



# POLICY BRIEF

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## Technology Transfer as a Measure to Tackle Global Warming in Asia

### Key Messages

- 📶 Strategic implementation of technology needs assessment. This will strengthen the effectiveness of the technology transfer through reducing the mismatch between technology provider and receiver as well as lessening the pertaining barriers.
- 📶 Emphasis on technologies at deployment and diffusion stage which are generally associated with lesser risks.
- 📶 IPR (intellectual property rights) pooling has the potential to promote the transfer of low-carbon technologies while benefiting the providers through obtaining technical standards and increased market shares.
- 📶 Enhancing business sector in various international initiatives. Business entities are important in terms of their financial and technical capabilities.
- 📶 Improved green governance. In conducting the above-mentioned measures, there needs to be willingness and commitment from relevant stakeholders, as well as technical assistance.



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## I Introduction

Developing countries in Asia, led by China and India, are among the fastest growing economies in the world today. Economic growth in the region in the coming 20 years will exceed the average level of world economy, boosting a continuous increase in primary energy demand (IEA 2009). While such economic development would offer great opportunity for poverty eradication in the region, it would sharply increase CO<sub>2</sub> emission levels unless properly designed in line with sustainable development. This sharp increase in CO<sub>2</sub> emission levels will result in a climate change outcome that will seriously endanger future environmental quality and human wellbeing of the region and, eventually, of the earth. The threat of climate change is already tangible for Asian countries. As many as 1.2 billion people in the Asia-Pacific region face the prospect of freshwater shortages by 2020, while crop yields in Central and South Asia could drop by half

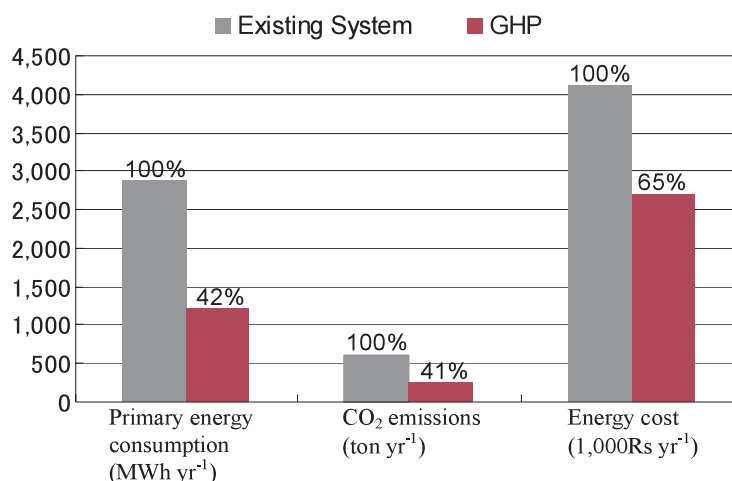
by 2050 (ADB 2009). Many key coastal cities could also see increasingly serious flooding. Thus, achieving environmentally sound development in Asia is an important policy issue.

The clear message is that low-carbon technology transfer from developed countries is the key to achieve environmentally sound development in Asia. For example, according to the study conducted by IGES Kansai Research Centre, a Japanese gas heat pump system can reduce CO<sub>2</sub> emission by nearly 60% while containing the energy cost up to 35% (Box 1). Thus, the dissemination of low-carbon technologies in the region should be scaled up, since they are the major contributors to CO<sub>2</sub> emission abatement. Promoting low-carbon technology transfer is widely considered a determinant factor to reduce CO<sub>2</sub> emission that would contribute to climate change mitigation.

### Box 1 A case study of application of Japanese gas heat pump system in India

IGES Kansai Research Centre has initiated several field investigations on examining CO<sub>2</sub> reduction potential in India by applying Japanese low-carbon technologies. The following is a case from a typical SME lost-wax casting unit of the foundry cluster in Rajkot, Gujarat. The temperature of the production rooms needs to be strictly controlled in order to prevent wax melting which can cause adverse effects on the quality of the products. Our estimation has proven the potential of replacing the existing chiller (ca. 86.5TR) with a Japanese gas heat pump (GHP) system, which can significantly reduce not only the energy consumption and CO<sub>2</sub> emissions, but can also save considerable amount of energy cost.

