Energy Efficiency
Continuous Improvement Activity
based on Toyota Way and Toyota Production System,
and Contributions to a Sustainable Society

TOYOTA DO BRASIL
Nov 2018
## 1. History – Vehicle production

<table>
<thead>
<tr>
<th>Year</th>
<th>SBC Plant</th>
<th>IDT Plant</th>
<th>SOR Plant</th>
<th>PFZ Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>'50~70</td>
<td>▼ 1962.11 Inauguration, Start Banderantes prod</td>
<td>▼ 1998.8 Inauguration, Start Corolla prod</td>
<td>Inauguration, Start Etios prod ▼ 9</td>
<td>▼ 9</td>
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<tr>
<td>'70~90</td>
<td>▼ 1997.2 Start Hilux Unit &amp; Body Parts prod</td>
<td>▼ 1998.8 Inauguration, Start Corolla prod</td>
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<td>'90~00</td>
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<td>'19</td>
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</tbody>
</table>

**Overall**

- ▼ 1958.1 Foundation
- ▼ TDB 50 years (100 years Immigration)
- ▼ TDB 60 years

**SBC Plant**

- ▼ 1962.11 Inauguration, Start Banderantes prod
- ▼ 1997.2 Start Hilux Unit & Body Parts prod
- ▼ 1998.8 Inauguration, Start Corolla prod

**IDT Plant**

- ▼ Forging 3rd shift
- ▼ Corolla minor model change
- ▼ Start Yaris production

**SOR Plant**

- ▼ Engine Plant inauguration

**PFZ Plant**

- ▼ Start Etios prod ▼ 9

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**Bandeirantes**

**ETIOS**

**YARIS**

**HILUX**

**COROLLA**

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**Our story began in 1958, 60 years ago.**
## I. Toyota do Brasil Outline

### 2. Sites

<table>
<thead>
<tr>
<th></th>
<th>SBC Plant</th>
<th>IDT Plant</th>
<th>SOR Plant</th>
<th>PFZ Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>Parts production for Hilux &amp; Corolla</td>
<td>Production of Corolla</td>
<td>Production of Etios and Yaris</td>
<td>Production of Engine</td>
</tr>
<tr>
<td>Prod capacity</td>
<td>Corolla 87K Forging 900K Hilux 131K</td>
<td>77K</td>
<td>112K</td>
<td>116K</td>
</tr>
<tr>
<td>Area Site</td>
<td>193,362 m²</td>
<td>1,776,000 m²</td>
<td>3,700,000 m²</td>
<td>870,000 m²</td>
</tr>
<tr>
<td>Building</td>
<td>68,400 m²</td>
<td>101,822 m²</td>
<td>98,500 m²</td>
<td>13,700 m²</td>
</tr>
<tr>
<td>Employees (2018 Jul)</td>
<td>1,437</td>
<td>2,115</td>
<td>2,434</td>
<td>623</td>
</tr>
</tbody>
</table>

We have 4 sites, all located in São Paulo State.
I. Toyota do Brasil Outline

2. Sites

All 4 plants located within 100 km of distance from São Paulo City.
I. Toyota do Brasil Outline

3. Import & Export

Export Corolla and Etios to South America,

Engine components to North America.

Import Hilux from Argentina.
TMC announced the Environmental Challenge 2050 in October 2015. There are 6 Challenges. TDB is also conducting activities regionally.

Kindly access URL for more details.
https://www.toyota.co.jp/jpn/sustainability/environment/index.html
II. Toyota Environment Challenge 2050

Challenge 1: New vehicle Zero CO₂ emission

Actions to reduce CO₂ emission of TOYOTA products.

Current:
Production of Flex Fuel Vehicle (FFV) – Gasoline / Bioethanol

Ongoing:
High energy efficiency technology (Hybrid, Fuel Cell)
- Development of Hybrid FFV to improve fuel efficiency.

Reference: CO₂ emission per Fuel
kg CO₂/l

Gasoline: 2.28
Ethanol: 1.51

Δ 34% 100%

Renewable (sugarcane)

Ethanol emission is less than gasoline

Ref.: “Emission Report” of Brazilian Ministry of Environment
II. Toyota Environment Challenge 2050

Challenge 2: Life cycle Zero CO$_2$ emission

Actions to reduce CO$_2$ emission in supplier, logistics and dealer activities.

