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

TOYOTA DO BRASIL
Nov 2018
# I. Toyota do Brasil Outline

## 1. History – Vehicle production

<table>
<thead>
<tr>
<th>Year Range</th>
<th>SBC Plant</th>
<th>IDT Plant</th>
<th>SOR Plant</th>
<th>PFZ Plant</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>'50~70</td>
<td>▼ 1958.1 Foundation</td>
<td>▼ 1962.11 Inauguration, Start Banderantes prod</td>
<td>▼ 1997.2 Start Hilux Unit &amp; Body Parts prod</td>
<td>▼ 1998.8 Inauguration, Start Corolla prod</td>
<td>▼ TDB 50 years (100 years Immigration)</td>
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<tr>
<td>'70~90</td>
<td></td>
<td>▼ 11 Start Forged Parts</td>
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<td>'90~00</td>
<td></td>
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<td>▼ 1 Forging 3 shift</td>
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<td>'01~05</td>
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<td>▼ 7 TMGA2.0 SOP</td>
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<tr>
<td>'06</td>
<td></td>
<td></td>
<td>▼ 9 Corolla FMC</td>
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<tr>
<td>'07</td>
<td></td>
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<td></td>
<td>▼ 3 Corolla MMC</td>
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<td>'08</td>
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<tr>
<td>'19</td>
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</tr>
</tbody>
</table>

- ▼ 1958.1 Foundation
- ▼ 1962.11 Inauguration, Start Banderantes prod
- ▼ 1997.2 Start Hilux Unit & Body Parts prod
- ▼ 1998.8 Inauguration, Start Corolla prod
- ▼ TDB 50 years (100 years Immigration)
- ▼ TDB 60 years

**Bandeirantes**

**ETIOS**

**YARIS**

**COROLLA**

**HILUX**

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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><strong>Operation</strong></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><strong>Prod capacity</strong></td>
<td>Corolla 87K Forging 900K Hilux 131K</td>
<td>77K</td>
<td>112K</td>
<td>116K</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>Site</td>
<td>193,362 m$^2$</td>
<td>1,776,000 m$^2$</td>
<td>3,700,000 m$^2$</td>
</tr>
<tr>
<td><strong>Building</strong></td>
<td>Building</td>
<td>68,400 m$^2$</td>
<td>101,822 m$^2$</td>
<td>98,500 m$^2$</td>
</tr>
<tr>
<td><strong>Employees</strong></td>
<td>Employees (2018 Jul)</td>
<td>1,437</td>
<td>2,115</td>
<td>2,434</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.
II. Toyota Environment Challenge 2050

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

\[ \frac{2.28}{1.51} \Delta 34\% \]

Ethanol emission is less than gasoline

100% Renewable (sugarcane)

Ref.: “Emission Report” of Brazilian Ministry of Environment
Challenge 2: Life cycle Zero CO₂ emission

Actions to reduce CO₂ 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
II. Toyota Environment Challenge 2050

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)

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

Community
- Support NGO seamstress cooperative recycling used uniforms.

Winner BRASA 2017 KANJIKO

Winner Ecodealer 2017 Orion – Cuiabá
### Challenge 6: Future Society in Harmony w/ Nature

**Promote Harmony with Nature in TDB, partners and community.**

<table>
<thead>
<tr>
<th>Plants</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Green Wave Project</td>
<td>Supported 190.000 trees planting</td>
</tr>
<tr>
<td><strong>Planted</strong> 335.000 trees</td>
<td><strong>Supported</strong> 190.000 trees planting</td>
</tr>
<tr>
<td>2) Today for Tomorrow</td>
<td>03 endangered species protection ongoing</td>
</tr>
<tr>
<td><strong>Inventory</strong></td>
<td><strong>Inventory</strong></td>
</tr>
<tr>
<td>Flora: 53 species</td>
<td>Flora: 53 species</td>
</tr>
<tr>
<td>Fauna: 16 fishes, 10 reptiles, 186 birds, 38 mammals</td>
<td>Fauna: 16 fishes, 10 reptiles, 186 birds, 38 mammals</td>
</tr>
<tr>
<td>3) Education for Sustainable Development</td>
<td>27 Cities influenced + 3 visitor centers established</td>
</tr>
<tr>
<td>Environmental Month, Tree Day Water Day, Eco Mind Survey involving all 5700 employees</td>
<td>27 Cities influenced + 3 visitor centers established</td>
</tr>
</tbody>
</table>
II. Toyota Environment Challenge 2050

Challenge 6: Future Society in Harmony w/ Nature

4. Dream Car Art Contest

Spread Eco Mind in society through art contest. Brazilian children won in 2015 and 2016!
II. Toyota Environment Challenge 2050

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!
II. Toyota Environment Challenge 2050

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”

   **Respect for People**

   Encourage members to work together in team, each one contributing with solution.

