AESIS

NETWORK FOR
ADVANCING & EVALUATING THE SOCIETAL IMPACT OF SCIENCE

Allianz Forum – 5-7 June 2019

Welcome to the seventh international **AESIS** *conference on*

Impact of Science

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FORTRAMA
Netzwerk Forschungs- und Transfermanagement e.V.

Plenary opening

Luc Soete

Honourary professor of International Economic Relations, Maastricht University
& Member of the Royal Dutch Academy of Sciences (KNAW)

Rotunde, 09:05-11:00

Plenary Opening: Policies for Impact

Dietmar Harhoff

Sarah Foxen

Yasunori Kikuchi

Frank Zwetsloot

Volker Meyer Guckel

Beverley Damonse

Plenary opening: Policies for impact

Dietmar Harhoff

Director, Max Planck Institute
for Innovation and Competition , Germany

Plenary opening: Policies for impact

Sarah Foxen

Knowledge Exchange Manager, Knowledge Exchange Unit, UK Parliament

On Behalf of David Sweeney

Executive Chair,
Research England, United Kingdom

UK Research and Innovation

Research England

Impact of Science
Annual Conference, Berlin

David Sweeney

Executive Chair, Research England

UK Research and Innovation

Different perspectives…

Define the problem

- What do people want to know?
- What does success look like?

- You have to know what is possible
- You have to steer people towards asking something you can answer

Socialize the problem

- Share ownership of the issue
- Consult widely
- Debate
- Be aware of the counter-argument

Align incentives

- Social Impact vs Academic Impact = PROBLEM
- Look for reputational incentives

UK Research
and Innovation

Plenary opening: Policies for impact

Yasunori Kikuchi

Presidential Endowed Chair for "Platinum Society",
Organisation for Interdisciplinary
Research Project, Japan

AESIS
NETWORK FOR
ADVANCING & EVALUATING THE SOCIETAL IMPACT OF SCIENCE

東京大学
THE UNIVERSITY OF TOKYO

An open platform for transformation in regional energy systems towards sustainability

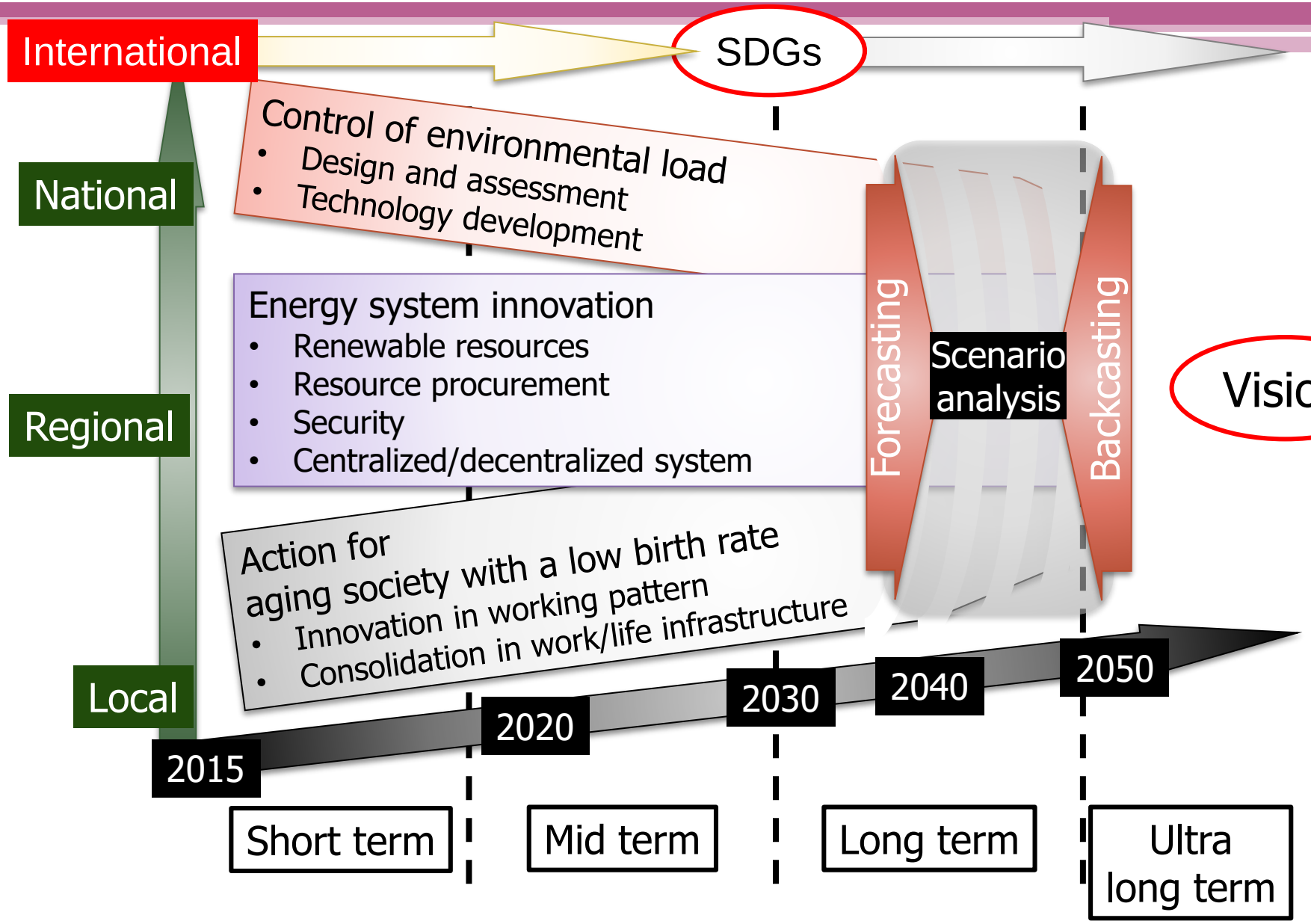
Presidential Endowed Chair for "Platinum Society", the University of Tokyo

Yasunori KIKUCHI

Institute for Future Initiatives
Department of Chemical System Engineering
at The University of Tokyo

東京大学未来ビジョン研究センター
Institute for Future Initiatives
The University of Tokyo

Scenario analysis of future society



Vision

- Sustainable
- Recycle-based
- **Platinum society**

- Forecasting scenario
  - Solving current issues
- Backcasting scenario
  - Chasing the visions

Platinum society: A inclusive vision of future society

Necessary Conditions for a Platinum Society

Ecology
- Overcoming pollution
- Biodiversity
- Global environment

Sufficient resources
- Energy efficiency and renewable energies
- Primary industries
- Recycle-based society

Everyone can participate
- Interaction
- Lifelong learning
- Aging healthily and securely

Freedom of choice
- Culture, arts, sports
- A variety of options
- Time, space, field

Job opportunities
- Innovation
- GDP
- Interface with society

These are the seeds for new businesses

New Vision 2050, Hiroshi Komiyama & Koichi Yamada, Nikkei BP

Hiroshi Komiyama, PhD
The 28th President of the University of Tokyo.
Knowledge award in 2017

New Vision 2050, Hiroshi Komiyama & Koichi Yamada, Nikkei BP

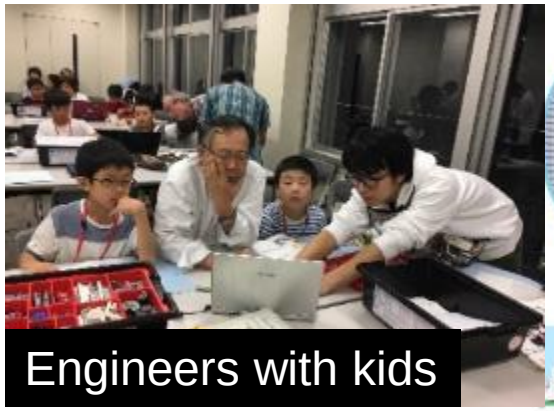
Sharing good practices

Better society with freedom and diversity

Robot suit HAL (lower-limb type, for care) Produced by CYBERDYNE (Japan)

It is possible to live independently as long as the brain is alive

Communication robot "Giraffe" Produced by Robotdalen (Sweden)



Engineers with kids

（Platinum Future School)

Seniors with students

（Platinum Future Human Resources Development School）

Telework at Miyazaki (900 km from Tokyo)

（Source: Aratana）

Experts with young

（Source: Mayekawa）

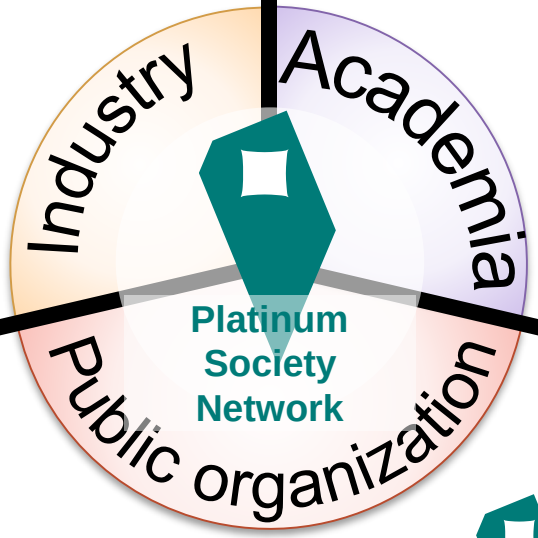
Network of networks:
Industry, academia, and public organization

Circular funds
→ Players in current economy

Platinum Society
Research Association
(Mitsubishi Research Institute, Inc.)

Circular knowledge and wisdom
→ Development and education of knowledge and wisdom

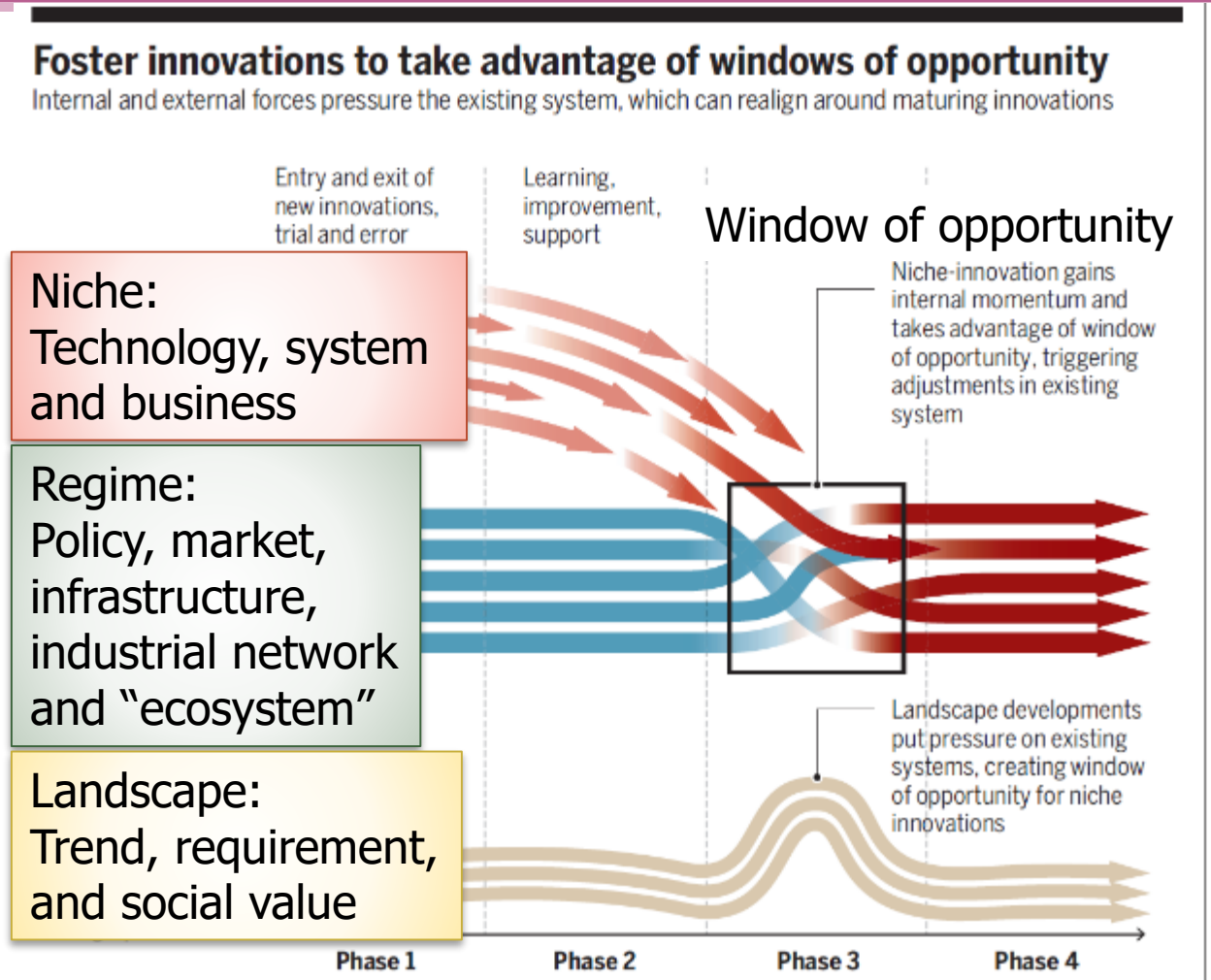
Presidential Endowed Chair for
"Platinum Society",
the University of Tokyo



