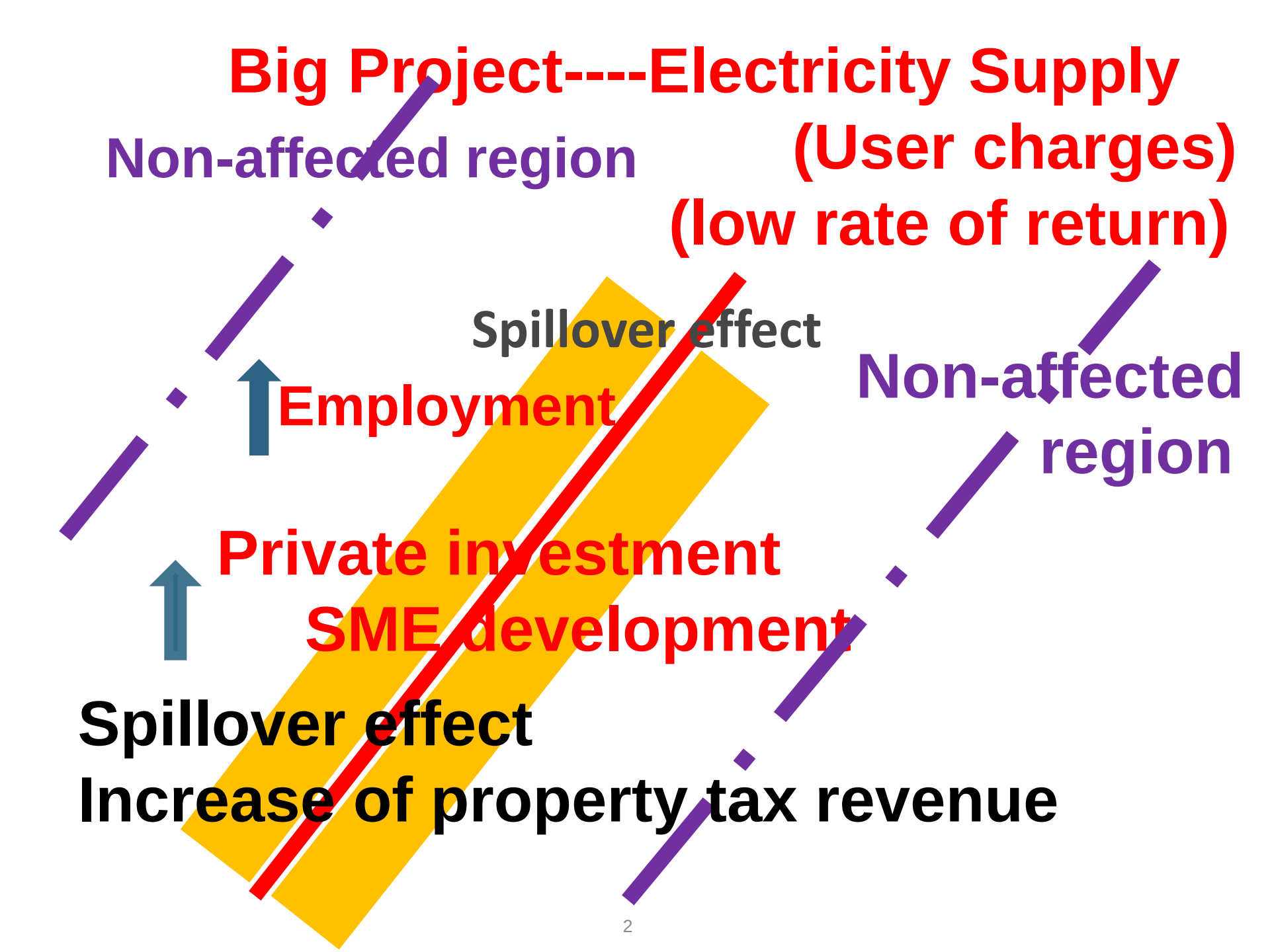
Green energy development

Role of Financing

Naoyuki Yoshino, Ph.D.
Dean, Asian Development Bank Institute (ADBInstitute)

Professor Emeritus, Keio University, Japan

Farhad Taghizadeh-Hesary, Ph.D.
Faculty member, Keio University ,
Visiting Professor, The University of Tokyo


Big Project----Electricity Supply
(User charges)
(low rate of return)
Non-affected region
Spillover effect
Employment
Non-affected region
Private investment
SME development
Spillover effect
Increase of property tax revenue