**Supplier**
- Good KAIZEN sharing (through BRASA – Brazilian Toyota Suppliers Association)
- Green purchase guideline revision.
- ISO14001 certification promotion.

**Logistics**
- Fuel source change (Diesel → Gas → Renewable)
- Route optimization
- Modal changes

**Dealer**
- Environmental KPI collection promotion.
- ECODEALER award for best practices by ABRADIT (Toyota Dealers Association).
- Promotion of ISO 14001 certification.
II. Toyota Environment Challenge 2050

Challenge 4: Challenge of Minimizing and Optimizing Water Usage

Actions to reduce water usage in TDB production process.

In TDB, major consumption occur in Paint Shop at vehicle production plants.

Paint Shop (pre-treatment process).

So far, TDB achieved 45% reduction in m³/veh
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Challenge 5: Establish a Recycling-based Society

Actions to reduce waste generation in TDB and partners.

**Plants**
- Waste generation reduction KAIZEN (ex. Paint sludge press)

**Supplier**
- Green purchase guideline
- Waste management KAIZEN sharing (through BRASA)

**Community**
- Support NGO seamstress cooperative recycling used uniforms.

**Dealer**
- DERAP - Dealer environmental audit
- ISO14001
- ECODEALER Award

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Winner BRASA 2017
KANJIKO

Winner Ecodealer 2017
Orion – Cuiabá
## II. Toyota Environment Challenge 2050

### Challenge 6: Future Society in Harmony with Nature

Promote Harmony with Nature in TDB, partners and community.

<table>
<thead>
<tr>
<th>Plants</th>
<th>Community</th>
<th>3) Education for Sustainable Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Green Wave Project</td>
<td>2) Today for Tomorrow</td>
<td>Environmental Month, Tree Day Water Day, Eco Mind Survey involving all 5700 employees</td>
</tr>
<tr>
<td>Planted 335,000 trees</td>
<td>Supported 190,000 trees planting</td>
<td>27 Cities influenced + 3 visitor centers established</td>
</tr>
<tr>
<td>Inventory</td>
<td>03 endangered species protection ongoing</td>
<td></td>
</tr>
<tr>
<td>Flora: 53 species</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fauna: 16 fishes, 10 reptiles, 186 birds, 38 mammals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
II. Toyota Environment Challenge 2050

Challenge 6: Future Society in Harmony w/ Nature

4. Dream Car Art Contest

Application at http://toyotadreamcar.com.br/

Spread Eco Mind in society through art contest. Brazilian children won in 2015 and 2016!

2015
Age 12 to 15
Gabriele

2016
Age 12 to 15
Victoria
Challenge 3: Plant CO₂ Zero Challenge

This Challenge is related to Energy Efficiency

Consumption of energy = emission of CO₂.

Energy Efficiency Up = Less CO₂ emission
Good for environment!
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Challenge 3: Plant CO₂ Zero Challenge

1. Energy Efficiency Management – Thinking Way
   1) Toyota Way.

   **Continuous Improvement**
   “Challenge members to tackle a problem and implement KAIZEN, after deep investigation through GENCHI GENBUTSU”

   **HR DEVELOPMENT TEAMWORK**

   **Respect for People**
   Encourage members to work together in team, each one contributing with solution.

First Principle is Toyota Way
Challenge 3: Plant CO₂ Zero Challenge

1. Energy Efficiency Management – Thinking Way
2) TPS (Toyota Production System)

Just-In-Time
“Produce only what is needed, in the amount needed, when is needed, with minimum resources.”

