Long Term Perspective on Climate change 2030-2050 Development

A presentation by IRADe

At the

National Conference on “Post Paris Climate Action”

12.07.2016, Hotel Le Meridien

Integrated Research and Action for Development

Insights from Modeling Studies at IRADE

- Activity Analysis – macro model covers the whole economy using Input output tables of 2007-08 and Alternative technologies to produce the same output
- Optimizes by maximising household consumption simultaneously for all years till 2050 based on trends of costs, resource availability and technology potentials
- Model computes GDP, production, consumption, Investment, income distribution and demand
- Captures feedback effects and macro consequences

Scenarios

- **Dynamic as Usual (DAU)** : Usual Efforts, Trend Energy Efficiency
- **Determined Actions (DETA)** : **Increasing Efficiency,** achievable technological intervention and life style change
- **Ambitious Actions (AMBA)** : **Increased Rate of Capacity Creation, Cost reduction** of technologies, drastic lifestyle change, energy conservation with Ambitious targets.

Model Results

INDC and IRADe Model Scenarios

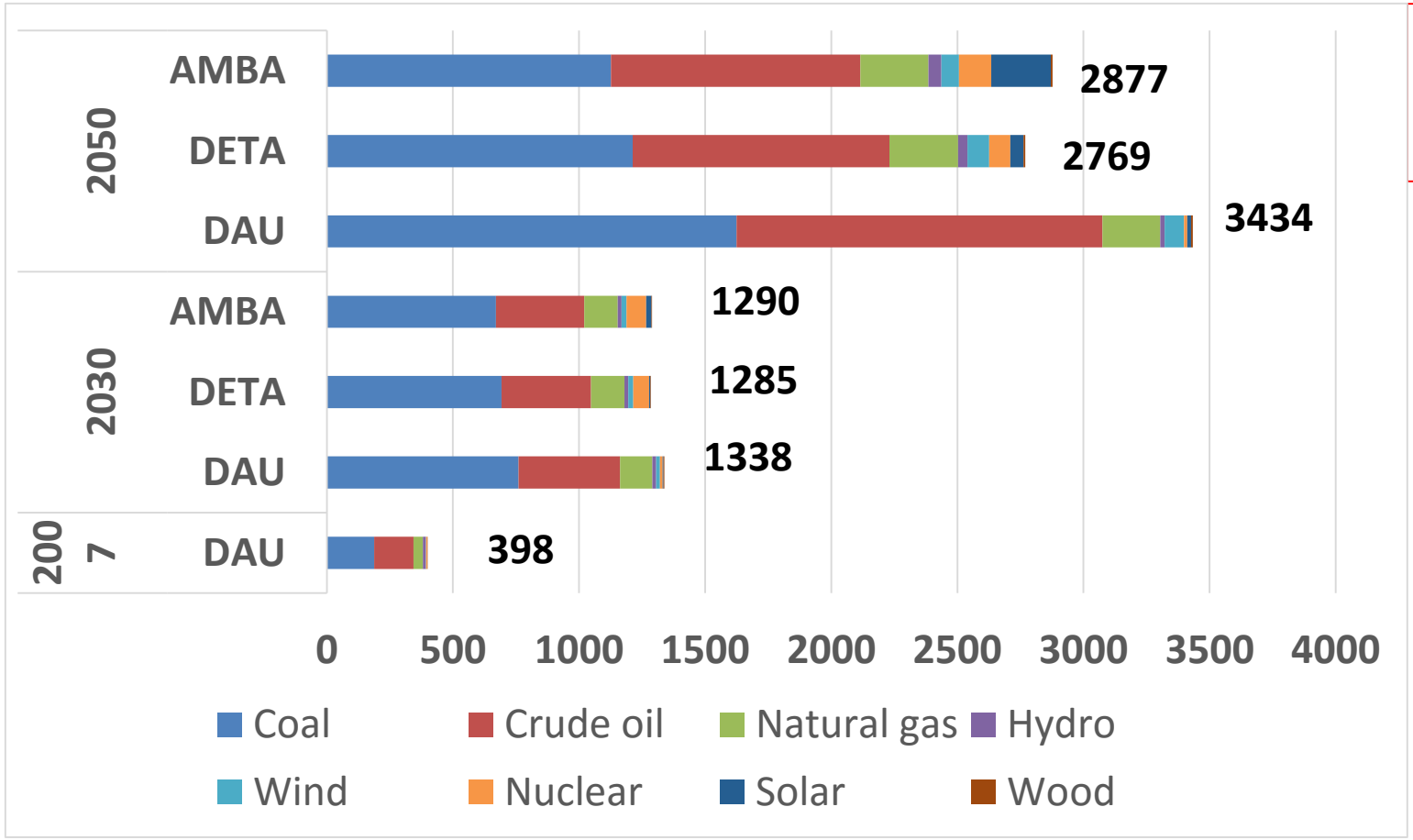
	INDC	IRADe-CC NEG50 model		
	2030	DAU-2030	DETA-2030	AMBA-2030
Reduction in Emission Intensity of GDP	33 to 35% by from 2005 level	32% from 2005 level	39% from 2005 level	43% from 2005 level
Cumulative Electric Power Installed Capacity- Non Fossil	40%	30%	40%	51%
Renewable Target (GW)	175 GW by 2022	104 GW	135 GW	209 GW