Injection of Increased Tax revenues

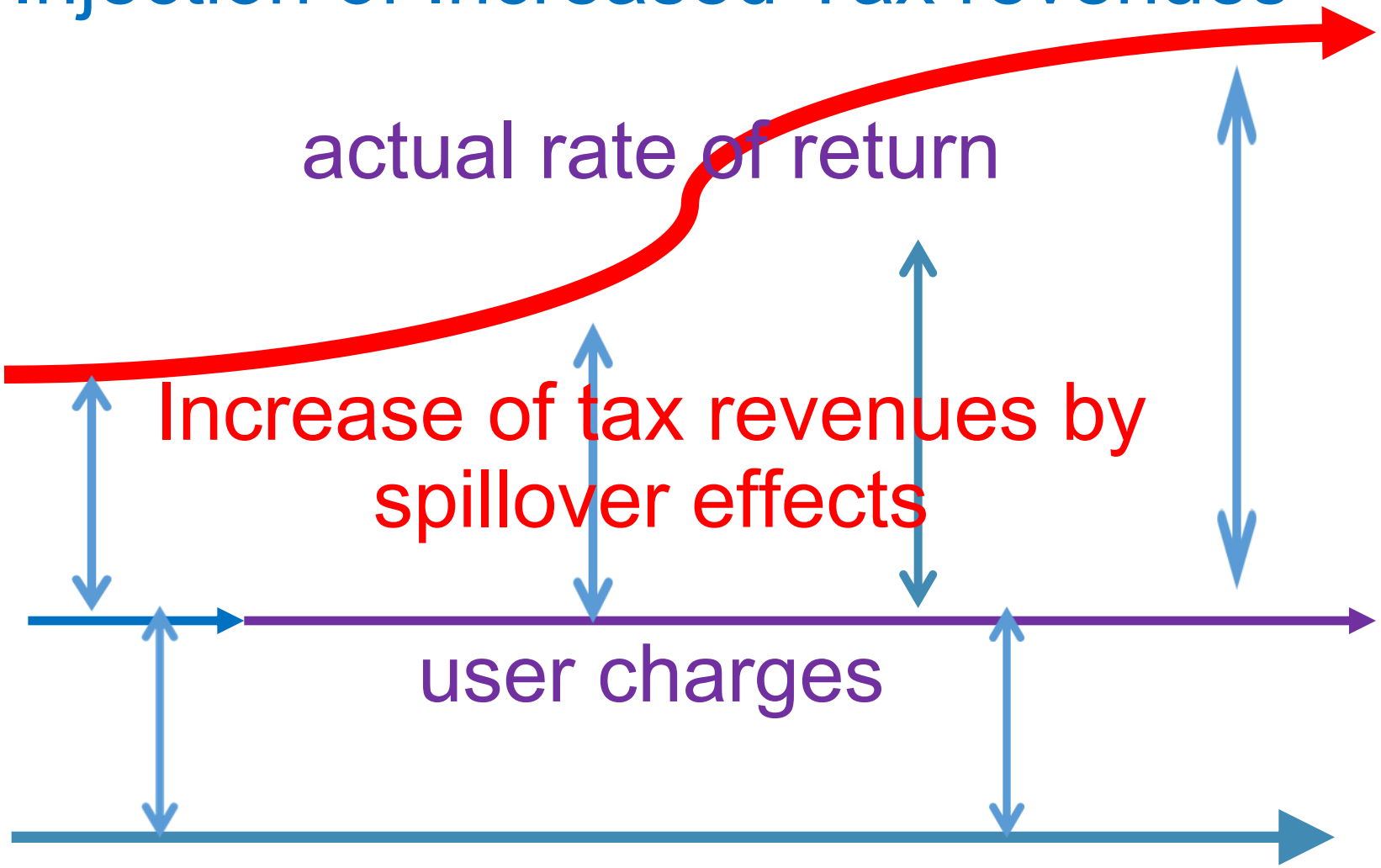


Table 3: Calculated Increase in Business Tax Revenues for the Beneficiaries Group relative to the Non-beneficiaries Group 4

(P million)