“Use necessary resources
Only when needed
Only amount needed”

Measurements & Control
(MIERUKA)

Second Principle is Toyota Production System
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO₂ Zero Challenge

1. Energy Efficiency Management – Thinking Way
   3) Management & GENBA

Management

GENBA

MIERUKA

TEAMWORK

Strategy

Measurement & Control

ENERGY EFFICIENCY 3 STEPS ACTIVITY

<table>
<thead>
<tr>
<th>STEP</th>
<th>1ST</th>
<th>2ND</th>
<th>3RD</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOCUS POINT</td>
<td>Turn Off if not in use</td>
<td>Eliminate Waste. Use only necessary amount</td>
<td>Upgrade equipment technology for better efficiency</td>
</tr>
<tr>
<td>EXAMPLES</td>
<td>Lights down activity</td>
<td>ABCD Concept</td>
<td>LED lamp adoption</td>
</tr>
</tbody>
</table>

Management give direction of KAIZEN implementation.
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Challenge 3: Plant CO₂ Zero Challenge


Now we will explain our Energy Management System.
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Challenge 3: Plant CO₂ Zero Challenge


1) On-line monitor and management report.

In each plant, we have Utility Management Room.
Challenge 3: Plant CO₂ Zero Challenge


2) Cover all utility items (boiler, steam, etc).

System allow to control all utility items.
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Challenge 3: Plant CO$_2$ Zero Challenge


4) Installation of meters (ex. water consumption points)

Meters are installed in key points for KAIZEN.
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Challenge 3: Plant CO₂ Zero Challenge

3) Data collection (via ethernet, optical cable, DH+ cable and RF – radio frequency net)

Data collection is done by meters and transmitted By 4 different ways.
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Challenge 3: Plant CO$_2$ Zero Challenge


5) On-line monitor and management report (cont.)

In case of abnormality, warning by alarm happens.
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Challenge 3: Plant CO₂ Zero Challenge

5. ABCD Concept

Now we will explain how GENBA conduct ABCD concept.
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Challenge 3: Plant CO$_2$ Zero Challenge

5. ABCD Concept

1) Classify energy usage amount by type.

2) Study and implement KAIZEN

2-1) Run PDCA to level up

2-2) Run PDCA to reduce volume

Identify type of consumption, upgrade and reduce.
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Challenge 3: Plant CO₂ Zero Challenge

5. ABCD Concept
   3) Deploy to all shops, all plants.
   4) Each shop map and control

5) Top management involvement
   EVP, VP and Director conduct GENCHI GENBUTSU to motivate members.

6) Recognition from Toyota top management
   Global Best (Toyota Motor Co.)

Important: strong support from top management.
Recognition from TMC top management.
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Challenge 3: Plant CO\textsubscript{2} Zero Challenge

1. Energy Efficiency Management – Thinking Way
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- Continuous Improvement
  “Challenge members to tackle a problem and implement KAIZEN, after deep investigation through GENCHI GENBUTSU”

- Respect for People
  Encourage members to work together in team, each one contributing with solution.

- HR DEVELOPMENT TEAMWORK
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Challenge 3: Plant Co2 Zero Challenge

Quality Control Cyrcle A0

Background

Root Cause Analysis

Problem clarification/Current Situation

GENCHI

GENBUTSU

Countermeasure implementation

Results evaluation

Target Setting
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Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples

HR DEVELOPMENT & CHALLENGE

Ex.1

Before COMPRESSOR SYSTEM

After

Maker operation controller. Expensive upgrade

Member studies equipment manual. Developed low budget controller. Optimized compressor usage.

Attention point

Results

Reduction:
0.11 kg CO2/Veh

1 – Monitor equipment operation and grasp idleness.
2 – Challenge member. Motivation up.

New Controller.
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Challenge 3: Plant Co2 Zero Challenge

Ex. 2

**Before**

**RTO**

**After**

Paint Shop Oven and RTO Operation started 4:20 AM.

After studying paint drying parameters and repeated try-outs, reduced start time.

**Attention point**

Teamwork Utility & Paint Shop

1 – Studying process minute by minute.

2 – Repeated try-out to define new equipment start time.

- 4:20 – Too Early ✗
- 5:00 – Too Early ✗
- 6:00 – Too Early ✗
- 7:00 – OK ✔
- 7:30 – Too Late ✗

**Results**

Reduction: 1,65kg CO₂/Veh

**STRATEGY DESCRIPTION KAIZEN TEAM WORK**

1) Change Category: D or C to B

2) Reduced into category: 3B → 2B

3) Change to Category: D to A

**LEVEL UP**
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Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples (cont.)

