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Toyota Daihatsu Engineering & Manufacturing Co., Ltd.

Low Carbon Asia Research Network (LoCARNet) 6th Annual Meeting
Bangkok, Thailand
1st November 2017
From 348,877 employees, Toyota conducts its business worldwide with 54 manufacturing companies in 28 countries, and sold to over 170 countries.
Toyota in Asia

Network of Toyota companies in Asia

Toyota manufacturing business in Asia covers
11 companies in 8 countries

- Assembly plants
- Unit plants

- Pakistan
- India
- Thailand
- Vietnam
- Malaysia
- Indonesia
- Taiwan
- Philippines
Global warming: Frequent ‘extreme weather events’ occur worldwide

Global mean temperature has risen 0.7°C per century. Temperature in 2016 was higher than record-high previous year. **Extreme weather events** such as droughts/bush fire by temperature rise, and enormous typhoons and floods by seawater temperature rise has become more frequent.

![Graph showing trend of temperature increase](graph.png)

- **Record-high exceeding trend**
- **Risen 0.7°C per century**
- **Food scarcity by drought**
- **Bush fire due to global warming**
- **Unexpected rise in sea level**

Source: Japan Meteorological Agency
Global trend: Paris Agreement was put into force

COP21(2015) • Adopted the Paris Agreement → Put into force in November 2016
*All Parties agreed to submit CO2 emissions reduction target and take domestic countermeasures.
~Keep temperature rise below 2°C and decarbonize 2050 onwards~
*ca. 196 countries

<Final agreement on the Paris Agreement>

<table>
<thead>
<tr>
<th>Item</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>Keep temperature rise below 2°C (collective efforts to limit temperature rise further to 1.5°C)</td>
</tr>
<tr>
<td>Long-term target</td>
<td>Latter half of this century (2050) onwards Balance emissions and absorptions <del>zero emissions</del></td>
</tr>
<tr>
<td>GHG* Emissions reduction target</td>
<td>① All the countries are obliged to submit reduction target and take domestic countermeasures ② Review the target every 5 years (UN verified progress every 5 years)</td>
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</tbody>
</table>

Prime Ministers from 150 countries participated = Climate change measures have become the global top agenda.

PMs from 150 countries (MOF HP) Unanimous agreement (BBC)

Two major emitters, US, CN and increasing emitting IN indicated reduction target for the first time (=Countries that have not ratified the Kyoto Protocol)

Despite US decision on withdrawal from the Paris Agreement, major companies in EU, China and US are insisting on remaining in the agreement.
Global trend: Agreement on 2°C scenario

COP21: Background of agreement
In order to prevent catastrophic damage on earth, it is evitable to hold the increase of the temperature to 2°C.

G7 leaders’ declaration ⇒ 40-70% reduction by 2050 (from 2010)

*Intergovernmental Panel on Climate Change
To go beyond zero environmental impact and achieve a net positive impact, Toyota has set itself six challenges. All these challenges, whether in climate change or resource and water recycling, are beset with difficulties, however we are committed to continuing toward the year 2050 with steady initiatives in order to realize sustainable development together with society.
<table>
<thead>
<tr>
<th>Challenge achieving zero</th>
<th>Challenge achieving zero</th>
<th>Net positive impact challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>① New Vehicles Zero CO2 Emissions Challenge</strong></td>
<td><strong>② Life Cycle Zero CO2 Emissions Challenge</strong></td>
<td><strong>④ Challenge of Minimizing and Optimizing Water Usage</strong></td>
</tr>
<tr>
<td>Develop and spread next-generation vehicles</td>
<td>Eco-friendly design from materials to disposal</td>
<td>Thoroughly reduce the amount of water used and clean thoroughly and return</td>
</tr>
<tr>
<td>Numerical target</td>
<td>Numerical target</td>
<td><strong>⑤ Challenge of Establishing a Recycling-based Society and Systems</strong></td>
</tr>
<tr>
<td>90% reduction by 2050</td>
<td><strong>③ Plant Zero CO2 Emissions Challenge</strong></td>
<td>Roll out resource recycling system globally</td>
</tr>
<tr>
<td>Low CO2-emitting innovative technology</td>
<td>Decarbonize by 2050</td>
<td><strong>⑥ Challenge of Establishing a Future Society in Harmony with Nature</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All-Toyota joint activities to connect communities and with the world</td>
</tr>
</tbody>
</table>
Challenge 3 - Plant Zero CO\textsubscript{2} Emissions

- CO\textsubscript{2} emissions under BAU
- Plant CO\textsubscript{2} emissions ⇒ Aiming for zero in the long run

Reduce by using:

1. Low CO\textsubscript{2}-emitting production technologies and Daily Kaizen activities

2. Using renewable energy and hydrogen

1) Innovative Technologies & Daily Kaizens for Energy Saving
2) Use of renewable energy and hydrogen energy
1. Low CO2 Production Technologies

- Thoroughly shortening production process
- Minimization and energy saving of moving parts
- Recovery of wastes energy
- Increasing energy storage

**Casting Process**

- Downsize equipment
- Harden sand mold at low temperature

**Existing (2001)**

- Existing
- Development (2020)

**Volume ▲50% CO2 reduction ▲30%**

**organic sand mold harden at high temperature**

**inorganic sand mold harden at low temperature**

**Energy saving ⇒ CO2 reduction by 40%**

**CO2 reduction ▲10%**
2 Daily Kaizens

- Elimination of unnecessary/inconsistent/unreasonable efforts
- Unpowered/low-thrust operation energy