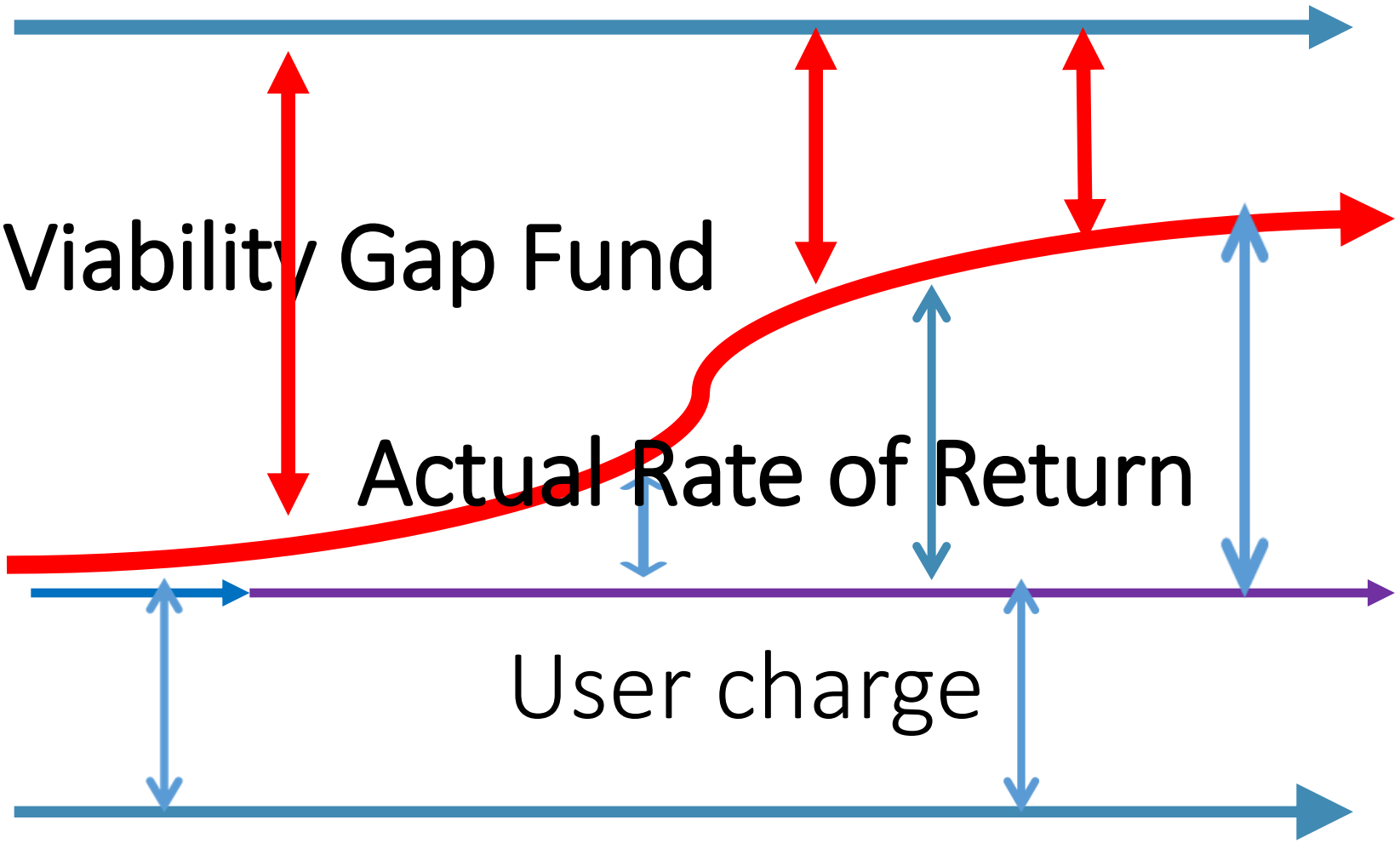
	t_{-2}	t_{-1}	t_0	t_{+1}	t_{+2}	t_{+3}	$t_{+4,\ forward}$
Lipa City	134.36	173.50	249.70	184.47	191.81	257.35	371.93
Ibaan	5.84	7.04	7.97	6.80	5.46	10.05	12.94
Batangas City	490.90	622.65	652.83	637.89	599.49	742.28	1208.61

Note: For the period t+4, forward in the case of Lipa City and Batangas City is the average increase in business tax revenues in each province.

Figure 2: Map of Batangas Province and the Location of the STAR Tollway

Source: http://en.wikipedia.org/wiki/Batangas

Secure fixed purchasing price



Trans-log Production Function

$$
\begin{aligned}
&(\ln Y_t - \ln \bar{Y}) - (\ln L_t - \ln \bar{L}) \\
&\quad = \alpha_K \left[(\ln K_{P,t} - \ln \bar{K_P}) - (\ln L_t - \ln \bar{L}) \right] \\
&\quad + \alpha_G (\ln K_{G,t} - \ln \bar{K_G}) + \beta_{KL} \left[(\ln K_{P,t} - \ln \bar{K_P})(\ln L_t - \ln \bar{L}) \right. \\
&\quad \left. - \frac{1}{2} (\ln K_{P,t} - \ln \bar{K_P})^2 - \frac{1}{2} (\ln L_t - \ln \bar{L})^2 \right] \\
&\quad + \beta_{KG} (\ln K_{G,t} - \ln \bar{K_G}) \left[(\ln K_{P,t} - \ln \bar{K_P}) - (\ln L_t - \ln \bar{L}) \right] \\
&\quad + \frac{1}{2} \beta_{GG} (\ln K_{G,t} - \ln \bar{K_G})^2 + \varepsilon_{P,t}
\end{aligned} \tag{2}
$$

$$
S_{L,t} = 1 - \alpha_K + \beta_{KL} \left[(\ln K_{P,t} - \ln \bar{K_P}) - (\ln L_t - \ln \bar{L}) \right] + \beta_{KG} (\ln K_{G,t} - \ln \bar{K_G}) + \varepsilon_{S,t} \tag{3}
$$

Yoshino, Nakajima and Nakahigashi (1999) and Nakahigashi (2003). Our marginal productivity of public capital from equation (2) is as follows:[2]

$$
\frac{dY}{dK_G} = \eta_{K_G} \frac{Y}{K_G} + \eta_{K_P} \frac{\eta_{K_G}\eta_{K_P} + \beta_{KG}}{\eta_{K_P}(1-\eta_{K_P}) + \beta_{KL}} \frac{Y}{K_G} + \eta_L \frac{\eta_{K_G}\eta_L - \beta_{KG}}{\eta_L(1-\eta_L) + \beta_{KL}} \frac{Y}{K_G} \tag{4}
$$

where η_{K_P}, η_L, η_{K_G}, represent the output elasticity of private capital, labor and public capital respectively. Based on equation (2), the output elasticity of labor is the same as equation (3) and the output elasticity of private capital and public capital is expressed as follows:

$$
\eta_{K_P} = \alpha_K + \beta_{KL} \left[(\ln L - \ln \bar{L}) - (\ln K_P - \ln \bar{K_P}) \right] + \beta_{KG} (\ln K_G - \ln \bar{K_G}) \tag{5}
$$

$$
\eta_{K_G} = \alpha_G + \beta_{KG} \left[(\ln K_P - \ln \bar{K_P}) - (\ln L - \ln \bar{L}) \right] + \beta_{GG} (\ln K_G - \ln \bar{K_G}) \tag{6}
$$