Circular public capital
→ Actors for public interests

Platinum Society School
for civil servants and
junior high school students

For deep implementation of *Niche*



Niche:
Technology, system and business

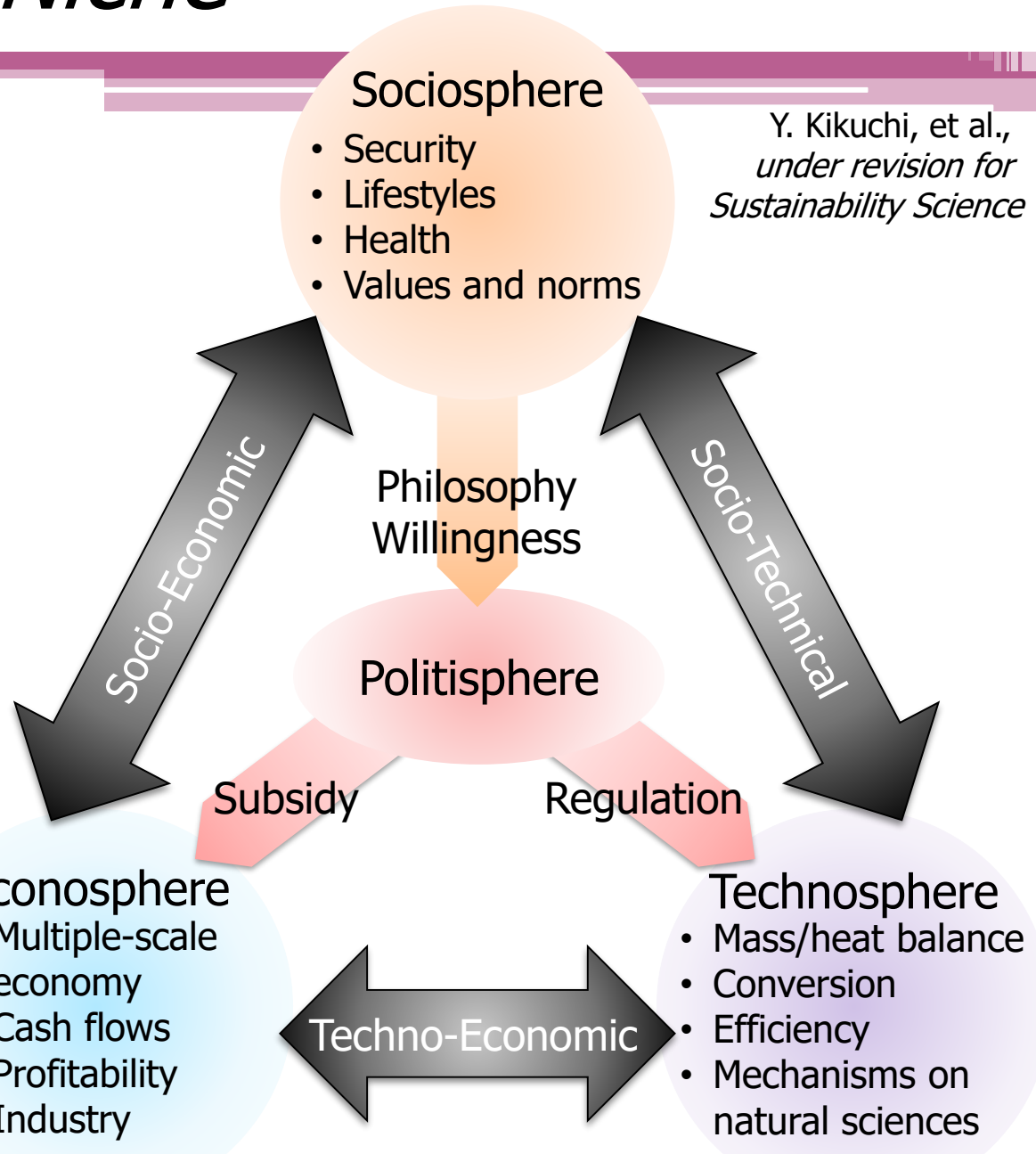
Regime:
Policy, market, infrastructure, industrial network and "ecosystem"

Landscape:
Trend, requirement, and social value

Geels et al., Science, 357:1242 (2017)

How can we collaborate between social and natural sciences? ➔ Case-driven discussion

Y. Kikuchi, et al., *under revision for Sustainability Science*



Social implementation trial in Tanegashima

System innovation
Behavioral systems analysis for medical check-up

Leading by technology
Demonstration of novel biodiesel process

Leading by technology
Demonstration of inverse production of sugar and ethanol

Alarming heatstroke

Biomass-derived chemical production

AI in agriculture

Welfare

Satoyama; Satoumi

Biodiesel production

Social problems

Education

Distributed energy system

Utilization of unused energy

Reforestation

Sugarcane

Systematic tourism

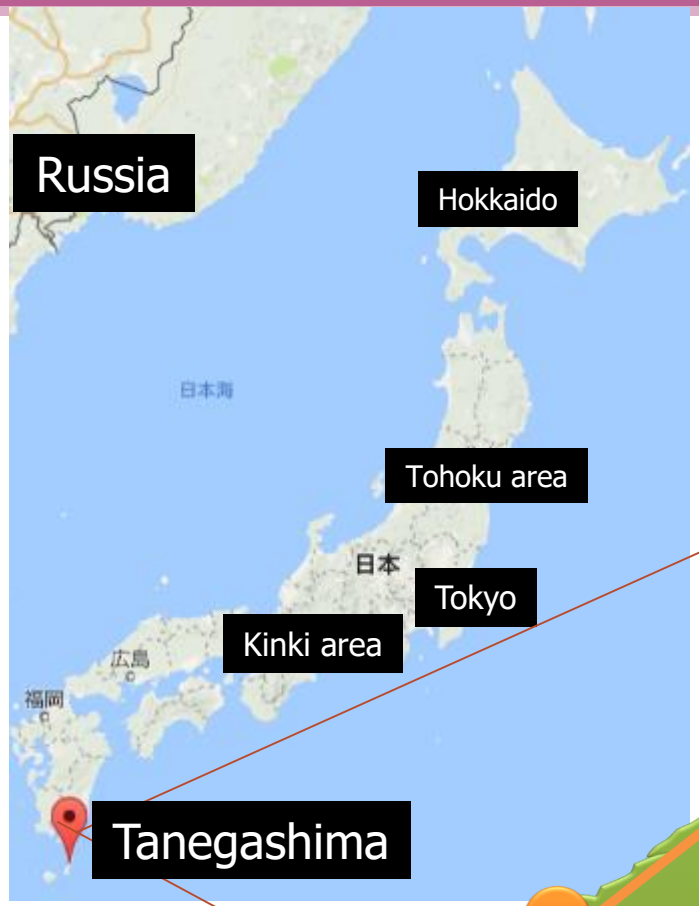
Implementation of natural energy

Communication and education
- Lecture at high school
- Management of symposiums

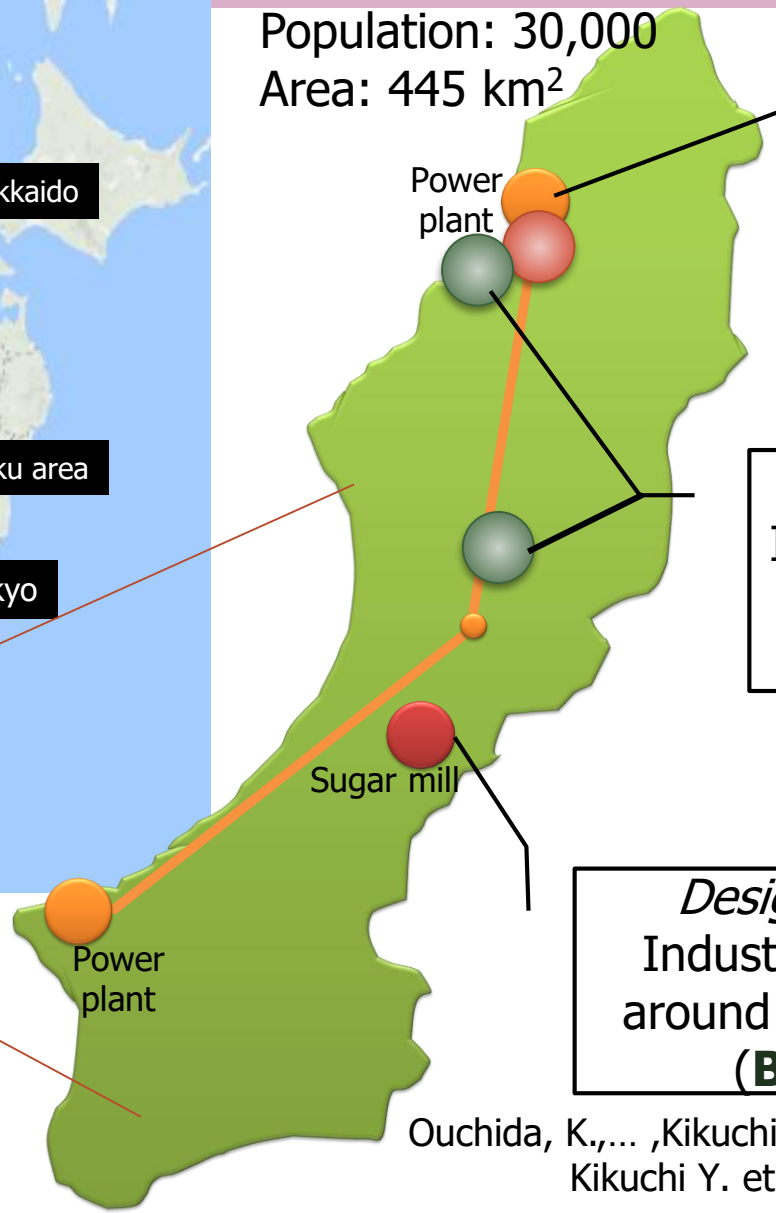
System innovation
- Energy system centering cane sugarmill
- Agri-Eng system optimization