- Primary energy consumption reduction: 58%
- CO<sub>2</sub> emissions reduction: 59%
- Energy cost saving: 35%



**Table 1 Energy-related CO<sub>2</sub> emission reduction by source in the 450 Scenario relative to the reference scenario; ASEAN region (Mt CO<sub>2</sub>)**

	2020	2030
<b>Efficiency</b>	84	319
- end-use	82	308
- supply	1	11
<b>Renewable</b>	2	121
<b>Biofuels</b>	9	20
<b>Nuclear</b>	3	33
<b>CCS</b>	1	18

Source: IEA 2010b

According to IEA (2010a), if governments worldwide introduce no new energy and climate policies, energy-related CO<sub>2</sub> emissions will increase from 28.8 Gt in 2007, to 34.5 Gt in 2020, and might reach 57 Gt in 2050. In contrast, through the promotion of low-carbon technologies this amount might be reduced to about 14 Gt according to BLUE Map Scenario which is consistent with stabilising long-term GHG in the atmosphere at 450 ppm (IEA 2010a). As indicated in Table 1, technologies related to energy efficiency measures are the major contributor to CO<sub>2</sub> emission abatement in the ASEAN region (IEA 2010b). They can contribute to a 319 Mt CO<sub>2</sub> reduction by 2030.

The transfer of low-carbon technology sounds simple; however, in reality it is a process that is quite difficult to be defined. It is a highly complex process of sharing physical assets including capital investment and products, and informational assets such as technical know-how and knowledge. This complex process is also influenced by domestic and international factors that hinder the application of even the most promising low-carbon technology. Barriers and challenges to, and instruments for this process are very different depending on the underlying conditions. Thus, the main objective of this policy brief is to provide several options on how to promote the transfer of low-carbon technology towards and within Asia, to achieve environmentally-sound development in the region.

## 2 Technology Transfer

### 2.1 Definition of Concept

Technology transfer refers to the transfer of a technology from one geographical location to another. The flow may take various forms. The flow may be through government (e.g. ODA) or business (e.g. FDI) channels. It may involve physical assets (e.g. capital investment and products) and informational assets (e.g. technical know-how and knowledge). The technology transfer process may be evaluated as successful if the recipient of technology can effectively utilise the transferred technology and eventually assimilate it. In this policy brief, this definition is valuable because it serves to clarify the fact that technology transfer is not simply about the supply and shipment of technology,

but it is about the complex process of selecting the most appropriate technology available in the provider country and adapting it to local conditions and building capacities in the recipient country.

#### 2.1.1 Government and Business Channels

Technology transfer can be conducted through government channels such as ODA (official development assistance) or through business channels. However, ODA only accounts for less than one percent of global investments (UNFCCC 2007). Thus, while ODA could be relatively more important in LDCs (least developed countries) and small developing countries in terms of the share of investment (6%), private business sector

investment is much more significant considering its portion of global investments (86%). This implies significant potential that private business can play in technology transfer. In addition, the business sector does not merely own technologies, but it is the actual entity to develop and deploy technologies. For example, 92% of the technological patents registered in the USA in 2010 are by the business sector and this figure is still in a growing trend (USPTO 2011). The business sector has an irreplaceable role in low-carbon technology transfer.

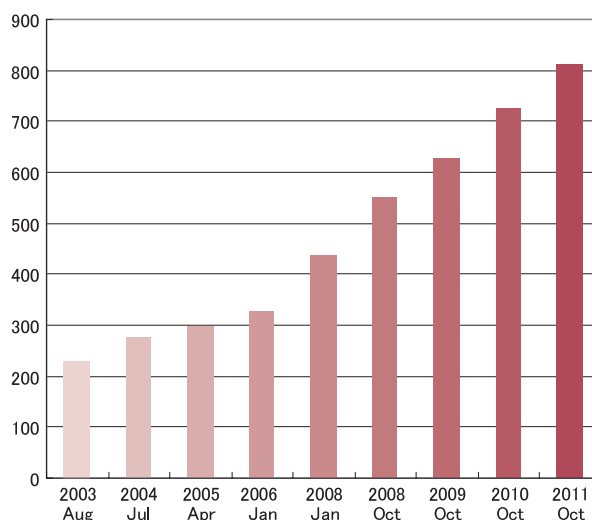
### 2.1.2 Technology Transfer of Physical and Informational Assets

Traditionally, capacity building was considered to automatically follow the capital investment and goods (physical assets) (Nelson and Pack 1999; Ivarsson and Alvstam 2005). Thus, only slight emphasis was put on the transfer of knowledge and know-how (informational assets). In contrast, however, several researchers have more recently found that knowledge and know-how are the key elements in accelerating the capital investment and achieving successful technology transfer (Nelson and Pack 1999; Ivarsson and Alvstam 2005).