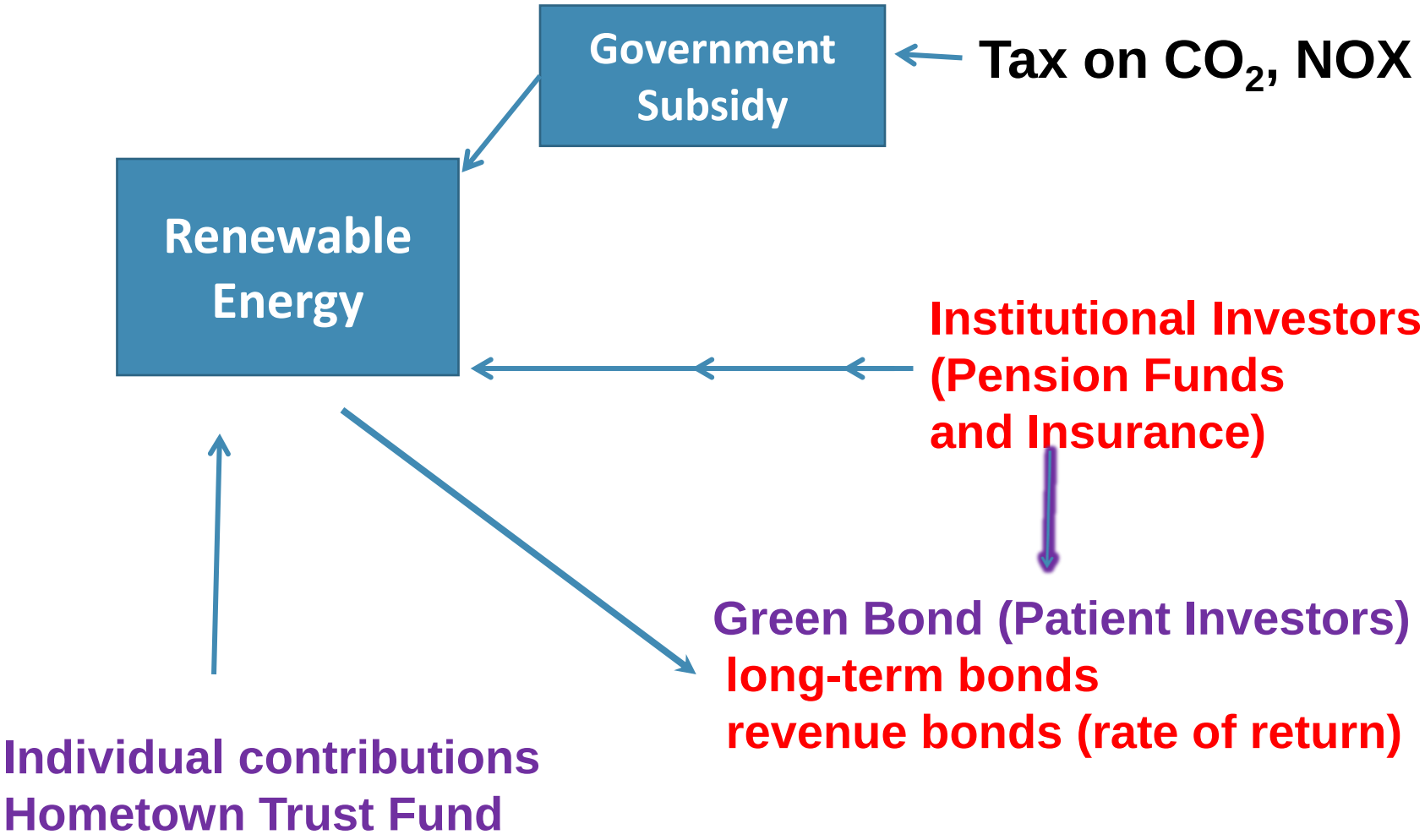
Return of Spillover tax revenues (Trans-log Production Function)

Increase of Rate of Return	1956-60	1961-65	1966-70	1971-75	1976-80	1981-85
Direct effect	0.696	0.737	0.638	0.508	0.359	0.275
Indirect effect(Kp)	0.452	0.557	0.493	0.389	0.270	0.203
Indirect effect(L)	1.071	0.973	0.814	0.639	0.448	0.350
% increment(50% share)	1.095	1.038	1.025	1.011	1.001	1.005
50% returned	0.762	0.765	0.653	0.514	0.359	0.276

	1986-90	1991-95	1996-00	2001-05	2006-10
Direct effect	0.215	0.181	0.135	0.114	0.108
Indirect effect(Kp)	0.174	0.146	0.110	0.091	0.085
Indirect effect(L)	0.247	0.208	0.154	0.132	0.125
% increment (50% share)	0.980	0.979	0.975	0.976	0.977
50% returned	0.210	0.177	0.132	0.111	0.105