Discovery through tourism
- New tourism
- Tourism monitor

Case study: Energy systems in Tanegashima



Population: 30,000
Area: 445 km^2



Design problem:
District heating and cooling with small scale CHP (**Woody biomass**)

Y. Kanematsu, K. Oosawa, T. Okubo, Y. Kikuchi, *Applied Energy* (2017)

Design problem:
Ion-exchange resin catalyzed biodiesel production (**Waste cooking oil**)

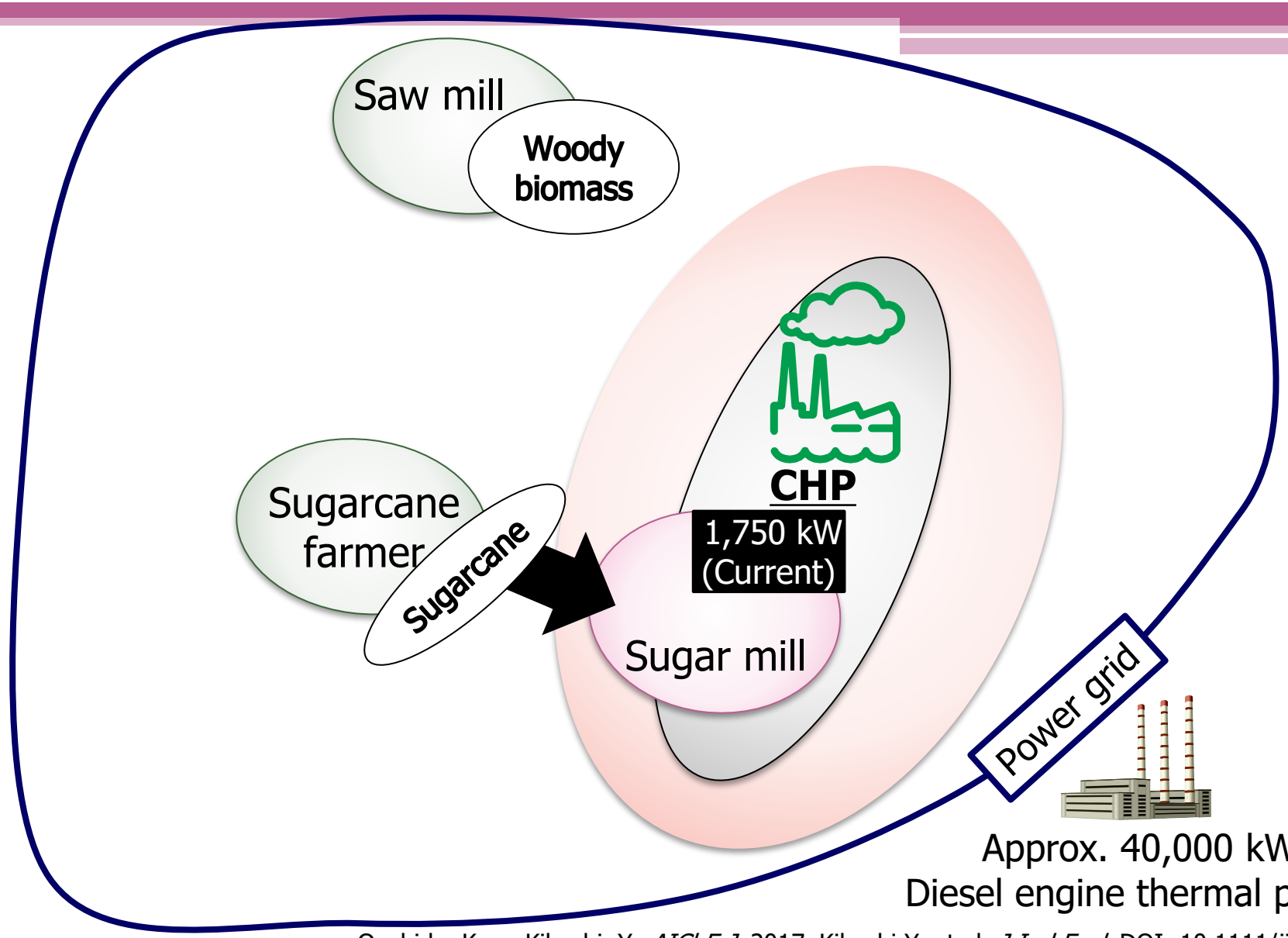
I. Chen, et al., *J Chem Eng Jpn* (2018)

Design problem:
Industrial symbiosis around sugarmill CHP (**Bagasse**)

Ouchida, K.,… ,Kikuchi, Y., *AIChE J*, (2017) , Kikuchi Y. et al. *J Ind Ecol*, (2016)

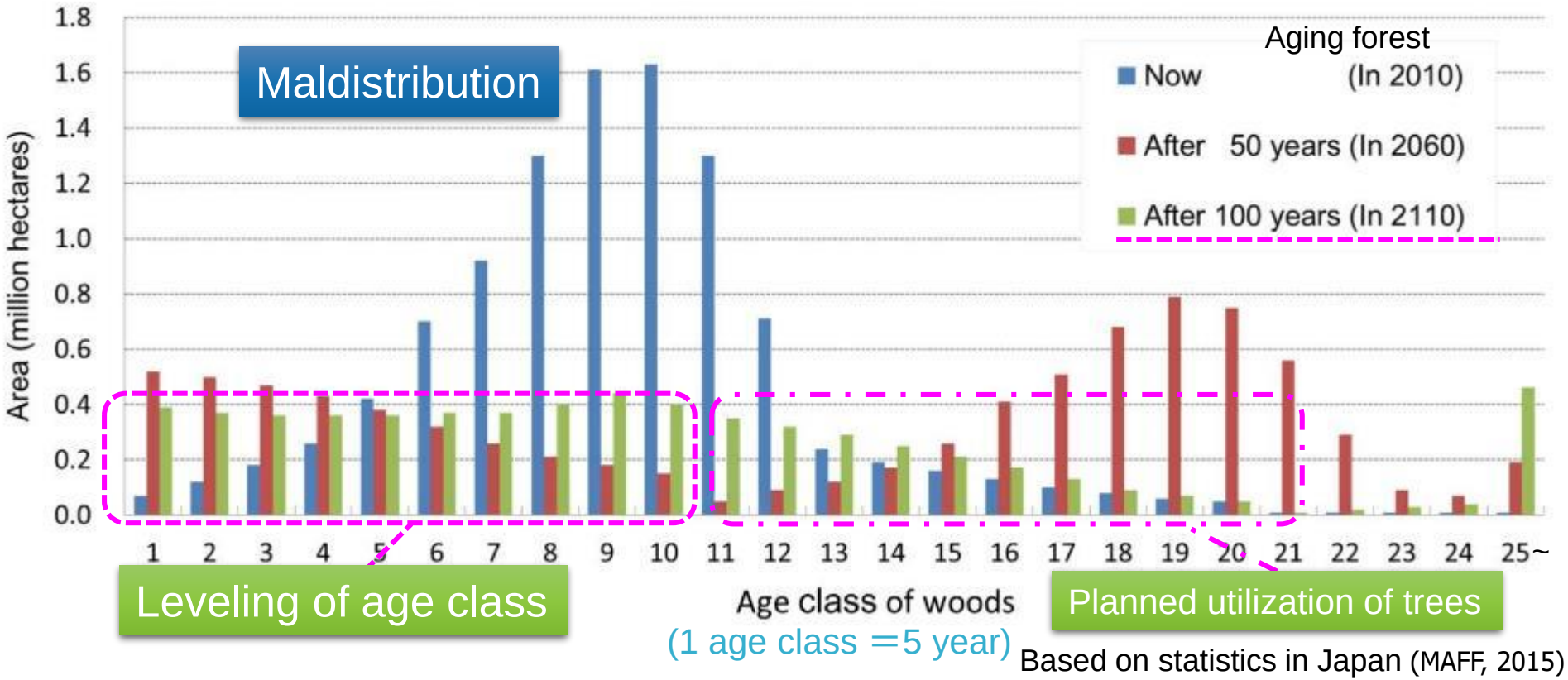
Technology implementation with systems transformation towards low carbon society

Design of industrial symbiosis



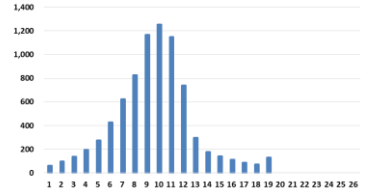
Ouchida, K.,… ,Kikuchi, Y., *AIChE J*, 2017 ,Kikuchi Y. et al. *J Ind Ecol*, DOI: 10.1111/jiec.12347（2015）

Aging forest in Japan

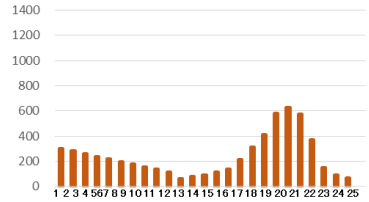


Based on statistics in Japan (MAFF, 2015)