A good example is the Toyota Technical Training Institute in Bangalore, India. Founded in 2007, the objective of this institution is to enable talented Indian students, who are otherwise unable to pursue higher education owing to economic constraints, to acquire special knowledge and skills — *Monozukuri* (skilled manufacturing) (TKM 2009). In this fully residential three-year programme, education is provided free-of-cost with fellowships for deserving students, and the graduates will be encouraged to join the company as a team member (TKM 2009). In India, Japanese companies other than Toyota are also developing similar technical training institutions. Considering the growing number of Japanese companies present in emerging economies (Figure 1), transfer of know-how and knowledge between developed and emerging economies through business-led programmes is expected to become even more important.

Technology transfer is a process of integrating

**Figure 1 Number of Japanese companies present in India**



Source: Embassy of Japan in India 2006 and 2011

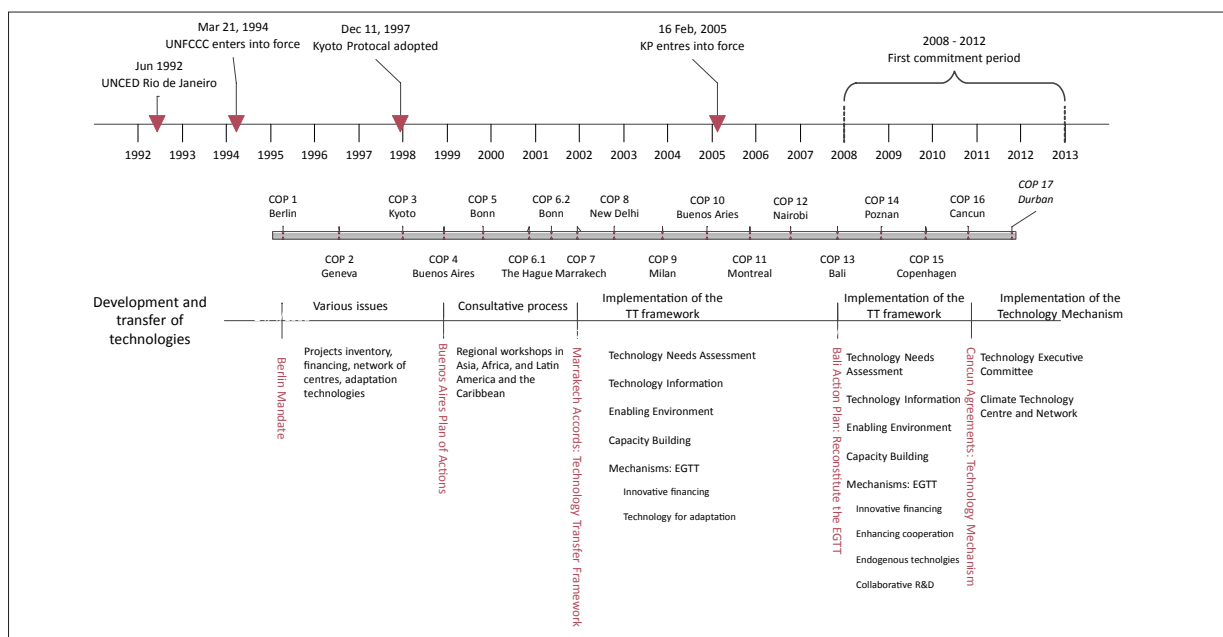
different stakeholders to overcome various economic, social, and institutional barriers related to the disparities between the two countries. Hence, it is a process of technology application rather than a simple transfer.

### 2.2 Discussion under UNFCCC Process

Since 1994, at each session of the Conference of the Parties (COP), Parties have taken decisions on the development and transfer of environmentally-sound technologies. Furthermore, the development and transfer of technologies is a standing agenda item of both the Subsidiary Body for Implementation (SBI) and the Subsidiary Body for Scientific and Technological Advice (SBSTA). The evolution of the issue over time and key decisions taken are illustrated in Figure 2.