Financing for Energy Projects

Accumulation of long term domestic saving is required



Private Financial Scheme of Wind Power Collected by Individuals (started in 2001-Sept)

Investors
2000
people

Each person
1000 US$

Hokkaido
Green
Fund

Construction
Costs =
2million
US $

Sell to
Power
Company

Final
User

PE
1+0.05
5%
surcharge

Financial Scheme of Wind Power Collected by Individuals

Donation

Hometown Investment Trust Funds (HTIF)

Hokkaido Green Fund (60%)

Senior Bank Loans (20%)

Government Fund, Carbon Tax (20%)

Sell to Power Company

Final User

PE=5% surcharge

Sales Of Power

Village Funds for Green Energy

1, Collect Small Amount of Money

2, Solar power panel with battery

3, Use solar power for local manufacturing

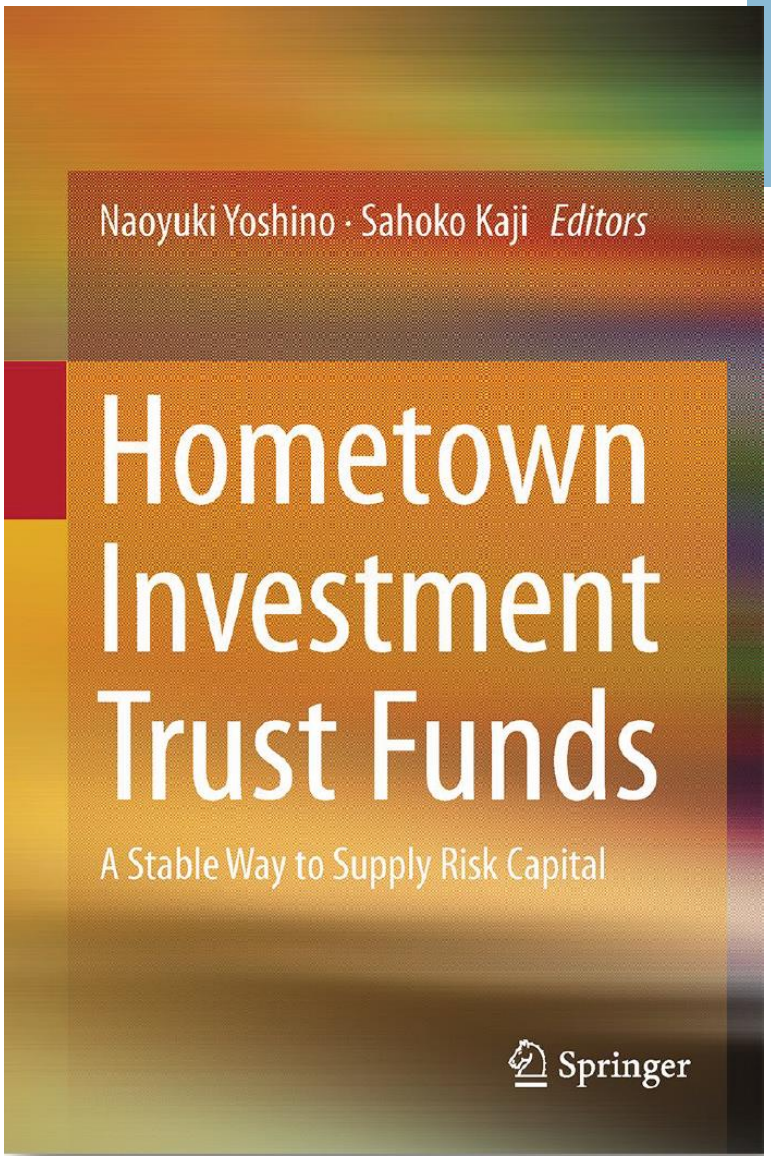
4, Use solar power for agriculture

5, Sales of village products will increase

6, Construct Another solar power plant

7, Step by step approach to increase electricity in the village