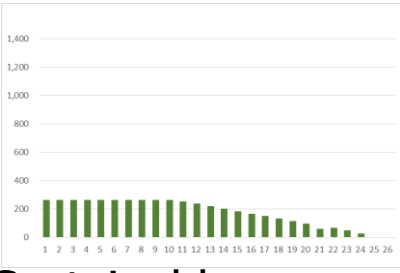
Current



- Aging forest
- Low metabolization



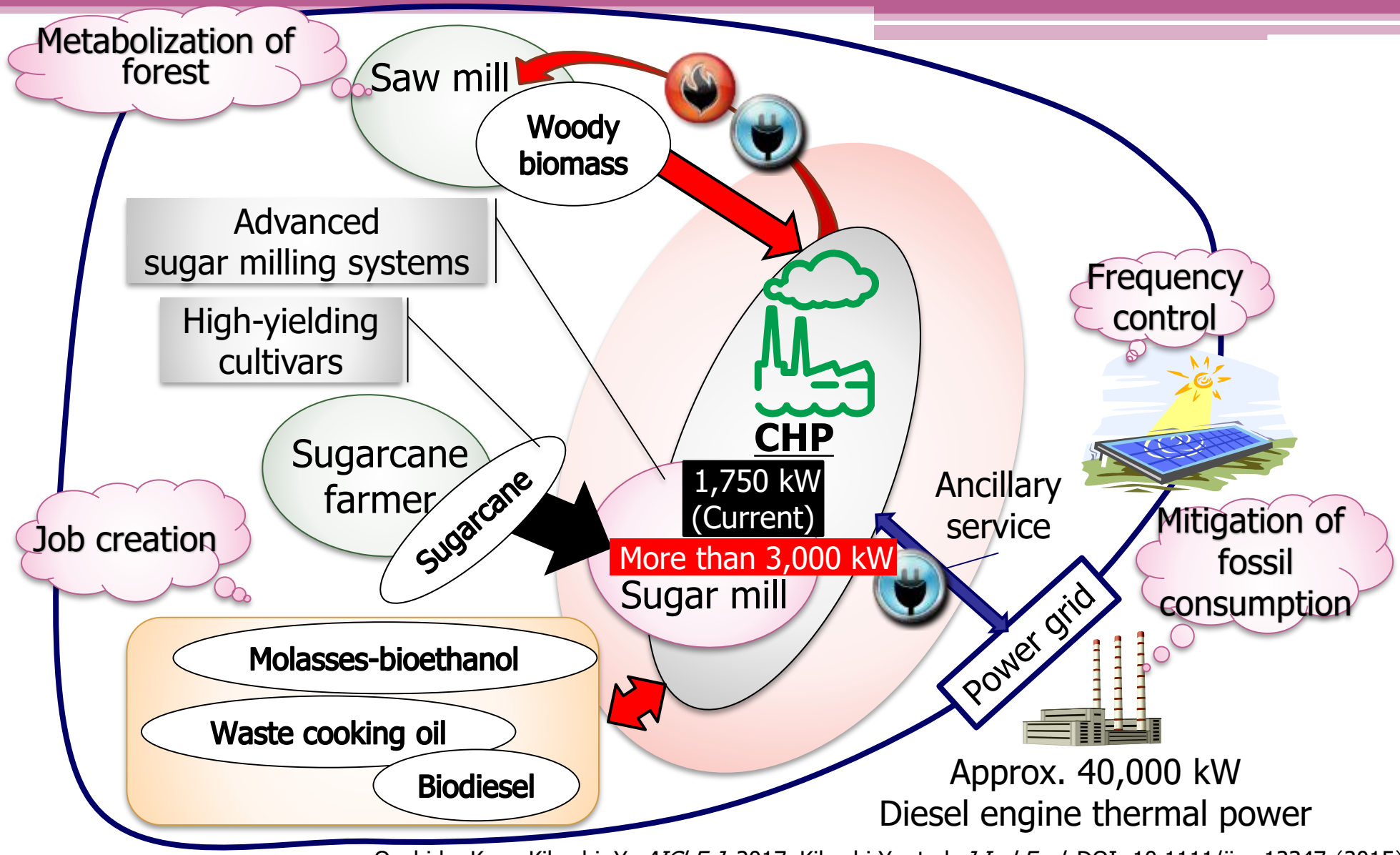
Preferable



- ✓ Sustainable
- ✓ Adequate carbon absorption

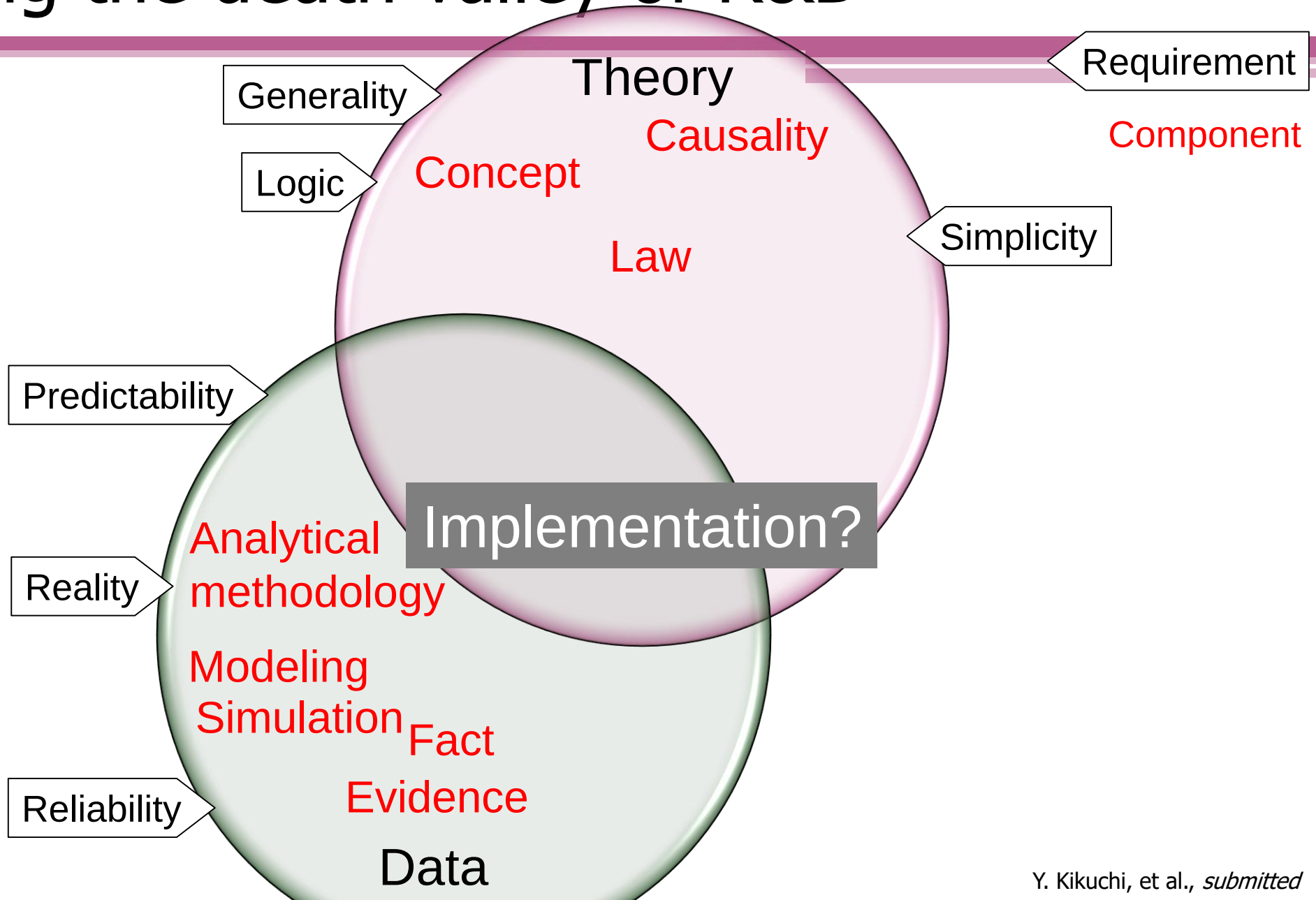
- Needs of forest management for sustainable acquisition of forest resources
  - Current aging forest should be changed into preferable distribution
- Ultra-longterm planning for forest metabolization

Design of industrial symbiosis



Ouchida, K.,… ,Kikuchi, Y., *AIChE J*, 2017 ,Kikuchi Y. et al. *J Ind Ecol*, DOI: 10.1111/jiec.12347（2015）