Energy Efficiency and Substitution

Models considers low carbon measures in

- In Consumption and production
- Power use
- Buildings
- Industry
- Transport
- Freight Shift to Railways
- Gas and Electric vehicles

Primary Energy Consumption (in MTOE)

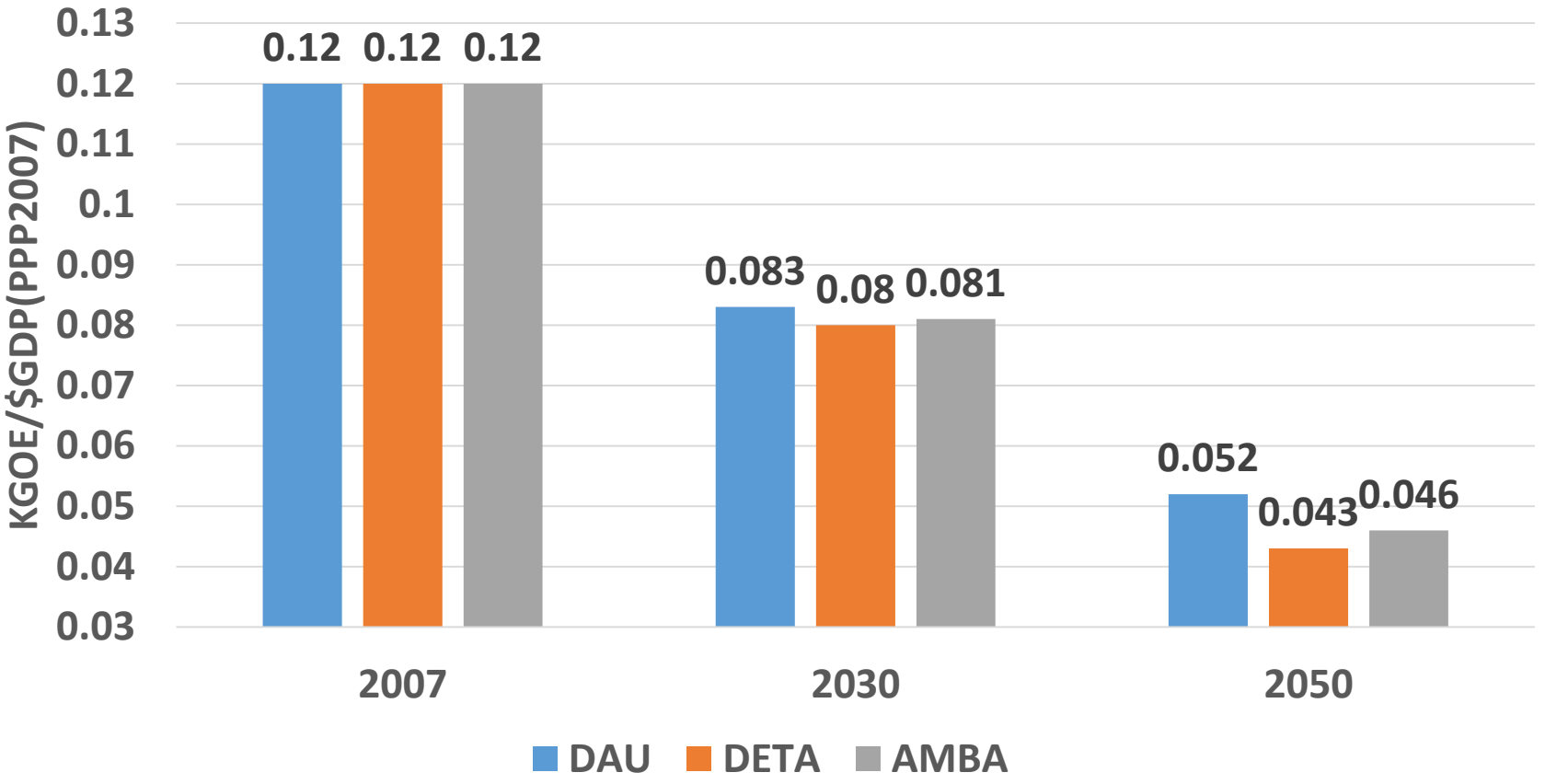


CAGR 2007-50:
DAU- 5.1%
DETA- 4.5%
AMBA- 4.6%

In DAU coal demand increases but in DETA and AMBA scenario this is reduced.

Coal remains a major source. Imports of Natural Gas increases in the low carbon scenarios

Energy Intensity of GDP
Impact of EE Measures and Substitutions



Reduction in Energy Intensity by 2050 at 2007 level:
DAU- 56% ,DETA- 64%, AMBA- 62%

