Status of Japanese ENE-FARM toward the full scale commercialization

Toshiba ENE-FARM
ENE-FARM is a common brand name of a residential fuel cell system in Japan.

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Overall Trend of Japanese ENE-FARM

As Whole Japan;
Past;
3,300 units FY 2005 through 2008
under NEDO Governmental Project

Commercialization in FY2009
Annual delivery 5,000 units

Present;
Annual 38,000 units in FY2014
Now; Total 140,000 units in the market
CAGR of these 6 years > 60%

Future;
Governmental Target
- 1.4 million units by FY2020
- 5.3 million units by FY2030

As Toshiba FCP;
[Volume of 120-140]
Past;
Annual in FY2005

Monthly in FY2009
Present:
Daily in FY2014

Future:
Challenge to 500-1,000 daily volume!!
- Content -

1. What is ENE-FAM

2. How we, Japan, have been promoting its dissemination.

3. How was/is the business & technology development in Toshiba

4. What were the key factors of the success and how shall it be toward the future: FULL SCALE COMMERCIALIZATION!!
What is ENE-FARM?

It’s the common brand name for a residential fuel cell system in Japan. The system is installed beside each house, and supplies both electricity and heat with higher efficiency to be 80 – 95%.

But its system configuration in not so simple to manufacture.
How we, Japan, have been promoting ENE-FARM dissemination

- After technology verification and large scale demonstration program, Japan started the commercialization of “ENE-FARM” in FY2009. And now, around 140,000 units are operated in Japanese houses.

<table>
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<tr>
<th>General Scheme</th>
<th>FY2000~</th>
<th>FY2005~</th>
<th>FY2010~</th>
<th>FY2020~</th>
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<td>Technology verification</td>
<td>Introduction</td>
<td>Popularization</td>
<td>Real Commercialization</td>
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<td>FY2002 - Field test</td>
<td>FY2005-2008 Large Scale Demonstration PJ</td>
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<td>FY2002</td>
<td>FY2005-2008</td>
<td>FY2020 10GW for Stationary</td>
<td></td>
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</tbody>
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Future Scenario (Possible Image for future)

- From Verification to Market Introduction by ENE-FARM
- Enlarge market size with cost reduction by mass production & technology breakthrough
- Introduction: Several k-units to several ten k-units
- Establishment: several ten k-units to several hundred k-units
- Real Commercialization: More than several hundred k-units

2009
Start commercialization

Starting by the joint declaration by government and industries on January, 28, 2009.

Governmental support

- Increasing total budget with decreasing subsidy per unit.
- Total support for 6 years, FY2009 to 2014, up to 88b-yen (650m-euro), and another 22b-yen (160m-euro) in FY2015

Trend of sales volume

The sales volume has been increased year by year. The accumulated volume reached to 120,000 units in the end of FY2014.

* Data by ACEJ
How was/is the business & technology development in Toshiba

- Joined to “Large scale demonstration program” since FY2005 through FY2008. Delivered 748 units for four years.
- Initial commercialization of ENEFARM started in FY2009 with estimated several thousands of annual volume.
- Selling volume around 8,000 units through 2011.
- Expanding business by 2nd generation units in FY2012 and 2013.
- Expanding manufacturing capacity with new facility (25,000 units/year in FY2014)
- New 3rd generation units was just delivered in April 2014.

Growth by 67% CAGR since 2009 to 9/014
50,000 units delivery achieved in Sep. 2014
70,000 units in the market as of Oct. 2015
How we have been promoting ENE-FARM improvement

Toshiba has been challenging ENE-FARM improvements with the highest priority for cost reduction.

- Lower Cost: more than 50% CR for 5 years
- Higher eff.: 39%(Elec.) 95%(Ttl.)
- Longer durability: 80,000hrs/4000SS
- Lower noise: 37dB
- Easier installation for narrow space
- Fuel diversity etc.

Major improvements in Toshiba ENE-FARM (FY2014 model)

Cost reduction
- Every effort by Technology, Purchasing and Manufacturing
- “Reduce” as CR Concept
  ⇒ Result: More than 50% reduction from 09 model

Enviromental Performance
- Higher efficiency and availability lead higher environmental contribution
  ⇒ The CO2 reduction increased to 1.6t/y

09年 10年 11年 12年 13年 14年 15年 16年

Reduction  >50%

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How we have been expanding our business chance

Various options or applications can offer the wider business opportunity and oversea business with ENE-FARM.

ENE-FARM as the core product

① Grid Independent Options
Three kinds of GI options related to function and price.

② Condominium installation
Two types application, balcony type and piping space type,

③ Oversea Business
EU can be the most promising market for CHP under the collaboration with BDR group.

Signing Ceremony (April 2014)
**Toshiba H2 FC for Future Hydrogen Society**

- Having delivered around 60 pure H2 FC units
- Developing variety of H2 FC as Toshiba group
- Tokyo Olympic/Paralympic as the opportunity to demonstrate the possibility of future H2 society

<table>
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<tr>
<th>Unit</th>
<th>Description</th>
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</table>
| 700W | After 2015 Commercialization  
- BCP (small scale)  
- H2 Station  
- Residential (close to H2 Station)  
- Tokyo Olympic village  
- PJ of Ministry of the Environment |
| Multi kW | After 2015  
- BCP (middle scale)  
- H2 Station  
- Institutional use |
| 100kW ~ MW System | After 2017  
- PJ of Ministry of the Environment  
Kyuusyu, Hokkaido, Olympic etc. |

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What were the key factors of ENE-FARM success

Japanese ENE-FARM just overcame the valley of death. So what were the key factors?

[Devil River] @R&D Phase
[Valley of Death] @Initial Commercialization
[Darwinian Sea] @Full Scale Commercialization

Residential PEM is on the commercialization phase since 2009 in Japan!

3 Aspects

- Governmental leadership
- Collaborative development under NEDO Project
- [Governmental efforts]

5 Factors

- Technology potential of manufacturers w/ long history
- [Core competence in technologies]
- Collaboration among Japanese companies FCCJ
- Partnership with Energy companies and manufacturers
- [Company collaboration]
How shall our challenge be toward the future FULL SCALE COMMERCIALIZATION?

Key challenges for full scale commercialization

1. ENE-FARM shall be really beneficial for end-customers related to three factors (i.e. ecology, economy and security)
   Another 20-30% of cost reduction is needed with every effort on design, manufacturing, and purchasing.
   Purchasing is even important rather than technology improvement in short term.
2. New sales channel to be explored in addition to current B2B channel

Good product with wider channel can lead the future ENE-FARM market toward 500k units as annual.

Market potential for ENE-FARM

3 million of annual sales in Japan.
Additional market is expected in EU and so on.
Summary

1. Dissemination result: The 88-yen (650m€) of governmental support for ENE-FARM for 6 years (FY2009-2014). Another 22b-yen (160m€) in FY2015. As the results, 140,000 units in now under the operation in Japan.

2. Toshiba efforts: The total volume is around 70,000 units and annual volume was 21,000 units in FY2015. More than 50% of cost reduction was achieved in 6 years.


4. Toward the future: Still need further 20-30% of cost reduction for “The really beneficial ENE-FARM for end customers”. Wider application and sales channel will be also key for Full Scale Commercialization. It’s really challenging, but has the reality to achieve.

And,,,, It must be some good example for the successful commercialization in EU.
Thank you! ~