Bridging the death valley of R&D

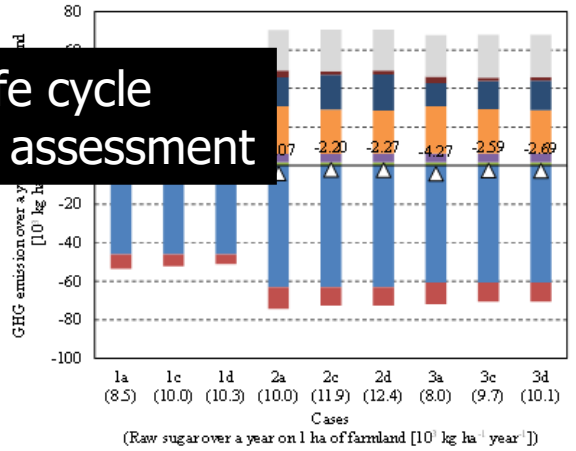


Y. Kikuchi, et al., *submitted*

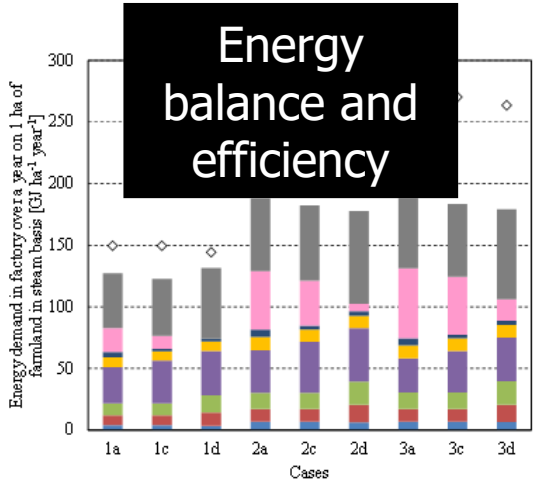
Technology assessment

Smart cane sugarmill

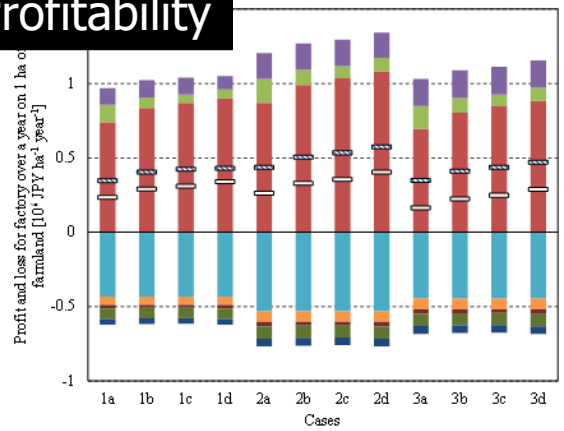
Life cycle impact assessment



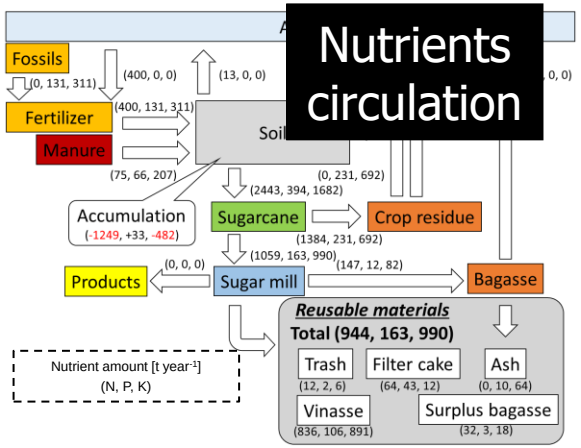
Energy balance and efficiency



Profitability

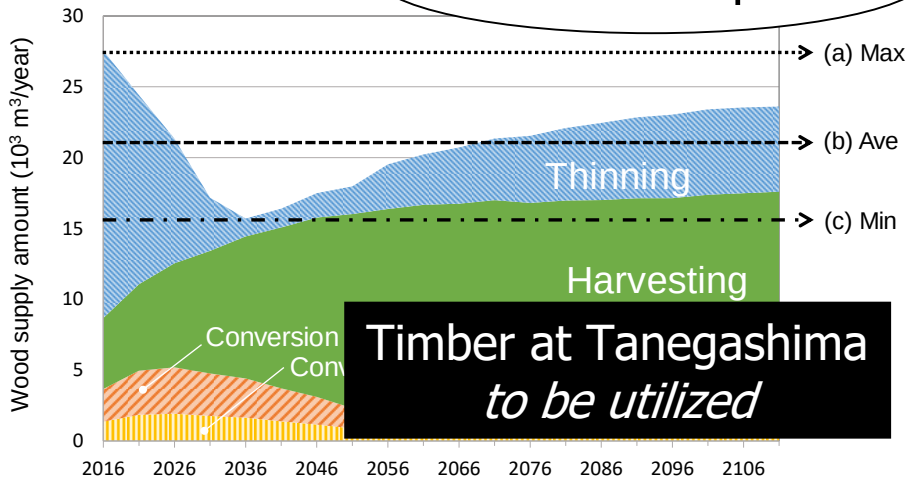


Nutrients circulation

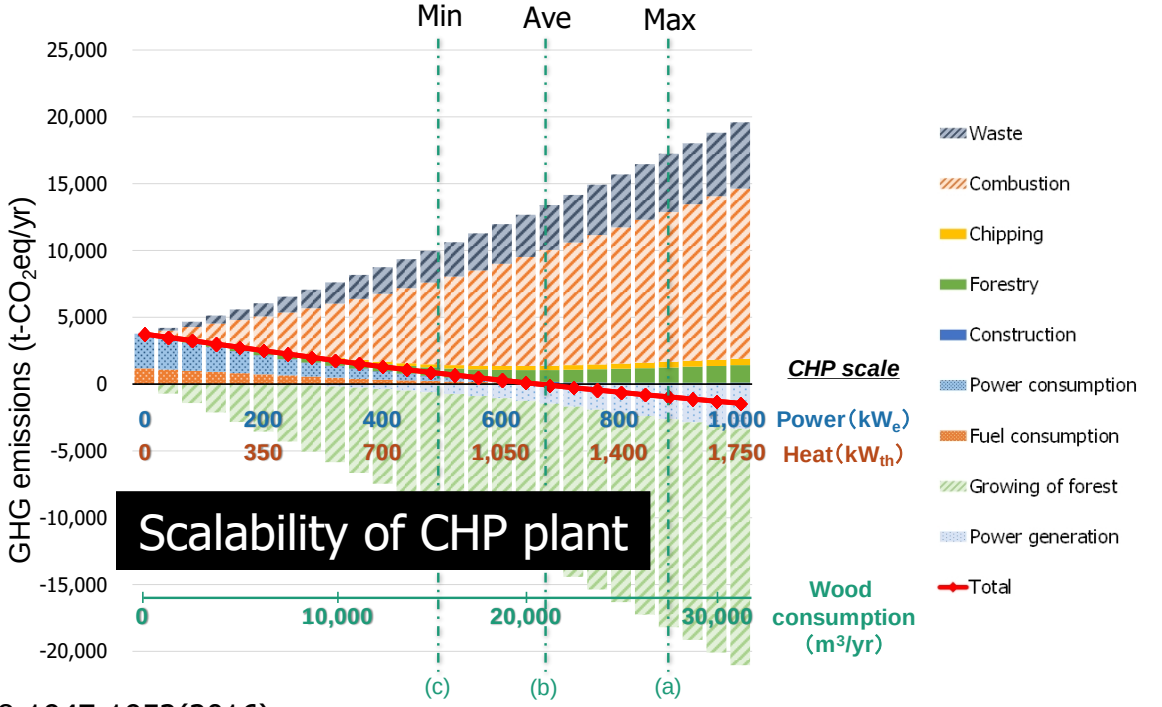


Small CHP plant

Timber at Tanegashima *to be utilized*



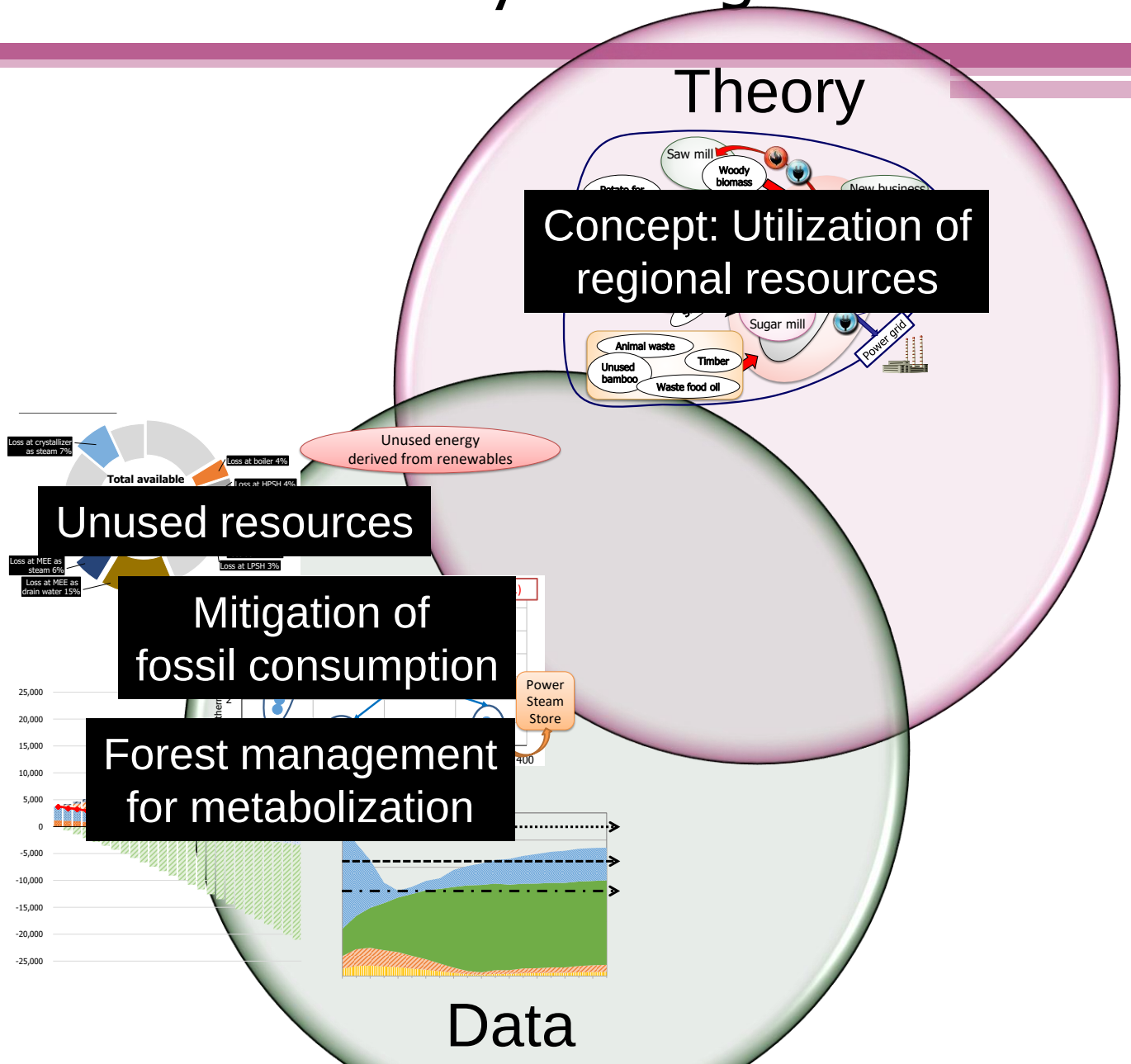
Scalability of CHP plant



K Ouchida, et al., *AIChE J*, 63(2):560-581(2017).; K Ouchida, et al., *Comput-aided chem eng*, 38:1947-1952(2016).