The negotiations on technology development and transfer under UNFCCC did result in multiple areas of convergence. While this is certainly a significant step forward, it is worth mentioning that these areas are the ones where consensus among parties was relatively easy to reach (Table 2). The more challenging components of the negotiation have not been settled yet and a number of areas of substantial disagreement still remain. Disagreements over the role and treatment of IPR (intellectual property rights) stand out in particular. Finance and the provisions for MRV (measurement,

**Figure 2 An evolution of technology transfer issues under the UNFCCC process**



Source: Technology Executive Committee 2011

**Table 2 Areas of agreement and controversy on technology transfer under UNFCCC**

Areas of agreement	Areas of controversy
<ul style="list-style-type: none"> <li>▪ Establishment of a technology mechanism</li> <li>▪ Enhanced strategic planning on technology and improved cooperation</li> <li>▪ Addressing the full technology cycle</li> <li>▪ Creating enabling environments for private investment</li> <li>▪ Overall efforts needed</li> </ul>	<ul style="list-style-type: none"> <li>▪ Intellectual property rights (IPR)</li> <li>▪ Finance</li> <li>▪ Measurement, reporting and verification (MRV) and compliance with respect to technology transfer</li> </ul>

Source: Marcellino et al. 2010

reporting and verification) and compliance with respect to technology transfer are other areas of contention.

Evidence points to the likely continuation of these disagreements among UNFCCC parties in some form.

### 3 Recommendations for Enhancing Low-Carbon Technology Transfer

As discussed in the previous sections, technology transfer has a significant potential to contribute to the economic development of the recipient country while simultaneously achieving a low-carbon society. However, successful low-carbon technology transfer cannot be easily achieved due to various barriers and disagreements amongst international communities. In order to lessen these barriers and reach further consensus amongst the relevant international communities, it is recommended to consider the following points:

#### 3.1 Technology Needs Assessment

National preferences for low-carbon technologies vary among countries in Asia reflecting economic size, developmental stage and geographical location. In order to prevent the mismatch between technology provider and receiver, and to provide the right incentives for appropriate technologies, appropriate low-carbon technologies for receiver countries should be carefully assessed and identified (TNA: technology needs assessment). In doing so, an equal emphasis should be put on technical aspects as well as on the development strategies of the receiver country in order

to ensure the feasible transfer. Considering that the receiver countries often lack information and capacity regarding the advanced low-carbon technologies (Ockwell *et al.*, 2007; ENTTRANS, 2008), entities with sufficient capacity including international institutions such as UN may need to provide support in these issues. However, these entities should simply provide a technical support in conducting TNA; it should be kept in mind that TNA must base on the perspectives of receivers and not the providers.

TNA is also important in reducing risks related to IPR. The cutting-edge technologies do not always have the highest priority in the receiver counties, where the latest state-of-the-art technologies are not always needed. For example, technologies at their deployment and diffusion stage and have already recovered their investment in the market, generally have lesser IPR risks. Wind turbine technology has been in the market for quite a while and thus its IPR risks are relatively lower compared to other low-carbon technologies at the higher stages of technological maturity. Developing Asian countries including India and China have large potential in terms of wind power generation. Careful TNA can indicate such technologies with high potential but with low pertaining risks, meaning they are more feasible in conducting technology transfer.

### 3.2 Emphasis on Technologies at Deployment and Diffusion Stage

Several specific barriers pertaining to technology transfer can be associated with particular stage of technology maturity (Table 3). As briefly introduced in

the previous section, the focus and emphasis should be more on low-carbon technologies that are at their deployment and diffusion stage of technological maturity rather than focusing on the whole process of technology transfer. These technologies are associated with fewer barriers, especially those associated with the areas of controversy under UNFCCC discussion, namely IPR, MRV and finance. Technology deployment and diffusion should be recognised as an urgent issue in the technology transfer process. Even by focusing only on the deployment and diffusion of proven and commercially available low-carbon technologies, a considerable amount of energy saving and CO<sub>2</sub> emission reduction can be achieved. Based on a research conducted by The Energy and Resources Institute (TERI) and its partners with the support of ADB in 2008, the technologies perceived to be most relevant for Asia and the Pacific are related to energy efficiency technologies, fuel cell, geothermal, micro-hydro, small wind turbine, solar etc. (Srivastava 2010). Most of these technologies are at their deployment and diffusion stage of maturity, thus their deployment and diffusion in Asia should be promoted.