Karakuri Mechanism
Using gravity or magnetic force to move tools without any external energy

Karakuri doll
- Gravity (weight)
- Magnetic force
- Balance
- Differential action
- Cam
- Link
- Gear

Utilize for Production equipment
- unpowered
- low-thrust

Wisdom & Ingenuity

Daily Kaizen Management
One of the core principles of Toyota Production System
“Continuous improvement “
‘Always a Better Way’
**Example of JCM Model**

**Project**: Introduction of gas engine cogeneration system at automobile manufacturing plant

PP (Japan): Toyota Motor Corporation, PP (Indonesia): PT. Toyota Motor Manufacturing Indonesia

**Outline of GHG Mitigation Activity**

- **gas co-generator** has been installed to reduce energy consumption and CO$_2$ emission (year 2015)
- system with high efficiency gas-engine and heat recovery system to generate steam and hot water.

**Expected GHG Emission Reductions**

**Expected CO$_2$ Emission Reductions** = 20,310 tonCO$_2$/ year

**Sites of Project**

Site of TMMIN
Jakarta, Indonesia
Renewable Energy

- Elimination of unnecessary/inconsistent/unreasonable efforts
- Unpowered/low-thrust operation energy

Toyota Group In-house, and on the premises

Production plants & office buildings

Improve amount per unit
- Accelerate low CO2 innovative technology
- Daily Kaizen
- Energy conversion (Steam, airless)

On-site renewable energy

Local (Business and residential) Motomachi Proof Test

Share electricity & heat

Power transmission infrastructure

Power transmission

Power company

Purchase from renewable energy operators
- Wind power
- Solar power
- Biomass
- Geothermal, hydro power, etc.

As the first process, wind power generation will be introduced in domestic plants by around 2020, for zero CO2 in the FCV production line

Toyota de Brazil in Brazil will be the first plant to start the use of 100% renewable energy from 2015
**RE Status - Other global companies**

**1 RE100 Collaboration**

**Introduction**: Global campaign working with the world’s most influential companies who committed to become 100% renewable energy source.

**Issuance**: 2014 Climate Week at New York, USA

**Requirement**:
1) Set goal to use 100% of total electricity consumption from renewable sources within a specified year.
2) Disclose electricity data annually (progress report by RE100).

**Joining companies**: Consists of a wide range of industries including telecommunications & IT, foods & drinks, cement and automobile manufacturing.

**%Renewable Energy Uses (Year 2014)**

- **IT**: 64%
- **Retail**: 60%
- **Financial, buildings, properties**: 60%
- **Manu.**: 50%
- **Medical**: 43%
- **Apparel**: 36%
- **Foods & Drinks**: 23%

Source: [http://there100.org/companies](http://there100.org/companies)
<table>
<thead>
<tr>
<th>No.</th>
<th>Country</th>
<th>Target of RE implementation</th>
<th>Target of Solar PV installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ASEAN</td>
<td>23% of RE in energy mix within 2025</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*From 2016-2025 Action Plan of ASEAN Energy Cooperation (APAEC)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Myanmar</td>
<td>15-20% of power capacity within 2030</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Thailand</td>
<td>30% of alternative energy in energy consumption within 2036</td>
<td>6,000 MW within 2036</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*From Alternative energy development plan (Sep 2015)</td>
<td>*From Alternative energy development plan (Sep 2015)</td>
</tr>
<tr>
<td>3</td>
<td>Laos</td>
<td>30% of total energy consumption within 2025</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Cambodia</td>
<td>&gt;2 GW of Hydroelectric power within 2020</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Vietnam</td>
<td>27 GW within 2030 (129.5 GW)</td>
<td>4 GW within 2025</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*From Power Development Plan 7th revision (Mar 2016)</td>
<td>12 GW within 2030</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*From Power Development Plan 7th revision (Mar 2016)</td>
<td>*From Power Development Plan 7th revision (Mar 2016)</td>
</tr>
<tr>
<td>6</td>
<td>Malaysia</td>
<td>• 2,080 MW within 2020</td>
<td>175 MW within 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 4,000 MW within 2030</td>
<td>4,000 MW within 2030</td>
</tr>
<tr>
<td>7</td>
<td>Singapore</td>
<td></td>
<td>350 MW of PV within 2020</td>
</tr>
<tr>
<td>8</td>
<td>Indonesia</td>
<td>23% of total energy consumption within 2025</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Brunei</td>
<td>10% of power generation within 2035</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Philippines</td>
<td>15 GW of power capacity within 2030</td>
<td>500 MW within 2016, 1,528 MW within 2030</td>
</tr>
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</table>
This project aims to reduce CO2 emissions by installing 1.1MW solar panels on the rooftop of the vehicle assembly factory of Toyota Motor Philippines Corp. in the south of Manila. Electricity generated by solar power systems is consumed in the factory and replaces part of grid electricity consumption.

**Expected GHG Emission Reductions**

859 tonCO₂/year

\[
= (\text{Reference CO}_2 \text{ Emission}) - (\text{Project CO}_2 \text{ Emission}) \\
= ((\text{Reference Power consumption}) - 0) \times \text{CO}_2 \text{ Emission Factor}
\]

Unit: CO₂ Emission [tCO₂/year]

- Power Consumption [MWh/year]
- CO₂ Emission Factor [tCO₂/MWh]

**Sites of Project**

**Site of TMP, Quezon City** (approx. 40km from Manila)