Y. Kanematsu, Y. Kikuchi, *Applied Energy* (2017)

Bridging the death valley: Tanegashima case

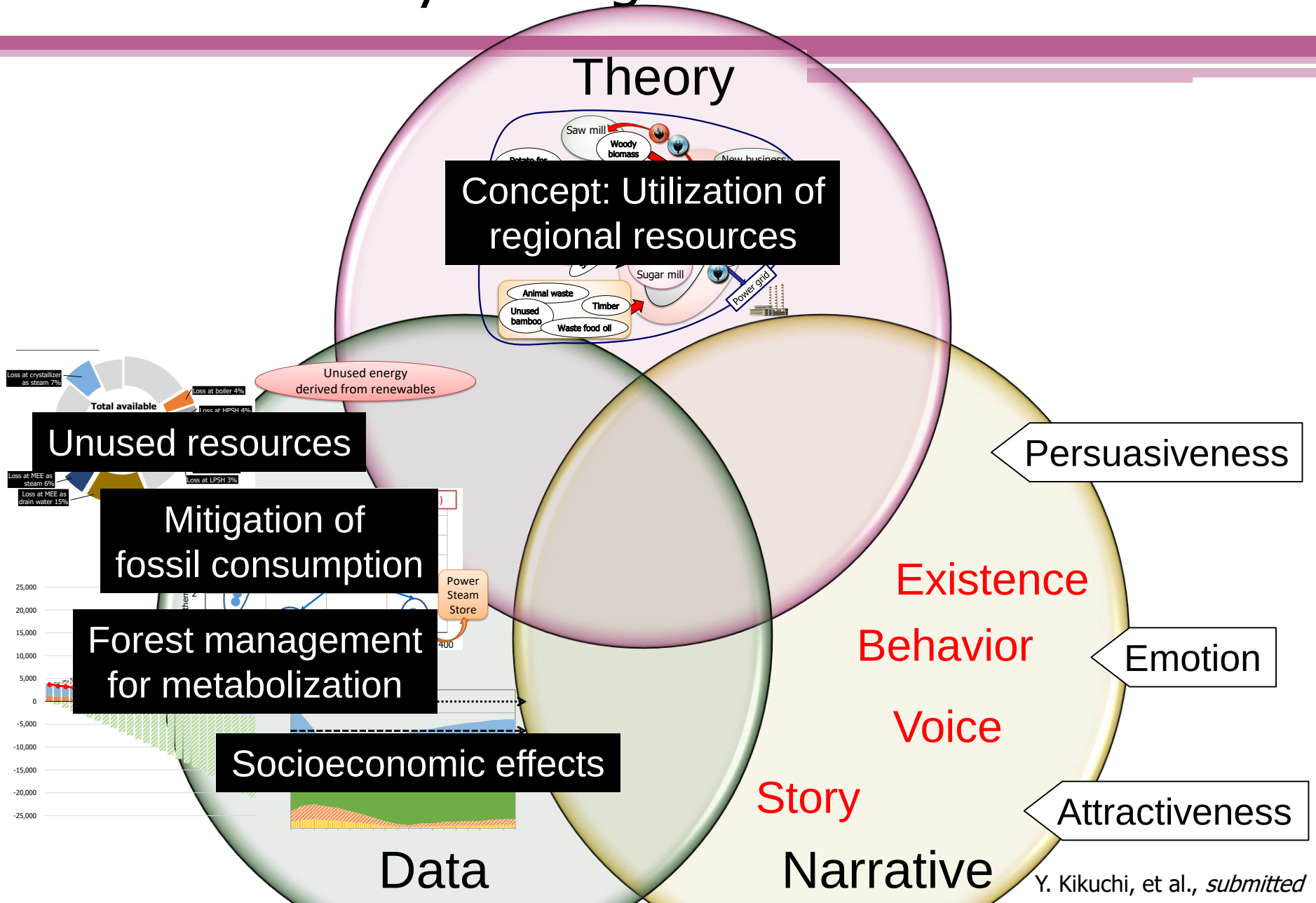


Y. Kikuchi, et al., *submitted*

Input-output analysis on socioeconomic aspects

Y. Kikuchi, et al., *submitted*

Bridging the death valley: Tanegashima case



Y. Kikuchi, et al., *submitted*

Colearning with industries and residents

Discussion with high school teachers

Alternative generation

Sharing the visions and conducting surveys

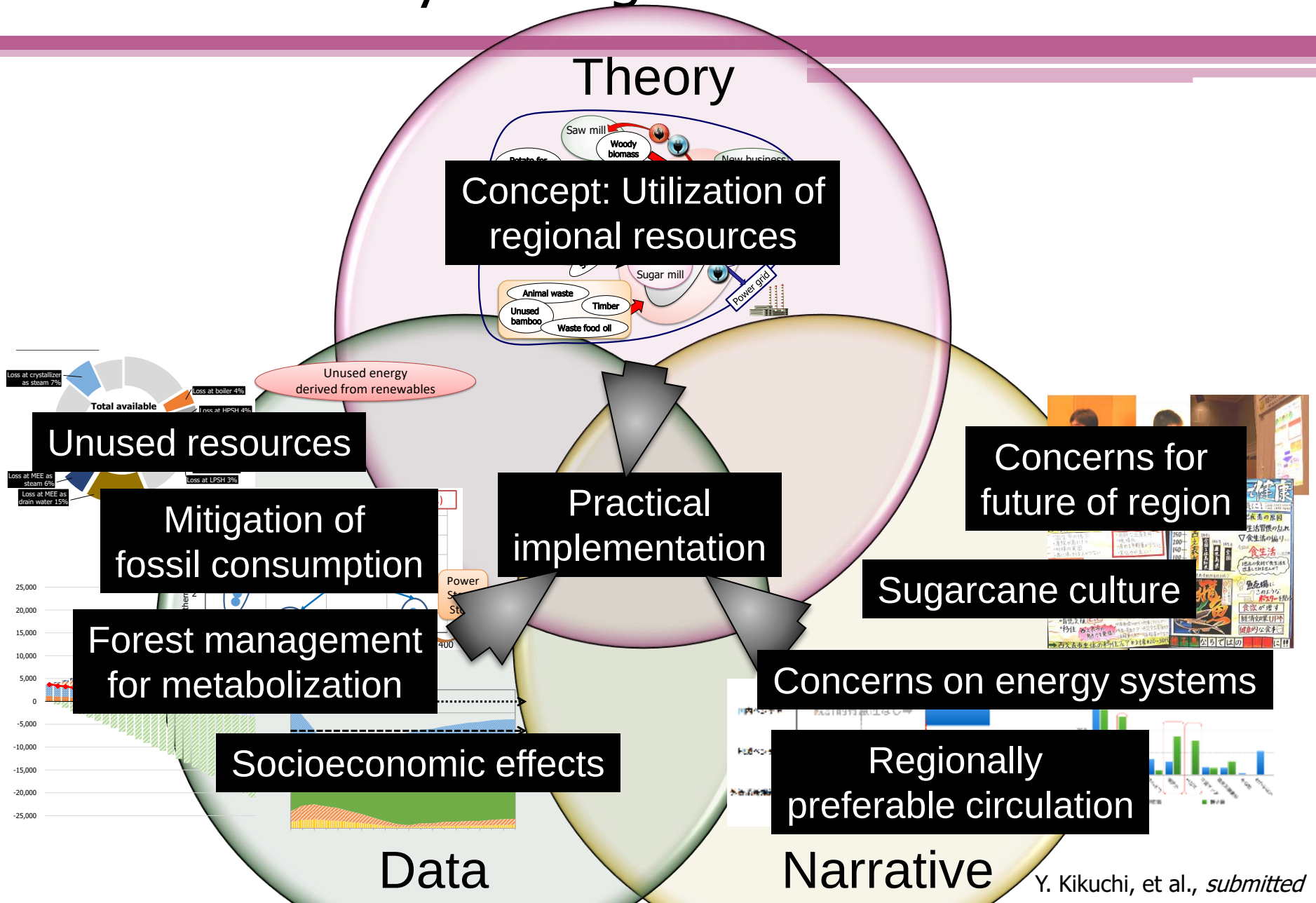
Scenario planning with local industries

Lectures for high school students

Scenario planning with residents

Reporting by high school students

Bridging the death valley: Tanegashima case

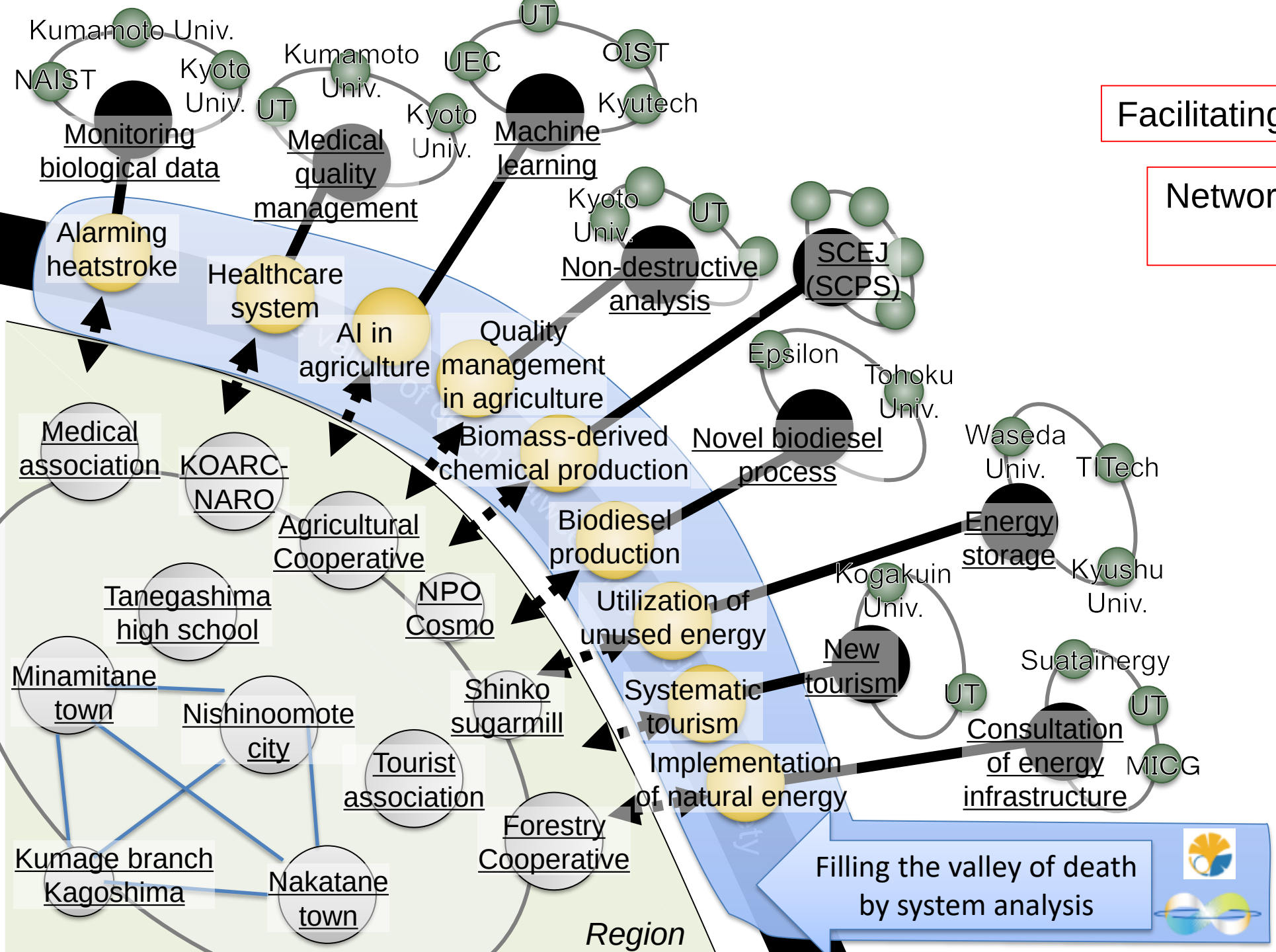


Y. Kikuchi, et al., *submitted*

For networking networks

Facilitating colearning community

Networking inside and outside of region

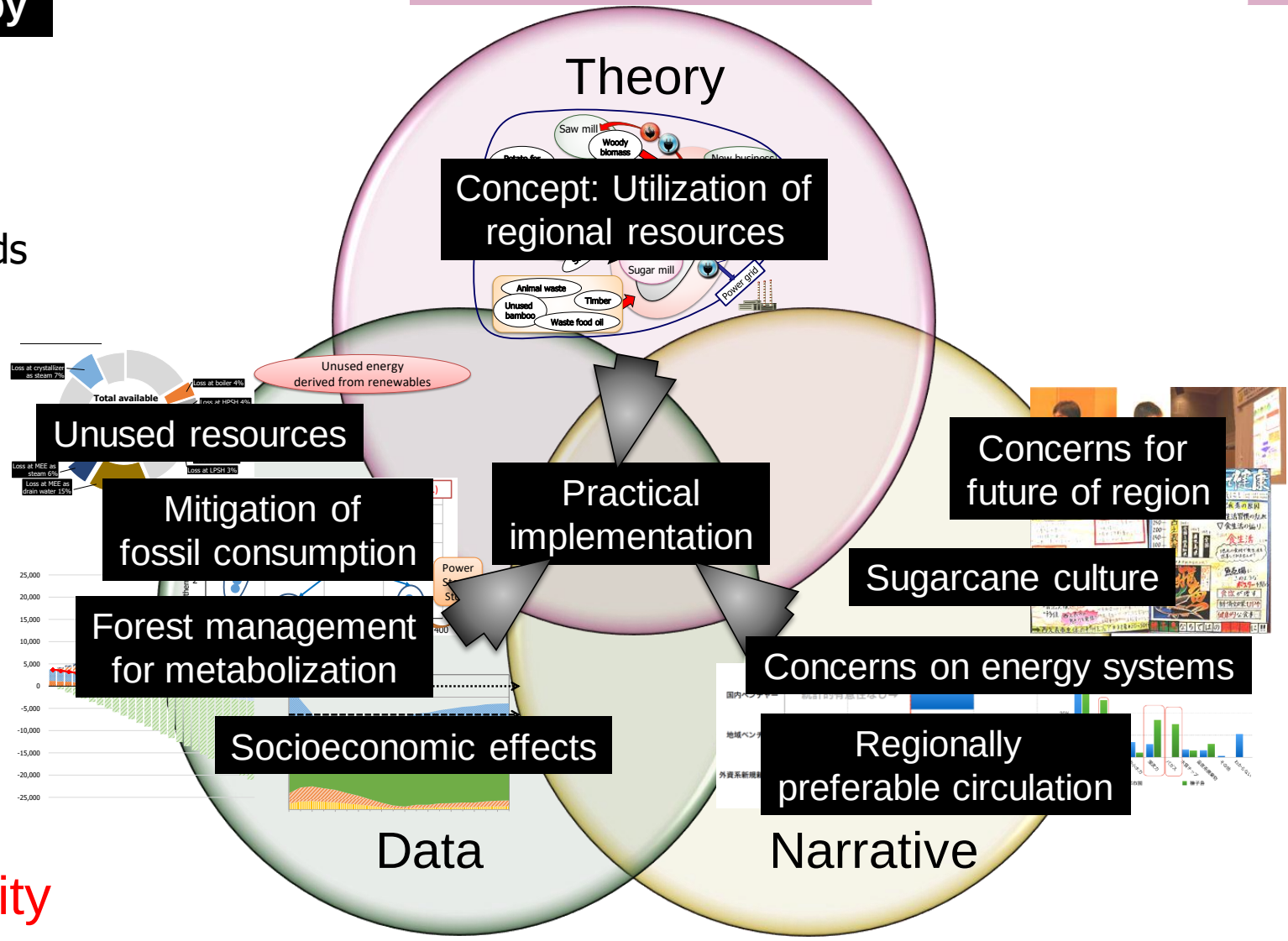


Summary: Regional transformation by technology implementation

Regional transformation can be supported by

- Multiscale simulation
  - Analysis on relationships among technology options and local systems
  - Specification of research and action needs
- Visualization of "circulation"
  - Roles of LCA, IO analysis, and MFA
- Colearning based on Theory, Data, and Narrative among multiple stakeholders to become players

Network of networks becomes a driving force towards sustainability



Y. Kikuchi, et al., *submitted to Sustainability Science*

Impact of Science

5-7 June 2019, Berlin

Plenary opening: Policies for impact

Frank Zwetsloot

CEO, AESIS, The Netherlands

On behalf of Burton Lee

Lecturer European Innovation at
Stanford University School of Engineering,
USA

AESIS

When ‘Freiheit von Forschung’ Is Not Sufficient :

On the Critical Importance of Roadmapping & Responsible Research Topic Selection Processes in Science

AESIS 2019 Conference on the Impact of Science

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European Innovation & Entrepreneurship || Stanford School of Engineering

Burton.Lee@innovarium.net

Frank Zwetsloot

CEO, ScienceWorks BV

6 June 2019 | Berlin DE

AESIS

NETWORK FOR ADVANCING & EVALUATING THE SOCIETAL IMPACT OF SCIENCE

Acknowledgments, Apologies & Caveats

- Many Thanks to Frank Zwetsloot, CEO of ScienceWorks BV, for delivering this presentation during the AESIS Opening Plenary in Berlin.