Ex. 3

**Before**

Welding Shop cooling tower on/off done manually. Sometimes member forget.

**Not good...**

**After**

After studying production control system and implementing control switch in cooling tower, on/off is done automatically with production.

**Teamwork & Challenge**

Attention point

1 – Involve all related areas to solve problem.

2 – Study, architect and implement interlock operation of cooling tower with ANDON.

**Results**

Reduction: 0.04kg CO₂/Veh

**▲ 50%**

Teamwork Utility & Welding Shop
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Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples (cont.)

Ex. 4  | Before - AIR SUPPLY HOUSE  | After

Plan | Actual

Paint Shop Air Supply House (ASH) operate with fixed parameters (JPN)

Implemented parameters to save energy to achieve good condition according to temperature and humidity (Enthalpy)

Attention point  | HR development, motivation up

Results  | Reduction: 14,25 kg CO₂/Veh ▲93%

1 – Study equipment advanced features.

2 – Study Thermodynamics and investigation of gap in Plan x Actual
### Challenge 3: Plant Co2 Zero Challenge

#### The Power of Team Work

<table>
<thead>
<tr>
<th>KAIZEN</th>
<th>PHOTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Water Consumption Reduction in PT/ED</td>
<td><img src="image1.jpg" alt="Image 1" /> <img src="image2.jpg" alt="Image 2" /> <img src="image3.jpg" alt="Image 3" /> <img src="image4.jpg" alt="Image 4" /></td>
</tr>
<tr>
<td>② Reduce excess of overflow at Surface Conditioner tank</td>
<td><img src="image5.jpg" alt="Image 5" /> <img src="image6.jpg" alt="Image 6" /> <img src="image7.jpg" alt="Image 7" /> <img src="image8.jpg" alt="Image 8" /></td>
</tr>
<tr>
<td>③ Sensor position change in cooling tower</td>
<td><img src="image9.jpg" alt="Image 9" /> <img src="image10.jpg" alt="Image 10" /> <img src="image11.jpg" alt="Image 11" /> <img src="image12.jpg" alt="Image 12" /></td>
</tr>
<tr>
<td>④ Reduce salt concentration by softener installation in cooling tower</td>
<td><img src="image13.jpg" alt="Image 13" /> <img src="image14.jpg" alt="Image 14" /> <img src="image15.jpg" alt="Image 15" /> <img src="image16.jpg" alt="Image 16" /></td>
</tr>
<tr>
<td>⑤ Reduce water consumption for cleaning food</td>
<td><img src="image17.jpg" alt="Image 17" /> <img src="image18.jpg" alt="Image 18" /> <img src="image19.jpg" alt="Image 19" /></td>
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<tr>
<td>⑥ Stroke limiter in toilets taps</td>
<td><img src="image20.jpg" alt="Image 20" /></td>
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</tbody>
</table>

Members of different area and skills contribute for results.
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Challenge 3: Plant Co2 Zero Challenge

7. Overall Energy Efficiency KAIZEN activity results

Despite production increase, emission per unit decreased 52% thanks to daily KAIZEN and renewable.
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Challenge 3: Plant CO₂ Zero Challenge

2. Roadmap towards Zero Emission

1) Conduct Energy Saving Daily KAIZEN Activity and
2) Increase renewable energy usage to achieve CO₂ Zero emission in 2025 (before TMC).
THANK YOU VERY MUCH!
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Challenge 3: Plant CO₂ Zero Challenge

2. Energy usage

1) Assembly plants

- Assembly
- Press
- Welding
- Paint

2) Unit plants

- Casting
- Machining
- Unit Assy

Energy usage depends on plant characteristics.
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Challenge 3: Plant CO₂ Zero Challenge


6) Example of remote measurement

Information is concentrated in hub, then transmitted by radio frequency.
Since January 2015, TDB is purchasing 100% energy from renewable sources. Kg CO$_2$ reduction per kWh = ▲ 47%