75</td>
<td>2h</td>
</tr>
<tr>
<td>1 week</td>
<td>$2</td>
<td>4h</td>
</tr>
<tr>
<td>Non-membership</td>
<td>1 day(90min.)</td>
<td>$1</td>
</tr>
</tbody>
</table>
1. History
- 2011 Public EV supply(140) / 2013 Private EV supply(422)
- 562 Vehicles Total(2011~2017), 55 Public Quick Charging Stations
- Enacted city ordinance for supporting EV(15 May 2014)

2. Benefits
- Subsidy for Purchasing($10,000~$20,000)
- Automobile Tax off
- Highway Toll 50% off
- EV Parking Area / Parking Tower
### Satisfaction Survey on EV

<table>
<thead>
<tr>
<th>Survey Targets (Purchasing)</th>
<th>Survey Period</th>
<th>Satisfied Total</th>
<th>Very Satisfied</th>
<th>Satisfied</th>
<th>Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘14~’ 15 (130)</td>
<td>Jan. ’16</td>
<td>86.6% (102)</td>
<td>26.6% (34)</td>
<td>60% (78)</td>
<td>13.3% (14)</td>
</tr>
<tr>
<td>‘15~’ 16 (92)</td>
<td>Jan. ’17</td>
<td>87.0% (80)</td>
<td>21.7% (20)</td>
<td>65.3% (60)</td>
<td>13.0% (12)</td>
</tr>
<tr>
<td>‘16~’ 17 (94)</td>
<td>Jan. ’18</td>
<td>93.6% (88)</td>
<td>52.1% (49)</td>
<td>41.5% (39)</td>
<td>6.4% (6)</td>
</tr>
</tbody>
</table>

- **Satisfaction Factors:** Vehicle Performance Enhancement, Increased Infrastructures
- **Dissatisfaction Factors:** Charging Time, Distance to Empty (DTE)
1. History

- Changwon – selected as a hub city of Supplying FCEV by the Ministry of Environment(2015)
- 1st Fueling Station in Changwon: Completion - March 9, 2017
- Capacity of Fueling Station: 5 vehicles in a row, 50 vehicles per day
- Budget(USD): $4.5m (initial budget, 2016), $7.3m (2018 projected)

<table>
<thead>
<tr>
<th>Budget Details</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>2016 initial budget</td>
<td>$4.5m</td>
</tr>
<tr>
<td>Fueling Station: $2.8m</td>
<td></td>
</tr>
<tr>
<td>Purchasing FCEV: 3.2m(40)</td>
<td></td>
</tr>
<tr>
<td>Subsidy for Citizens: $0.25m</td>
<td></td>
</tr>
<tr>
<td>2018 budget</td>
<td></td>
</tr>
<tr>
<td>Fueling Station: $6m</td>
<td></td>
</tr>
<tr>
<td>Purchasing FCEV: $0.68m</td>
<td></td>
</tr>
<tr>
<td>Subsidy for Citizens: $0.61m</td>
<td></td>
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</tbody>
</table>

*2018 Total Budget for eco-friendly vehicles (EV, FCEV, NGV): $13.6m
# Specification of FCEV & Subsidy

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Specification</th>
</tr>
</thead>
</table>
| HYUNDAI  | Tucson IX Fuel Cell    | Driving range: 415km(260mi)  
|          |                        | Acceleration(0 → 100km/h): 12.5sec  
|          |                        | Max. speed: 160km/h(100mph)  
|          |                        | Fueling time: 3min  
|          |                        | Fuel cell stack: 100kw  
|          |                        | Fuel efficiency: 83km/kg |

Subsidy: $35,000 out of $80,000 (Total Price)

Changwon Hydrogen Fueling Station (Maintenance - $0.11m/yr)
### Major Effect

**Air Quality Improvement**

<table>
<thead>
<tr>
<th>Total Distance</th>
<th>Total Amount of CO₂</th>
<th>Total Amount of PM Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>242,139 km (Daily Avg. Dist. 37km per vehicle)</td>
<td>Reduction 47 t until 2017 (192.2g/km)</td>
<td>4,840,000 mg</td>
</tr>
</tbody>
</table>

※Based on 40 Public FCEVs, As of 18 Jan. 2018

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**FCEV Project**

1. **Fuel cell electric vehicle operating principles**
   - **STEP 1**: Air (oxygen) taken in
   - **STEP 2**: Oxygen and hydrogen supplied to fuel cell stack
   - **STEP 3**: Electricity and water generated through chemical reaction
   - **STEP 4**: Electricity supplied to motor
   - **STEP 5**: High-pressure hydrogen tank
   - **STEP 6**: Water emitted outside vehicle

2. **Demonstration – How to Filter PM**
   - **Before**
   - **After**

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**Filters**
## Comparison – EV vs. FCEV

<table>
<thead>
<tr>
<th>items</th>
<th>Fueling (Charging) Stations</th>
<th>FCEV 3 (2018 Projected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV 55</td>
<td>Driving Range</td>
<td>Over 400km</td>
</tr>
<tr>
<td></td>
<td>Fueling (Charging) Time</td>
<td>3~5min.</td>
</tr>
<tr>
<td></td>
<td>Generating electricity (Thermal Power Generation 55%)</td>
<td>CO₂ Emission</td>
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<tr>
<td></td>
<td>Extracting hydrogen gas</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>$20k~$0.1m</td>
<td>Vehicle Price</td>
</tr>
<tr>
<td></td>
<td>$10k~$20k</td>
<td>Subsidy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50k~$80k</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$30k</td>
</tr>
</tbody>
</table>
Supplying 34 FCEVs
(Hyundai NEXO – Subsidy $31,000 per vehicle)
Building 2 New Fueling Stations
- 1 on-site hydrogen produce available

**Plans in 2018**

**Plans after 2018**

- Introduction of public transportation – ELEC CITY(Bus)
- Investing $85m total for hydrogen industries project
- Building hydrogen energy circulation test site
  *production-storage-transportation-usage
- Promotion of hydrogen energy related industries

**Visions**

- Growth of hydrogen industries – A new driving force of the city
- Economic effect of $2.8b, over 6,000 employment for 300 companies
- Achieving Environmental Capital 2020
- Liveable & resilient city Changwon
Conclusions

I. Participation of Citizens – Key to the Success
II. Intercity Cooperation – Share Practices & Policies
III. One Step Closer to A Sustainable City