Focusing on deployment and diffusion of technology does not mean that R&D and demonstration are not important, but just emphasises that deployment and diffusion are more urgent given the risks associated with current world environmental and economic situations.

### 3.3 IPR Pooling

As discussed above, more emphasis should be put on those technologies with fewer IPR risks; however,

**Table 3 Stage of technological maturity and barriers to technological transfer**

Barrier	Stage	Research and development	Demonstration	Deployment and diffusion
Proof of concept		✓		
Intellectual property rights		✓	✓	
Measurement, Reporting and Verification (MRV)		✓	✓	
Financial		✓	✓	✓
Social		✓	✓	✓
Institutional		✓	✓	✓

in some cases, we may need to face those risks. Shared use of IPR such as an IPR pool is an important measure in reducing risks related to IPR. An IPR pool is an agreement between two or more IPR holders or owners of IPR(s) to license one or more of their IPR(s) to one another or third parties.

The IPR pool can be formed as a consortium of private firms. For example, IPR owners of a certain low-carbon technology (e.g. EV) can each bring their relevant IPR and establish a package or a pool of IPRs which can be utilised as a “common” amongst the consortium members. In order to lessen the financial burden (particularly, an initial cost) of the recipients, affordably low royalty charge should be offered in utilising the IPR pool. In this way, recipients will be able to easily access to a package of IPRs which covers the whole, or at least a meaningful portion, of the product at reasonable cost. IPR providers can also benefit from this mechanism through enhanced market share and competitiveness of their technologies in the recipient country through increased usage of their IPRs. The benefit can be expected to be large enough to compensate the lower royalty charge.

As can be seen in the automobile industry, obtaining a technological standard is the ultimate goal for manufacturers. Especially in the field of low-carbon technologies, not to mention the technical alliance of Suzuki-Volkswagen or Toyota-BMW, competition amongst the firms is becoming more harsh and severe year by year. In addition to this, emerging economies in Asia such as China and India are attractive markets for automobile industry. Therefore, it may be a good option for them to utilise the IPR pool as a measure to obtain a technical standard as well as to increase their presence in the emerging markets at the same time.

Governments or standards body such as ETSI<sup>1</sup> can also play a leading role in formulating an IPR pool through tax incentives etc. However, an IPR pool for

low-carbon technologies should be formed according to the needs of recipient country revealed through TNA and not merely on the interest of the provider. To this end, in order to form a fair and effective IPR pool amongst various stakeholders, contributions and support from international institutions such as the UN might be needed.

### 3.4 Enhancing Business Sector

The participation of the private business sector in several bilateral and multilateral initiatives focusing on technology transfer has contributed to the effectiveness of these initiatives. Thus, another option in promoting low-carbon technology transfer toward Asia and within Asia could be through a more proactive involvement of the private business sector. Participation of private business sector is crucial since they do not merely own technologies (both physical and informational assets) but they are the actual entities to develop and deploy technologies. Moreover, private business sector investment has a significant potential in promoting low-carbon technologies as discussed in Section 2.1.1. Thus, the mobilisation of human capital and financial capital from the private business sector is a determinant factor in low-carbon technology transfer process.

The success of this option largely depends on incentives to be provided to enhance private business sector participation in the initiatives. A stable framework of incentives should be provided from governments as well as from regional and international organisations to leading companies willing to play a more proactive role in transferring low-carbon technology. These incentives should include material incentives (financial, IPR protection, increase in market share etc) as well as non-material incentives (honorarium, public awards etc).

Furthermore, as low-carbon foreign direct investment (FDI) in Asia is soaring, the potential for further

<sup>1</sup> ETSI (European Telecommunications Standards Institute) is an independent, non-profit organisation responsible for standardisation of information and communication technologies in Europe. ETSI consist of various European governments, as well as telecommunication industries, manufacturers and research institutions.

low-carbon FDI is huge. Further, additional FDI is most likely to be redirected to the region given the risk associated with the ongoing economic and financial crises in USA and Europe. As the Japanese economy is strained by the soaring national currency, many Japanese companies are likely to move out of Japan and to relocate in other Asian countries. This additional FDI should not encourage exports of highly polluting brown sectors to the region, but should be oriented to low-carbon technologies in order to ensure sustainable economic development.