Possible Solutions
by use of community funds

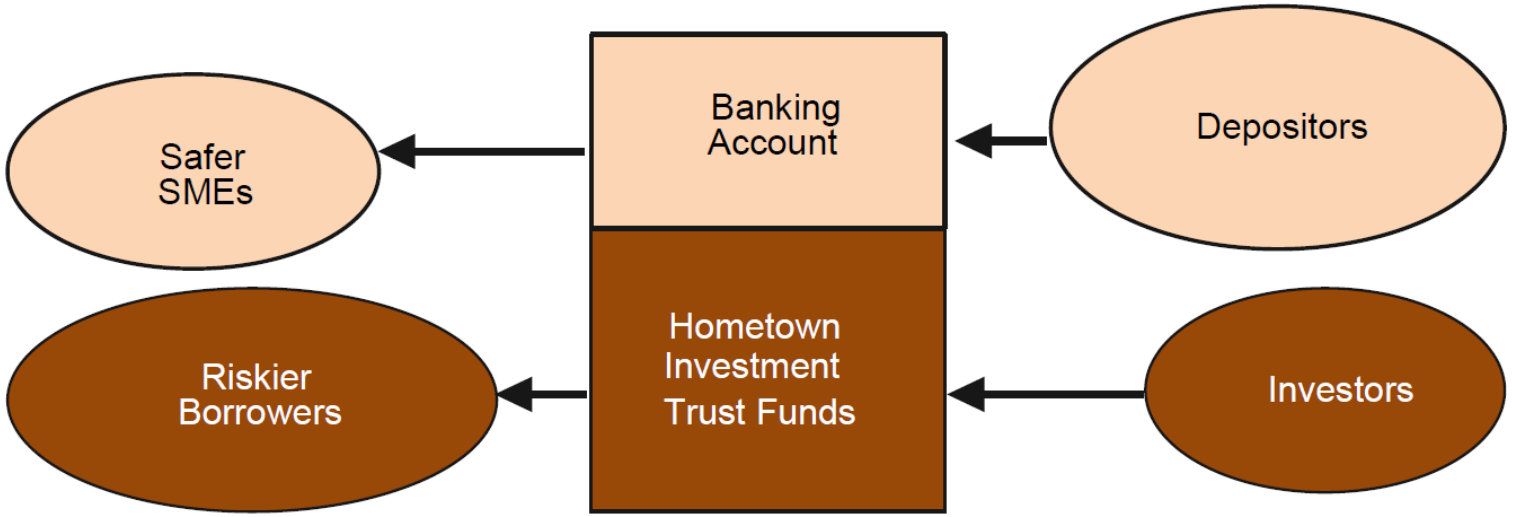


Hometown Investment

A Stable Way to Supply Risk Capital

Yoshino, Naoyuki; Kaji Sahoko (Eds.), 2013,

Hometown investment trust funds a new way to finance for Wind power generators, solar power panels etc.

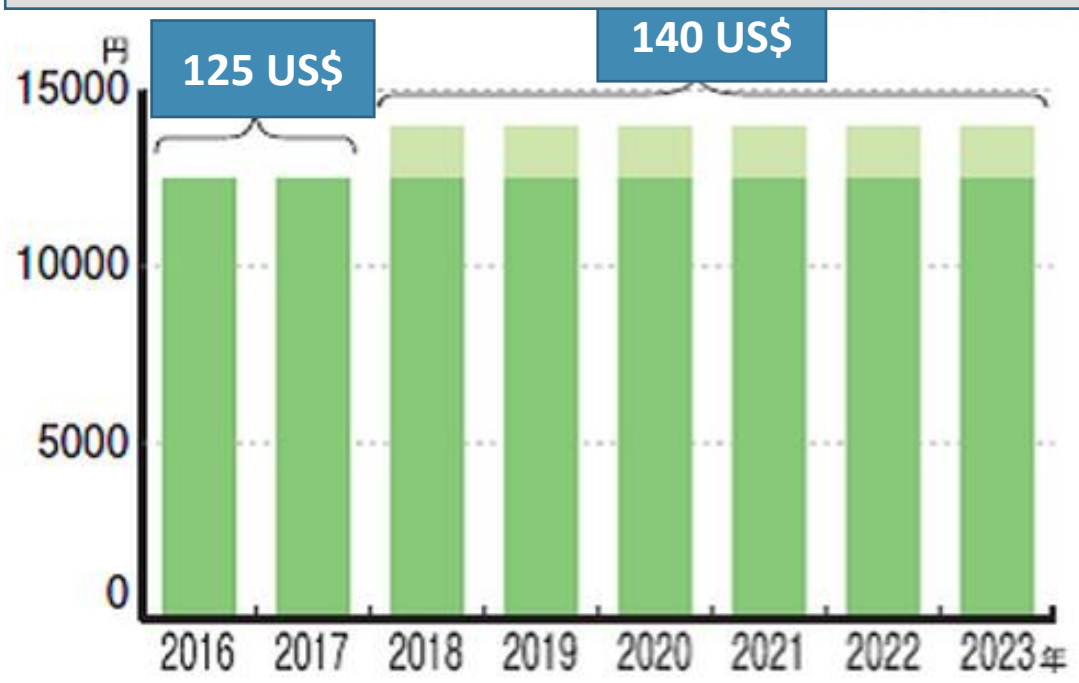


SME =small and medium-sized enterprise.

Source: Yoshino and Taghizadeh-Hesary (2014).

8-years'-Fund - per person 1000 US $:
Expected Dividends

Total = 1090 US $



Structure of Wind Power Fund

249 people participated (donation and investment)

Total cost of one wind power = 2 million US $

5% extra price is charged = (1+0.05)X PE

People should reduce Energy consumption by 5%

so that total energy costs remain the same

<Bank Loans to environmental projects>

Revenue : **sales price** of electric power supply

cannot set the price based on MC (Price=MC)

Government Financing (Externality Effects)