Power Sector Technologies

Power Generation Technologies considered in the model

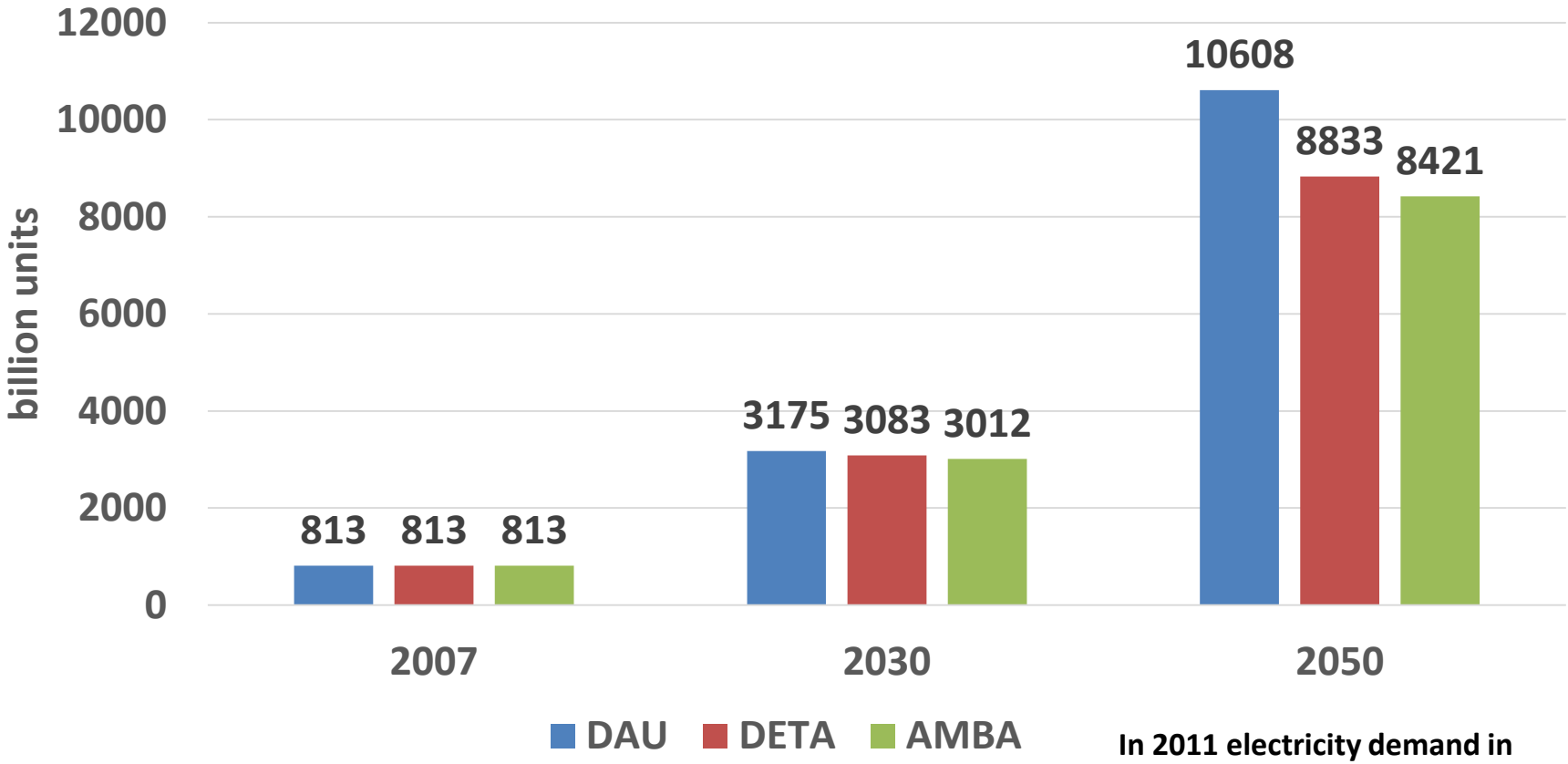
Conventional technology

- **Sub critical Coal**
- **Gas**
- **Hydro**
- **Diesel**

New & Low carbon technology

- **Super critical coal**
- **Wind without storage**
- **Solar PhV without storage**
- **Solar Thermal without storage**
- **Biomass**
- **Nuclear**