### 3.5 Green Governance

The effectiveness of the decentralised mechanism explained in Section 3.4 largely depends on the willingness and commitment of various stakeholders to overcome the main hurdles that continue to impede the transfer of low-carbon technology to the region. More specifically, it depends on the willingness and commitment of various stakeholders to shift from current governance mechanisms toward green governance. Green governance should be streamlined at company and government levels. In addition, regional and international organisations should provide the necessary support to private companies and governments in the region to make this transition.

**Green governance at the corporate level** - Companies in countries receiving technology should develop their own green governance. For example, top managers should attend, and enable other workers to engage in, various education and training programmes relevant to low-carbon technology. They should continually search for alternative low-carbon technologies available in the market, and assess the co-benefits of applying them in their companies. They should encourage initiatives regarding energy saving and low-carbon emission reduction in their company through developing a specific rewarding system for good initiatives from workers. They should also respect their commitments to national regulations and standards as well as their commitments in term of IPR. Furthermore, these activities should be disseminated through environmental and corporate social responsibility reports (CSR) to attract socially and environmentally responsible investors. Top managers in developed countries should also

continuously search for opportunities for low-carbon FDI, and assess the co-benefits of applying their low-carbon technologies overseas.

#### **Green governance at the government level**

- Capacity building and awareness-raising activities for top managers may not be enough to engage them in corporate green governance processes. Further supporting activities and incentives from the government may be needed. Technological advances alone are not sufficient to ensure the transfer of low-carbon technology. It is equally crucial that there is the political will for large-scale economic transformation toward green governance to create a rewarding and enabling environment. Green governance at the government level should be promoted and may include the following:

Governments of recipient countries should assess local technology needs in terms of low-carbon technologies. It should establish a supportive institutional infrastructure as well as introducing investment policies that respond to country's specific needs and situation (such as strengthening IPR, tax holidays, tariff adjustments and industry parks, as well as making markets more transparent) to stimulate markets for low-carbon technologies. Furthermore, governments of recipient countries should reduce or eliminate subsidies for fossil fuels as well as include environmental costs in the overall price of energy services. In addition, they should foster research in low-carbon technologies as well as adapt technology transferred from other countries to suit local conditions. The governments in recipient countries also should introduce low-carbon technologies in their state-owned companies through public procurement, which will provide a showcase for the private business sector to follow. Governments should create a public database on the potential for low-carbon technology investment potential, and then disseminate such information.

#### **Supporting measures from regional and international institutions**

- Current regional and international policy frameworks are not effective in promoting low-carbon technology transfer in Asia. Low-carbon technology transfer can be better leveraged through the support of regional and international organisations.



While their support should include financing, they have a more important role in information sharing, knowledge building and technical assistance. Financial support can be ensured through efficient mobilisation of business sector funds through promoting business sector participation in various initiatives and through promoting green governance at corporate and government levels. Information sharing and knowledge building, however, is quite difficult without the support of

regional and international organisations. These organisations should collect and disseminate the information available from each country regarding low-carbon technologies, build knowledge and provide necessary technical assistance. For instance, comprehensive technology needs assessments and a formulation of effective and fair IPR pool can be quite difficult without their participation and support.

## 4 Summary and Conclusions

Unless economic development in Asia is properly designed and targeted at sustainable development, it will seriously endanger the future environmental and human resource of the region and, eventually, of the earth. Transfer of low-carbon technologies to, and within Asia is the key to achieve environmentally-sound development in the region.

Given the risks due to the current global environmental and economic situation as well as the

shortcomings of current technology transfer mechanisms, this policy brief proposed five ideas in promoting the transfer of low-carbon technologies, aimed particularly at receiver countries, as follows: (i) strategic implementation of technology needs assessment; (ii) emphasis on technologies at deployment and diffusion stage which are generally associated with lesser risks; (iii) IPR (intellectual property rights) pooling; (iv) enhanced business sector in various international initiatives; and, (v) improved green governance.

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