   **HR DEVELOPMENT TEAMWORK**

   **First Principle is Toyota Way**
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO\textsubscript{2} 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.**”

**JIDOUKA**

“Stop automatically when defect is detected”.

**Measurement & Control (MIERUKA)**

“Use necessary resources
Only when needed
Only amount needed”

**Identify and Eliminate WASTE**

(in japanese, MUDA)

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 give direction of KAIZEN implementation.
Now we will explain our Energy Management System.
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO₂ Zero Challenge


1) On-line monitor and management report.

In each plant, we have Utility Management Room.
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO$_2$ Zero Challenge


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

System allow to control all utility items.
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO$_2$ Zero Challenge


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

Meters are installed in key points for KAIZEN.
II. Toyota Environment Challenge 2050

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.
Challenge 3: Plant CO₂ Zero Challenge


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

In case of abnormality, warning by alarm happens.
Now we will explain how GENBA conduct ABCD concept.

**Challenge 3: Plant CO₂ Zero Challenge**

5. ABCD Concept

**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>

**Measurement & Control**

**MIEKUKA**

**GENCHI GENBUTSU**

**Challenge 3**
II. Toyota Environment Challenge 2050

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.
II. Toyota Environment Challenge 2050

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.
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO₂ Zero Challenge

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

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

- HR DEVELOPMENT TEAMWORK
II. Toyota Environment Challenge 2050

Challenge 3: Plant Co2 Zero Challenge

Quality Control Cycle A0

Background

Root Cause Analysis

Problem clarification/
Current Situation

Countermeasure
implementation

GENCHI

GENBUTSU

Target Setting

Results evaluation
II. Toyota Environment Challenge 2050

Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples

HR DEVELOPMENT & CHALLENGE

Ex.1

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
</table>

**COMPRESSOR SYSTEM**

**Attention point**

1 – Monitor equipment operation and grasp idleness.

2 – Challenge member. Motivation up.

**Results**

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

Reduction: 0.11 kg CO2/Veh

**Energy Consumption**

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Number of vehicles produced.</th>
<th>Number of vehicles produced.</th>
</tr>
</thead>
</table>

**New Controller.**
II. Toyota Environment Challenge 2050

Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples

Teamwork & GENCHI GENBUTSU

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

Level up

Before

After
Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples (cont.)

Teamwork & Challenge

Ex. 3  
Before  
COOLING TOWER

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

Attention point

1 – Involve all related areas to solve problem.

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

After  
Andon System

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

Results

Reduction: 0.04kg CO₂/Veh

50%
II. Toyota Environment Challenge 2050

Challenge 3: Plant Co2 Zero Challenge

7) KAIZEN examples (cont.)

Ex. 4

Before

AIR SUPPLY HOUSE

After

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%
Members of different area and skills contribute for results.
II. Toyota Environment Challenge 2050

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.
II. Toyota Environment Challenge 2050

Challenge 3: Plant CO\textsubscript{2} Zero Challenge

2. Roadmap towards Zero Emission

1) Conduct Energy Saving Daily KAIZEN Activity and
2) Increase renewable energy usage to achieve CO\textsubscript{2} Zero emission in 2025 (before TMC).
THANK YOU VERY MUCH!
Energy usage depends on plant characteristics.

II. Toyota Environment Challenge 2050

Challenge 3: Plant CO₂ Zero Challenge

2. Energy usage

1) Assembly plants

Assemble
Press
Welding
Paint

2) Unit plants

Casting
Machining
Unit Assy

Energy usage depends on plant characteristics.
II. Toyota Environment Challenge 2050

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 CO₂ reduction per kWh = ▲ 47%