

# TMC Exhibits Biotechnology and Greening Technologies

October 03, 2011

Toyota City, Japan, October 3, 2011—Toyota Motor Corporation (TMC) today held an event at its Toyota Biotechnology and Afforestation Laboratory in Aichi prefecture to showcase technologies developed there as part of its biotechnology and afforestation businesses. Technology on display included a newly developed yeast that increases the production yield of cellulosic ethanol bio-fuel, new technologies for the greening of parking lots and walls, and a new “cool-spot creation technology” for simulating and analyzing the effects of greening.

## **Development status of bio-fuels (cellulosic ethanol)**

TMC, through the use of gene recombination technology, has recently developed a new strain of yeast that will play an important role in the fermentation process for producing cellulosic ethanol.

Fermentation of xylose, one of the sugars produced when plant fibers are broken down in the enzymatic saccharification process, is normally difficult to achieve with naturally occurring yeasts. However, TMC’s newly developed yeast is not only highly efficient at fermenting xylose but also highly resistant to such fermentation-inhibiting substances as acetic acid. As a result, the yeast has achieved one of the highest ethanol fermentation density levels in the world\* (approximately 47 g/liter), and is expected to improve bio-fuel yield and significantly reduce production costs.

TMC, with the goal of reducing CO<sub>2</sub> emissions and responding to the growing need for diverse sources of energy, is working on developing renewable energy sources such as bio-fuels in addition to its work in developing next-generation environment-friendly vehicles. TMC is focusing on cellulosic ethanol, which is produced from non-edible plants that have significantly less impact on world food supplies. Research is underway on developing comprehensive technologies for the various processes involved in producing cellulosic ethanol, including raw material pretreatment, enzymatic saccharification and yeast fermentation. Aiming to achieve production-cost parity with other liquid fuels such as gasoline, TMC is striving to achieve a stable supply of raw-material plant fibers as well as technologies that reduce production costs.

Ultimately, TMC plans to further improve bio-fuel production yield and to cooperate with energy companies to realize its goal of commercializing cellulosic ethanol by 2020.

## **New technology for urban greening and greening-effect simulation**

To aid in reducing the effects of urban heat-island phenomenon, TMC has been working on urban greening products, of both the rooftop and indoor variety. Two newly developed urban greening products—“Smart Green Parking”, for the greening of parking areas, and a new wire-based “Smart Green Wall”—will be sold through Toyota Roof Garden Corporation, starting today. TMC hopes to meet a wider range of urban greening needs through this expansion of its greening product line.

## **Overview of Newly Launched TMC Greening Technologies**

Product name	Smart Green Parking	Smart Green Wall
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Components	Main panels (bricks and path-reinforcement material), greening plants (TMC-developed TM9 grass, <i>Ophiopogon japonicus Ker-Gawler</i> (dwarf Japanese snake's beard), thyme, moss phlox, etc.)	Wire rolls, tension-adjusters, wire-end adjusters, and climbing plants
Characteristics	<ul style="list-style-type: none"> <li>– Earthen base is wide enough to allow a durable and ample space for long lasting plant growth</li> <li>– Specially developed blocks ensure both plant sustainability and surface safety</li> <li>– Uses recycled car bumper materials</li> </ul>	<ul style="list-style-type: none"> <li>– Permanent installation with low-maintenance</li> <li>– Lightweight ladder-shaped wires are easy for plants to attach to and easily installed on buildings</li> <li>– Wire tension adjustment function reduces wind-caused fluttering, achieving high wind resistance</li> </ul>
Effects (According to TMC survey)	Achieves temperature of 35°C on sunny summer days, approximately 15°C cooler than asphalt surfaces (50°C)	<ul style="list-style-type: none"> <li>– On sunny summer days, reduces electricity use for indoor air conditioning by approximately 25% compared to a building without green walls.</li> <li>– Achieves an indoor temperature of 32°C cooler than a building without green walls (outside temperature of 32°C)</li> </ul>
Standard specifications	Total length: 5,000 mm Total width: 2,500 mm	—
Suggested retail price (Varies on locale and installation conditions)	Starting from 222,000 yen (Price per parking space in a four-space parking lot; excluding grading and foundation preparation work)	Starting at 18,000 yen/m <sup>2</sup>
Sales target	1,000 units/year (2014)	10,000 m <sup>2</sup> /year (2014)
Production and sales	Toyota Roof Garden Corporation	

TMC's Toyota Biotechnology and Afforestation Laboratory is also developing "cool-spot creation technology" for simulating the effects of greening and predicting the cooling effects of shade and transpiration created by trees. TMC, in conjunction with Tokyo Institute of Technology, developed a method of accurately measuring the amount of transpiration from trees and is building a model for predicting the surface temperature of trees. Through use of this model together with thermal environmental simulators, TMC aims to achieve a visual simulation of greening effects that can determine the types, numbers, and positioning of trees needed to achieve the desired cooling effect. This cool spot formation technology is aimed for commercialization by the end of 2012.

Going forward, TMC plans to link its urban greening technologies and products with smart grids that will become key in building the cities of the future. By doing so, TMC hopes to enhance the functionalities of its greening systems and promote them widely to help build low-carbon houses and cities.

#### Overview of TMC's Toyota Biotechnology and Afforestation Laboratory

Address	1099 Marune, Kurozasa-cho, <i>Miyoshi</i> City, Aichi prefecture
Established	May 1999
Number of employees	Approximately 110
Site/floor area	45,800 m <sup>2</sup> /3,000 m <sup>2</sup>

Facilities	Research Building (1F: cellulosic ethanol test production plant; 2F: offices; 3F: laboratories), work building, technology exhibit building, fields and greenhouse
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\*According to TMC survey data as of the end of September 2011