1, Measure the negative external effects of CO_2 and NOX

2, Levy Tax on CO_2 and NOX

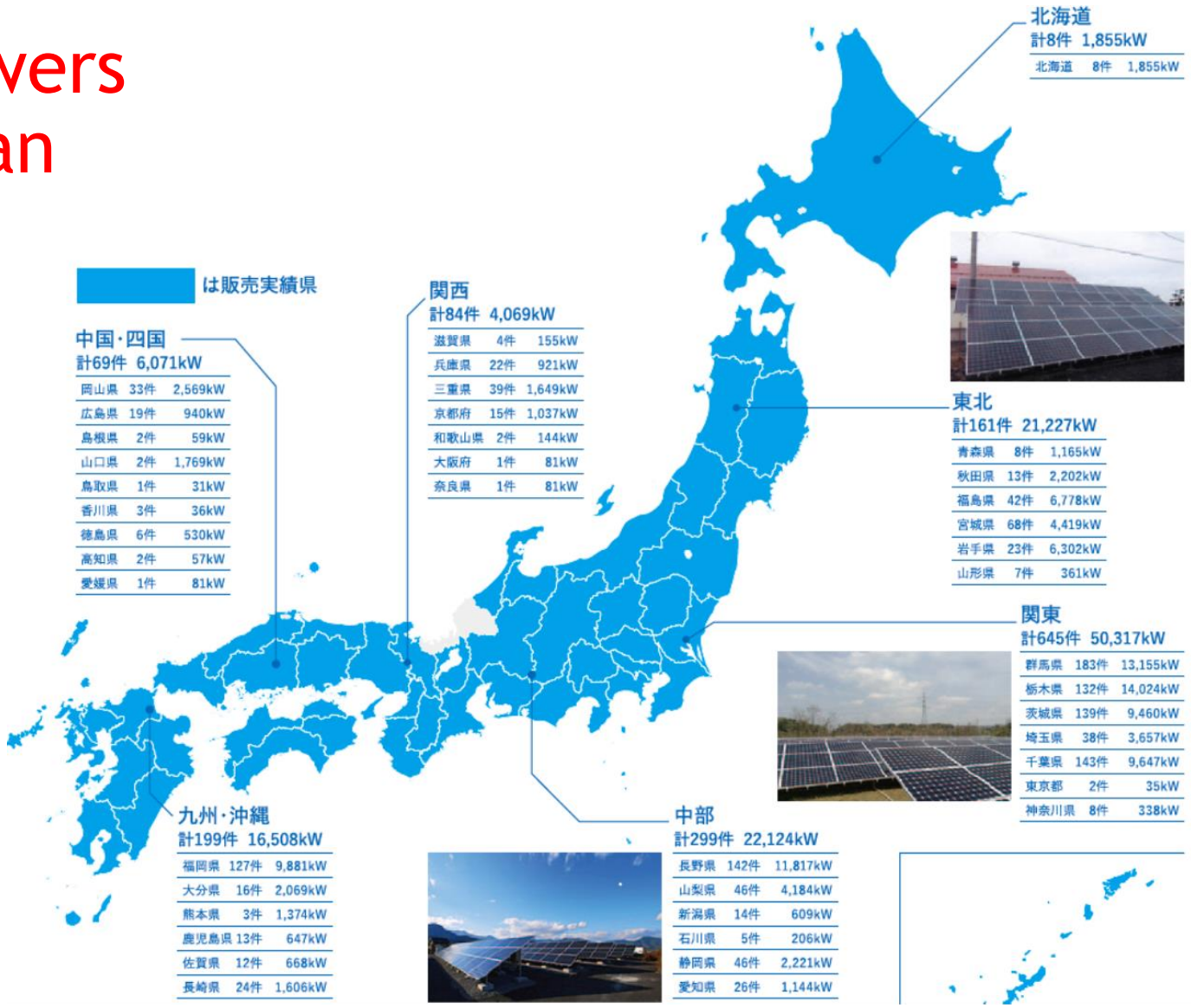
→ Transfer to renewable energy

3, Provide R&D subsidy to renewable energy projects

→ Injection of tax revenues to investors in renewables

→ R&D (renewable energy sector)

Solar Powers in Japan



Scheme of Financing Power Panels

Local Government

Subsidies (2/3)

377

Solar power

plants

Power

Company

Private Individuals

Hometown Trust Funds

1000 US$ -– 5000 US $

Revitalization of Tsukubane Hydro Power (Nara state)

250 investors, total 525 thousand US dollars, Japan

Original Dam was constructed more than 100 years ago

Green Bond and Revenue Bond

1, Frequent Issue

2, Various maturities (5 years, 10 years, 20 years)

3, Rate of return and Principal guarantee

4, Secondary Market (Retail government bond)

5, Credit Rating of each green bond

6, Sales channels (Post office, Regional banks)