- **Wind with storage**
- **Solar PhV with storage**
- **Solar thermal with storage**

Electricity Demand in BU

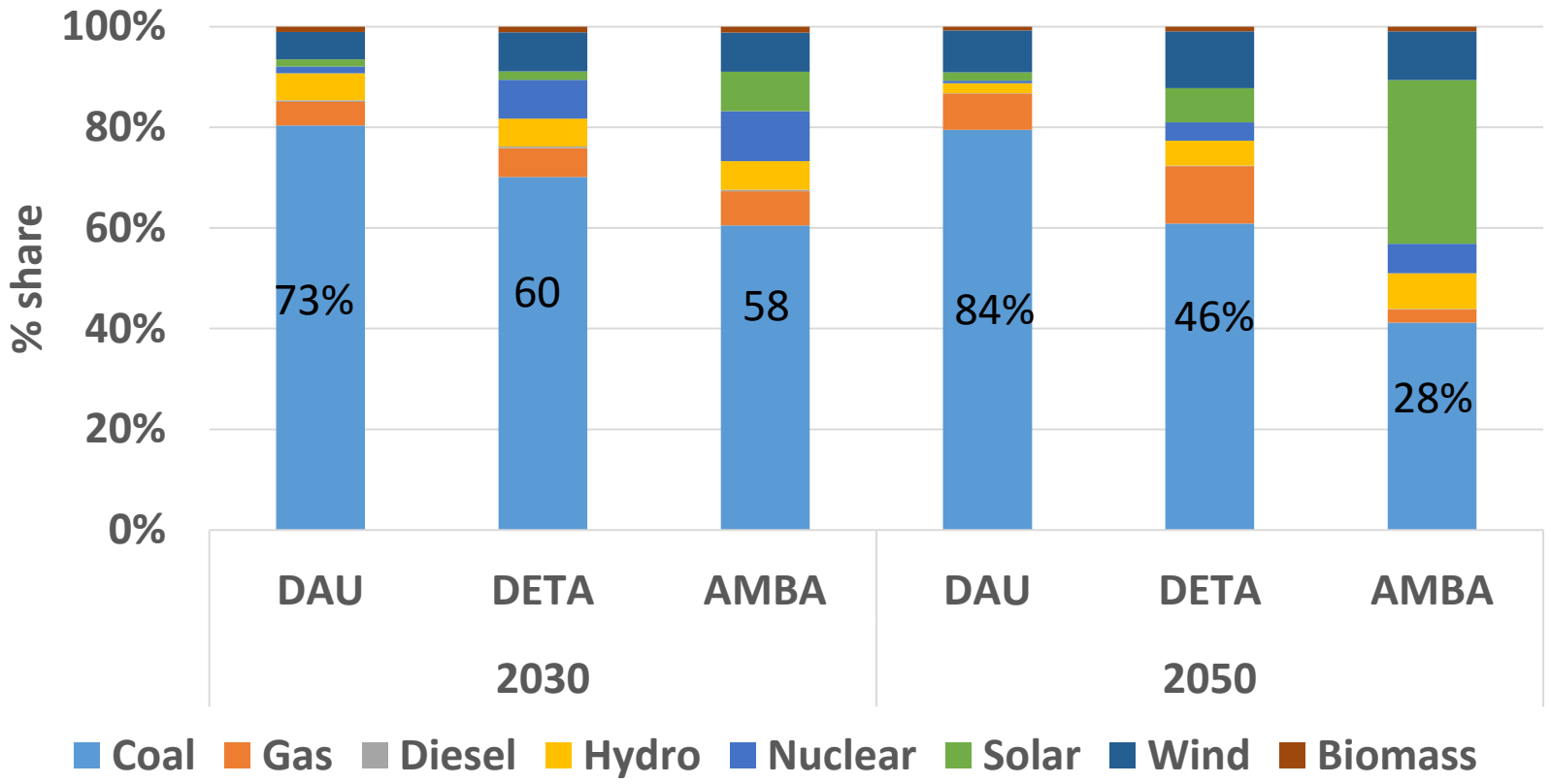


In 2011 electricity demand in China was 3298 BU and in USA was 13248 BU

Low carbon measures reduces electricity demand by 3% and 5% In DETA and AMBA respectively in 2030. In 2050, this reduces by 17% and 20% in DETA and AMBA.