- Apologies to AESIS conference participants for the co-Author's absence due to an unexpected and urgent medical condition that prevents long distance travel.

- Interim Findings presented herein are highly suggestive but not fully conclusive.

Dr. Burton H Lee

Abbreviated Professional Qualifications - Academic & Industry

- Lecturer, European Innovation & Entrepreneurship, Dept of Mechanical Engineering, **Stanford School of Engineering** (2008-2019)
- Senior Advisor – Artificial Intelligence, Government of Upper Austria, Linz AT (2018)
- Visiting Professor/Scientist & Senior Research/Innovation Strategy Advisor (2011-2018)
  - LMU München, Ruhr Universität Bochum, TU Dortmund, TU Braunschweig, TU Graz, IST Austria, Technion (IL)
- Member, Advisory Council, **German Accelerator**, Silicon Valley (2013-2016)
- Senior Invited Expert, Assessment of Horizon2020 ICT Work Programme 2014-15, **DG CONNECT, European Commission** (2014)
- Science & Technology Policy Fellow, **National Academy of Sciences, Computer Science & Telecommunications Board** (CSTB), Washington DC (2006)
- Strategy Leader / AI Researcher – **General Electric, Daimler Forschungslabor**, **Hewlett Packard Corporation** (1998 - 2004)

- **PhD, Mechanical Engineering and Artificial Intelligence**, Stanford University (2002) [Topic: Bayesian Networks in Equipment Diagnostics and FMEA Engineering Design]
- Student, Volkswirtschaft u. Physik, LMU München (1975-77)

Why Did Germany Allow Itself, over Three Decades, to Fall Behind in Many Critical Emerging Areas of Computer Science, Software Engineering, Information Technology and Artificial Intelligence?

Interim Research Findings

- The sustained gap in many key areas of ICT research and industrial performance reveals several fundamental and systemic shortcomings in Germany's science funding and strategy system

- In this presentation, we elaborate on only one of these identified gaps (Research Topic Selection and Roadmapping), and set aside the rest for subsequent discussion and publication

- Methodology: site visits, interviews, program assessments and literature reviews at key German and European research organizations, companies and government entities (1998-2019)

Historically, Formal Science **Roadmapping** Processes Seem Largely Absent as a Prioritization, Planning and Resource Allocation Tool in Certain German Science Funding Organizations

This appears to be the case with DFG Computer Science (Informatik) research topics and funding over past 20 years

Source: Interviews of DFG staff, September 2017

What is Science & Technology Roadmapping?

- Purpose
  - Goal is to establish a consensus set of challenges/questions, fundamental/applied research objectives, priorities and progress milestones for a narrow or broad scientific discipline or technology competency deemed of importance to the nation or humanity, for the coming 5-10 years
- Who?
  - Working group, committee or board composed of leading experts from academia, industry, foundations or government; typically can be 10 – 25 persons invited to join the group, domestic and international experts; supported with full time staff to coordinate activities
- How?
  - Group typically convenes for 3-12 months, depending on complexity and urgency of topic, task and committee; meets every 6-12 weeks, frequent remote consultations
- Outcomes
  - Final Report issued to the public or internally, as a consensus of group; dissenting opinions may be included
  - Used as the basis to establish new science and technology topic focus areas and programs, with funding attached

Roadmapping is a Key Tool Used Across the US Science & Technology Strategy and Funding System

- National Academies of Sciences, Engineering & Medicine
- National Science Foundation (NSF)
- National Institutes of Health (NIH)
- NASA
- DARPA
- Dept of Energy
- And many other science and technology units

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May 22 — An international commission has been convened by the U.S. National Academy of Medicine, the U.S. National Academy of Sciences, and the Royal Society of the U.K on the clinical use of human germline genome editing.

ANNOUNCEMENT
International Commission Launched on Heritable Human Genome Editing

NEW REPORT
Promoting Positive Adolescent Development and Closing the Opportunity Gap

NEW REPORT
Assessing Flame Retardants

ELECTION
NAE Elects President, Foreign Secretary, and Four Councillors

National Academy of Medicine

EMERGING LEADERS IN HEALTH AND MEDICINE

The National Academy of Medicine announced 10 new Emerging Leaders in Health and Medicine Scholars. These individuals are early- to mid-career professionals from a wide range of health-related fields, from microbiology and surgery to sociology and biomedical engineering.

NAS and NAM Presidents Give Commencement Addresses

NAS President Marcia McNutt delivered the commencement address to Boston University graduates, and NAM President Victor Dzau spoke to graduates of Western University's School of Medicine & Dentistry.

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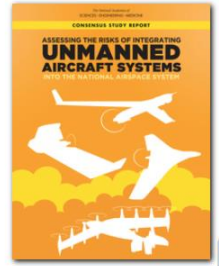

Assessing the Risks of Integrating Unmanned Aircraft Systems (UAS) into the National Airspace System

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NSF is divided into the following seven directorates that support science and engineering research and education: Biological Sciences, Computer and Information Science and Engineering, Engineering, Geosciences, Mathematical and Physical Sciences, Social, Behavioral and Economic Sciences, and Education and Human Resources. Each is headed by an assistant director and each is further subdivided into divisions like materials research, ocean sciences and behavioral and cognitive sciences. Within NSF's Office of the Director, the Office of Integrative Activities also supports research and researchers. Other sections of NSF are devoted to financial management, award processing and monitoring, legal affairs, outreach and other functions.

Biological Sciences (BIO)

- Biological Infrastructure (DBI)
- Environmental Biology (DEB)
- Emerging Frontiers (EF)
- Integrative Organismal Systems (IOS)
- Molecular and Cellular Biosciences (MCB)

Computer and Information Science and Engineering (CISE)

- Office of Advanced Cyberinfrastructure (OAC)
- Computing and Communication Foundations (CCF)
- Computer and Network Systems (CNS)
- Information and Intelligent Systems (IIS)

Education and Human Resources (EHR)

- Graduate Education (DGE)
- Research on Learning in Formal and Informal Settings (DRL)
- Undergraduate Education (DUE)
- Human Resource Development (HRD)

Achieving High Science Impact Starts at the Front End of the Science System … by Exercising Responsibility in the Proper Selection of Research Topics

Roadmapping Improves Science Impact by Bringing Rigor, Discipline & New Stakeholders to the Research Topic Selection Process:

* Asking the Right Questions, & Proper Design of Problem Statements;
* Identifying the Most Critical Global & European Challenges;
* Ensure Different Science Traditions and Outside Perspectives are Included; and
* Selecting the Optimal Mix of Research Themes and Topics of Interest to Scientists and Industry

‘Freedom of Research’ – Freiheit von Forschung - is Important, but Alone Does Not Guarantee High Quality Research or High Impact Science

Freedom Always Comes with Responsibility

In a science system – *including* freedom of research – these responsibilities imply that researchers should:

- aim for groundbreaking research and new knowledge
- try to maximise their Impact in Society
- be judged by a science system that evaluates *both*

The Current German Science System:

- Evaluates its researchers too much on peer review
- Evaluates its researchers still almost exclusively on their “Impact on Science” (like the scientific citations/H-index)
- Is considering pathways to awards its researchers on the “Impact on Society”

Freedom-of-Research in a Modernised Science System:

- Awards researchers for public-private cooperation, Teaching in practise, serving societal goals; in a – KPI based – modernised science evaluation system

- Awards researchers for their research excellence

- Makes sure that performing science is *not only* a solitary process but also the most challenging job within society!

Plenary opening: Policies for impact

Volker Meyer Guckel

Deputy Secretary General and Member of the Executive Committee, Stifterverband, Germany

STIFTERVERBAND

Bildung. Wissenschaft. Innovation.

Berlin, 6 June 2019

PARAMETERS AND CONDITIONS FOR AN IMPACT ORIENTED SCIENCE POLICY

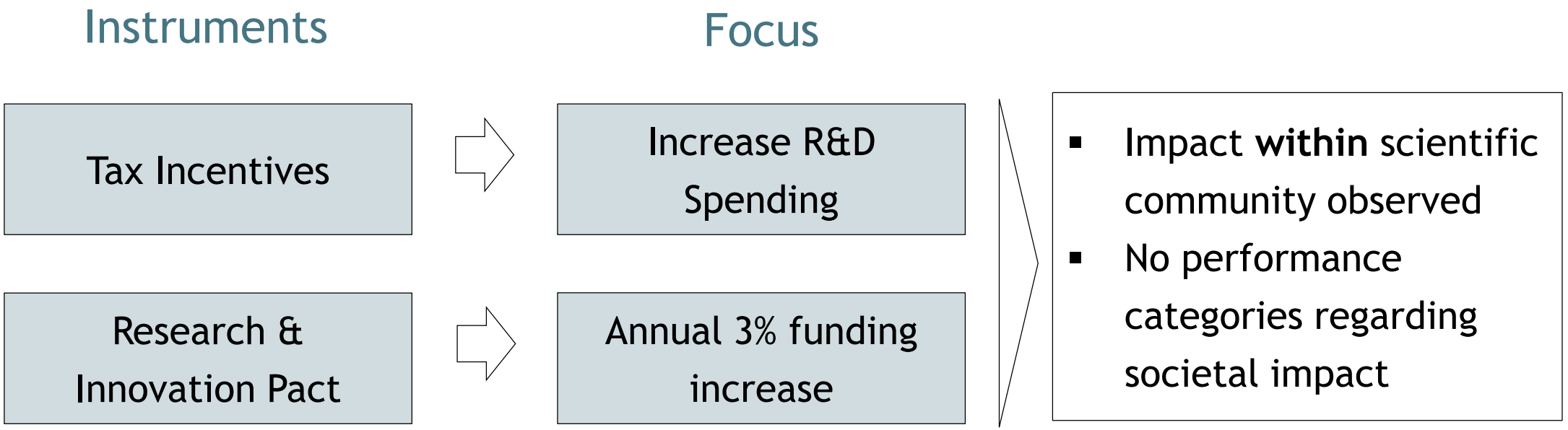
Dr. Volker Meyer-Guckel

PRIORITIES OF GERMAN SCIENCE & INNOVATION POLICY TODAY

- Strengthen basic research
- Adress grand challenges
- Strengthen collaborative R&D
- Enable disruptive innovation
- Strengthen knowledge transfer

→ Relevance of Impact?

INSTRUMENTS FOCUS ON IN INPUT – IMPACT NOT MONITORED:
TWO EXAMPLES



WHY FOCUS ON IMPACT?

- Transparency & Legitimization of Public Spending
- Marketing & Profile Building
- Self-governance & Organisational Development
- Institutional Comparisons and Benchmarking

WHY FOCUS ON IMPACT?

INTERNATIONALLY IMPORTANCE OF IMPACT INCREASES

Three examples

Knowledge Exchange Framework (KEF) und Research Excellence Framework (REF)

Standard Evaluation Protocol
Relevance for Society as Key Criterium

Engagement and Impact Assessment
Australian Research Council

WHAT COULD IMPACT-ORIENTIED SCIENCE & INNOVATION POLICY MEAN?