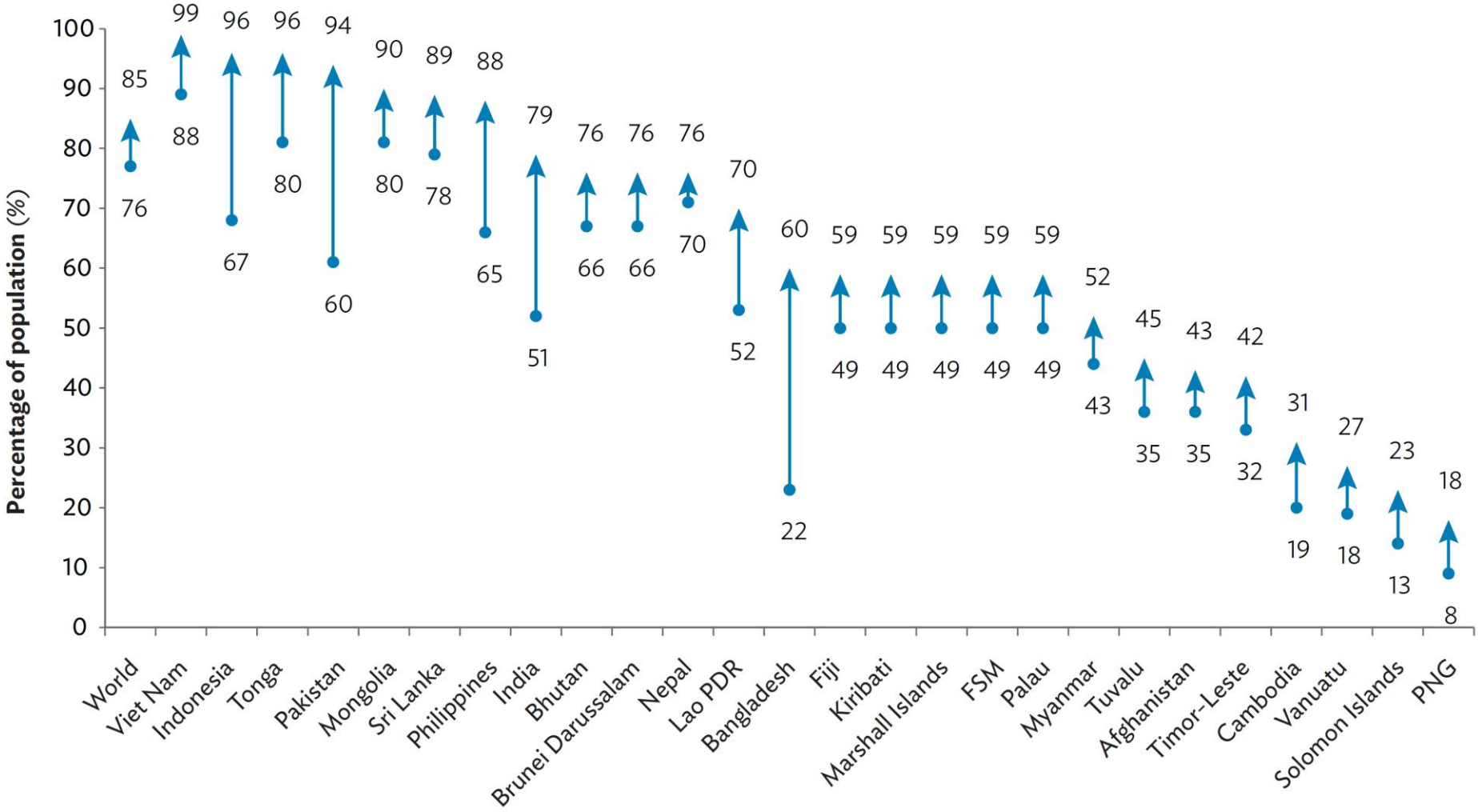
7, Internet, mobile phone

Hometown Investment Trust Funds

8, Small scale renewable energy

(sell through Internet)

Percentage of Population with Access to Electricity, 1990–2012 (%)



FSM = Federated States of Micronesia, Lao PDR = Lao People's Democratic Republic, PNG = Papua New Guinea.

Note: Presented here are Asia and the Pacific countries that have not yet reached 100% electrification. World estimates are also shown.

Source: World Bank/ESMAP and IEA (2015b).

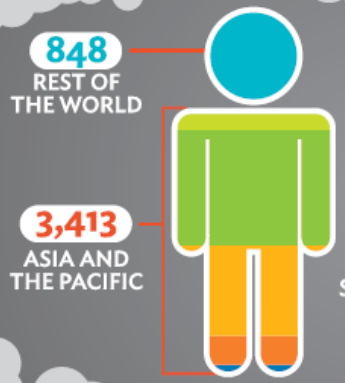
ENERGY–WOMEN–CHILDREN–HEALTH NEXUS

WITHOUT SUSTAINABLE ENERGY

Women and children are burdened with collecting traditional fuels such as dung, fuelwood, charcoal, and agriculture residues.

Across the world, women and girls spend **up to 20 hours a week** collecting these fuels.[1]

Household indoor air pollution attributable deaths, 2012 ('000)



80% of deaths from indoor air pollution in 2012 were from ADB developing members in Asia and the Pacific.[2]

WOMEN AND CHILDREN HAVE HIGHER RISKS[3]

Health outcome	Evidence	Population	Relative risk
Acute infections of the lower respiratory tract	STRONG	Children aged 0-4 years	2.3
Chronic obstructive pulmonary disease	STRONG	Women aged ≥ 30 years	3.2
	MODERATE I	Men aged ≥ 30 years	1.8
Lung cancer	STRONG	Women aged ≥ 30 years	1.9
	MODERATE I	Men aged ≥ 30 years	1.5

Studies show that in the developing world:

291 million children go to unelectrified schools[4]

1 billion are served by health facilities without electricity[5]

50% of vaccines perish due to lack of energy for cold storage[6]