Impact-orientied innovation policy is successful, if

- we can observe an **increase of economic and societal value creation**
- it results in **transformation of society**
- it **mobilizes potential of unusual providers of knowledge**
- it **integrates expertise beyond established institutions**
- it **facilitates participation** to align innovation with demands of society

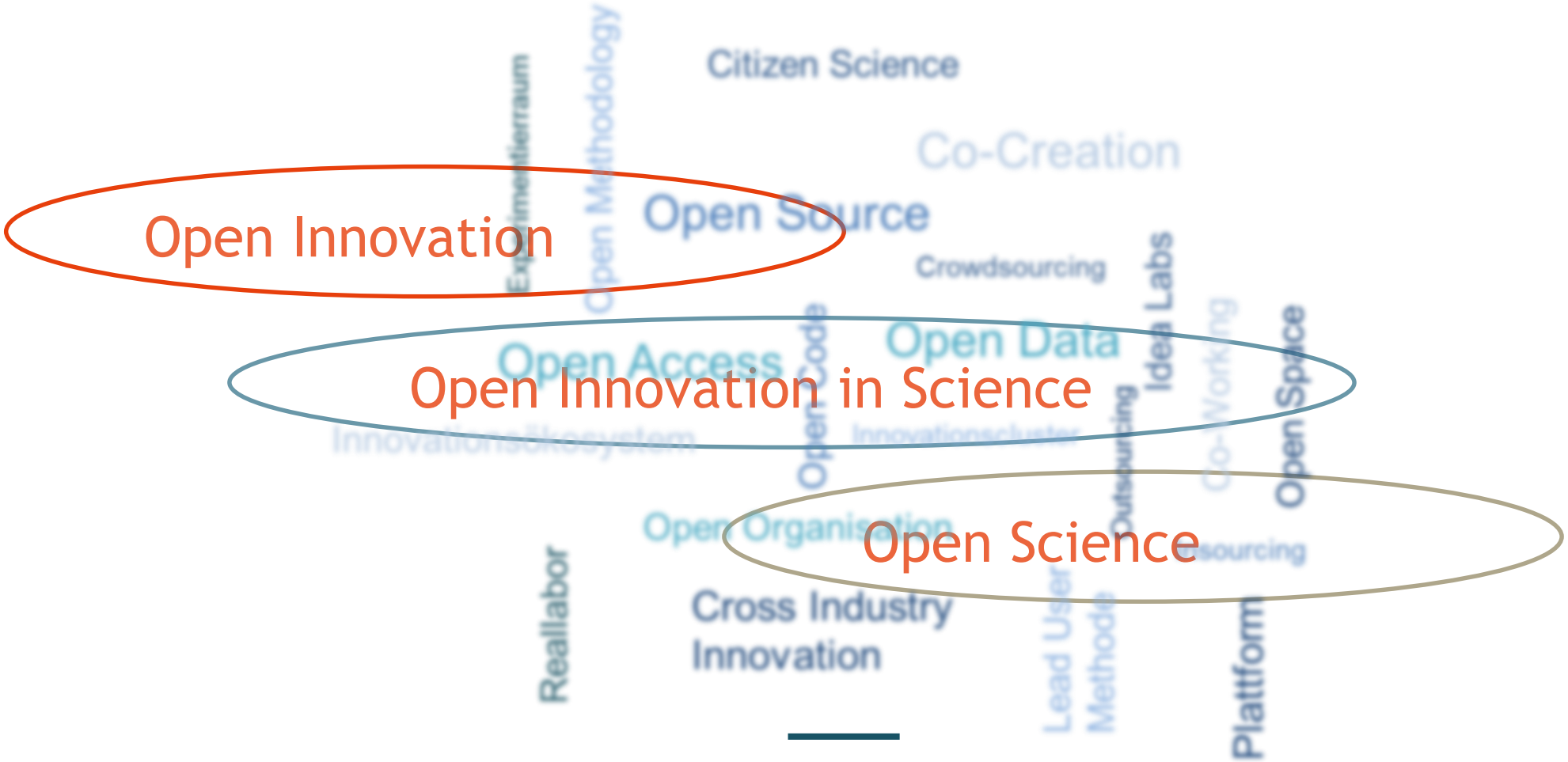
INNOVATION SYSTEM IN TRANSITION

KEY DRIVERS

- **Driver ‘Digital Transformation’**: Technical and social digital innovations promote networking and systemic solutions (e.g. plattform economy, sharing economy, intelligent mobility, etc.)
- **Driver ‘Sense of Responsibility and Transparency’**: Social requirements for disclosure of research results and participation are increasing (e.g. EU Responsible Research concepts, transparency laws, coverage in media)

HOW CAN WE ACHIEVE THIS?

OPENNESS AS A KEY CONCEPT – DISCOURSES STILL SEPARATE



EXAMPLES

In Academia

» Open Access is becoming more and more the publishing standard
» Researchers participate in innovation and crowdfunding competitions

In Industry

» More cooperative R&D: External R&D increases by 33% (2007 bis 2017)
» Opening of R&D processes (e.g. user innovation)
» Companies form innovation ecosystems (e.g. App-Stores, Siemens Campus)

In Politics

» Open innovation culture as pillar in High-Tech Strategy
» Agency for disruptive Innovation as a new instrument
» Initiatives at EU and national level

HIGHTECH STRATEGIE 2025
Köpfe. Kompetenzen. Innovationen.

WHAT DOES THAT MEAN FOR POLITICS?

RECOMMENDATIONS

(1) New Innovation Policy Framework

Develop a national political framework for **strategic openness**: in the process of strategy formation, business, science and society should jointly define potentials and fields of action.

(2) Research & Innovation Impact Monitoring

Extend national research and innovation monitoring to better measure and assess the **impact of (open) research and innovation.**

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CONCLUSION

IMPACT-ORIENTATION IS A CHANGE OF PARADIGM

It challenges

» the role of universities/academia in society

» collaboration routines and stakeholder interaction

» existing funding schemes for research and innovation

» self-understanding of researchers and universities

» the academic reputation system

THANK YOU

STIFTERVERBAND
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Plenary opening: Policies for impact

Beverley Damonse

Executive of Science Engagement and Corporate Relations, National Research Foundation (NRF), South Africa

Public engagement as a key pathway to impact

Beverley Damonse (PhD)

National Research Foundation OF South Africa (NRF)

AESIS Impact of Science Conference

6th June 2019

National Level

WHITE PAPER on STI (2019)

Focus on using **STI** to accelerate inclusive economic growth.

Innovation for inclusive development

- Grassroots innovation for inclusive development/collaborations within civil society
- Creating an innovation culture in partnership with civil society
- Building a science literate and science aware citizenry
- Principles of Responsible Research and Innovation
- Transdisciplinarity

Science Engagement Policy Framework

….informed by the values of contemporary, post-apartheid South Africa;

….imperative of empowering its citizens to engage processes and issues that impact on their lives; and

…systematise , coordinate, professionalise, ...raise profile of science communication.

NRF Revised Mandate (Amended Act 2019)

Contribute to national development by:—

(a) supporting, promoting and advancing research and human capacity development;

(b) developing, supporting and maintaining national research facilities;

(c) supporting and promoting public awareness of, and engagement with science; and

(d) promoting the development and maintenance of the national science system and support of Government priorities.

Science Engagement Mandate

NRF Engagement with science which is:

- **Embedded in our core missions** of supporting and promoting new knowledge and growing new knowledge workers.
- Essential part of our **transformation mission.**
- A key pathway to **enhance research impact** in society.
- An effective route to **inform and influence** public discourse.

National Research Foundation | SARAO South African Radio Astronomy Observatory

Science and Society

Recognising the role of engagement to maintain our ‘license to operate’

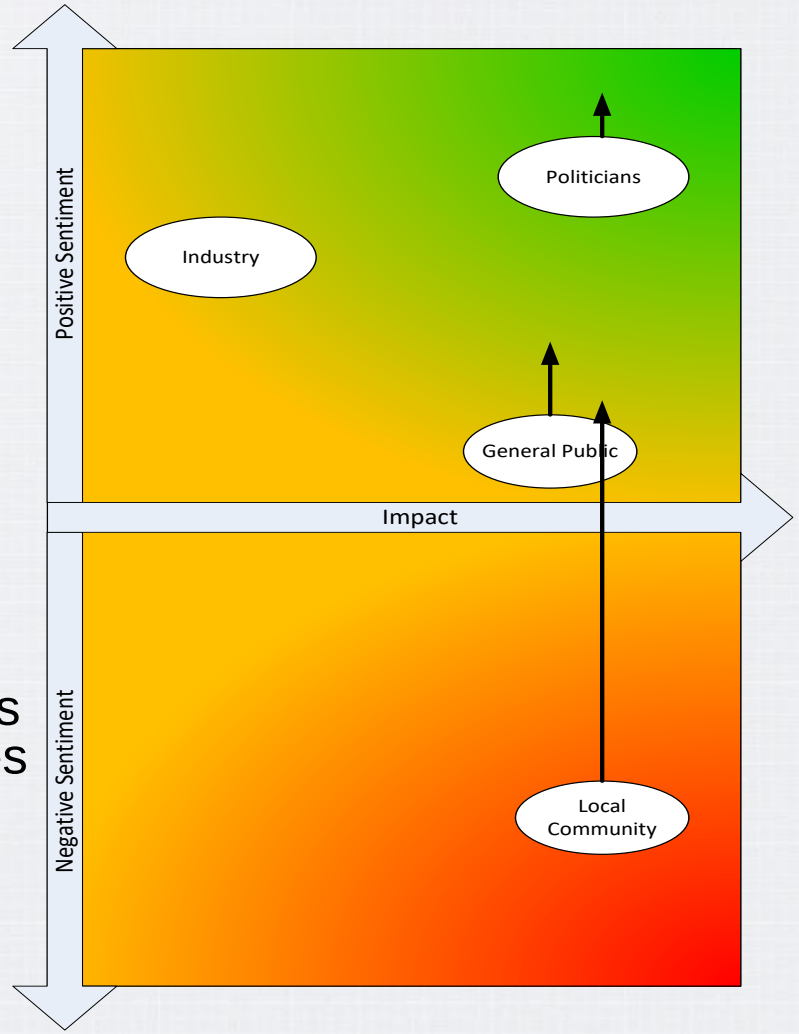
Engagement - License to Operate

Referring to the level of acceptance of approval by stakeholders inside and outside of the project…

- **Legal License**
  - International law
  - Domestic law
- **Economic License**
  - Government
  - Politicians
  - Business
  - Voters
- **Social License**
  - Local Communities
  - General Public
  - Media
  - Special Interest Groups/NGOs

Engagement Framework

- Framework design to enable targeted strategies for different publics.
- Politicians (high impact positive sentiment)
  - General Public (moderate impact, positive sentiment)
  - Industry (low to moderate impact, positive sentiment)
  - Local Community (high impact, negative sentiment)
- Strategy
  - Determines direction (usually vertical)
  - Dynamic context- evolving relationships
  - Science communication just one vehicle – (as science communication will not move all types of stakeholders)
  - Way in which society can influence knowledge agenda – problem identification, co creation
  - More assessment required on impact of strategy



Impact Considerations

- Science engagement must be recognised as an integral part of the research and innovation system.
- Unique social, cultural, economic, political complexes will shape the context in which engagement is executed .
- Listening to and acknowledging the interests and concerns of the publics is essential.
- Engagement value high when science is controversial or when human contexts are most complex an /contentious.
- Innovation in science engagement approaches is needed to tackle new societal challenges.
- Funding for engaging citizens with the process and outcomes of science and innovation needs a significant increase.

Plenary opening: Policies for impact

Panel discussion

Chaired by Luc Soete

Dietmar Harhoff

Sarah Foxen

Yasunori Kikuchi

Frank Zwetsloot

Volker Meyer Guckel

Beverley Damonse