The projected electricity demand in 2050 will be nearly 7 to 9 times higher than 2015 demand

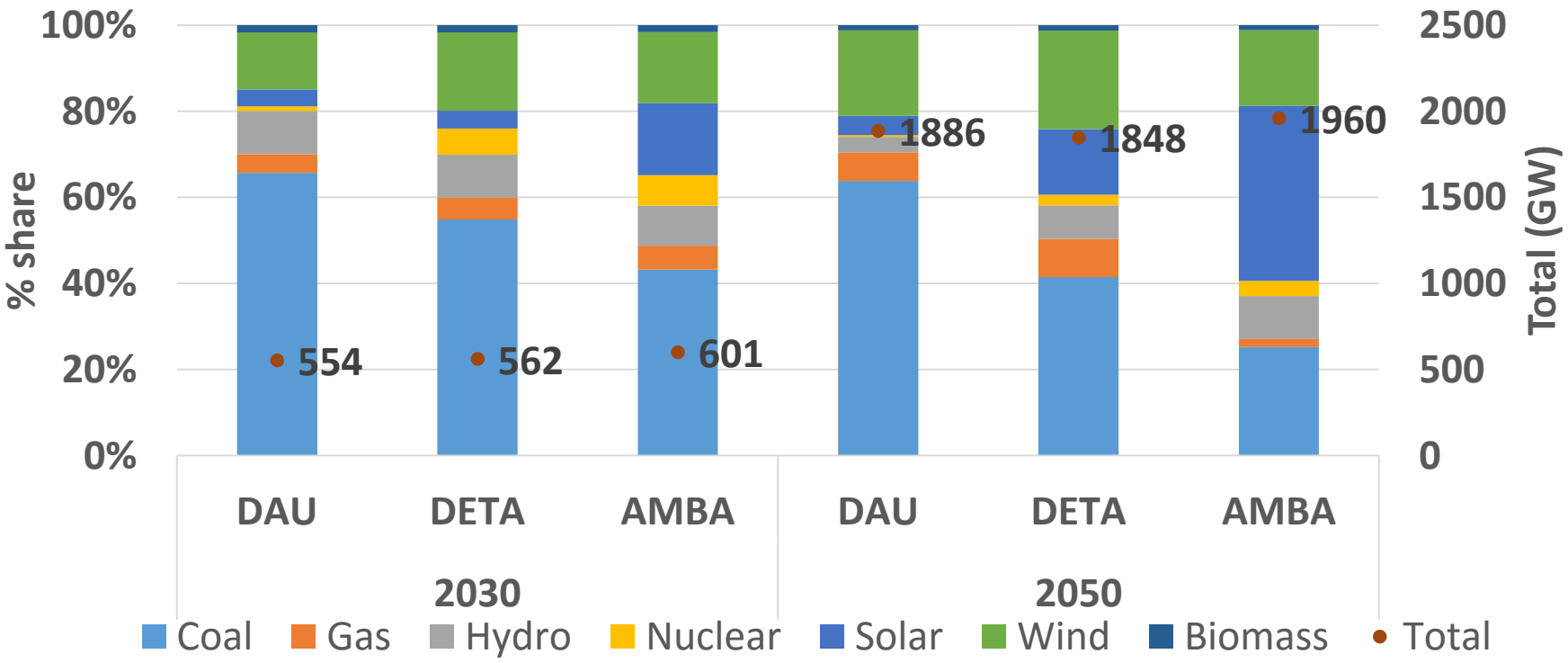
Electricity Generation by Fuel Type (in BU)



Coal still a major source for power generation with a share of nearly 30% in AMBA and 84% in DAU in 2050

share of non-fossil fuels in electricity generation in DAU is **15% and 13%** in **2030 and 2050** respectively. This becomes **24% and 28%** respectively In DETA by **2030 and 2050**. In AMBA, this further increases to **32% and 56%** in **2030 and 2050**.

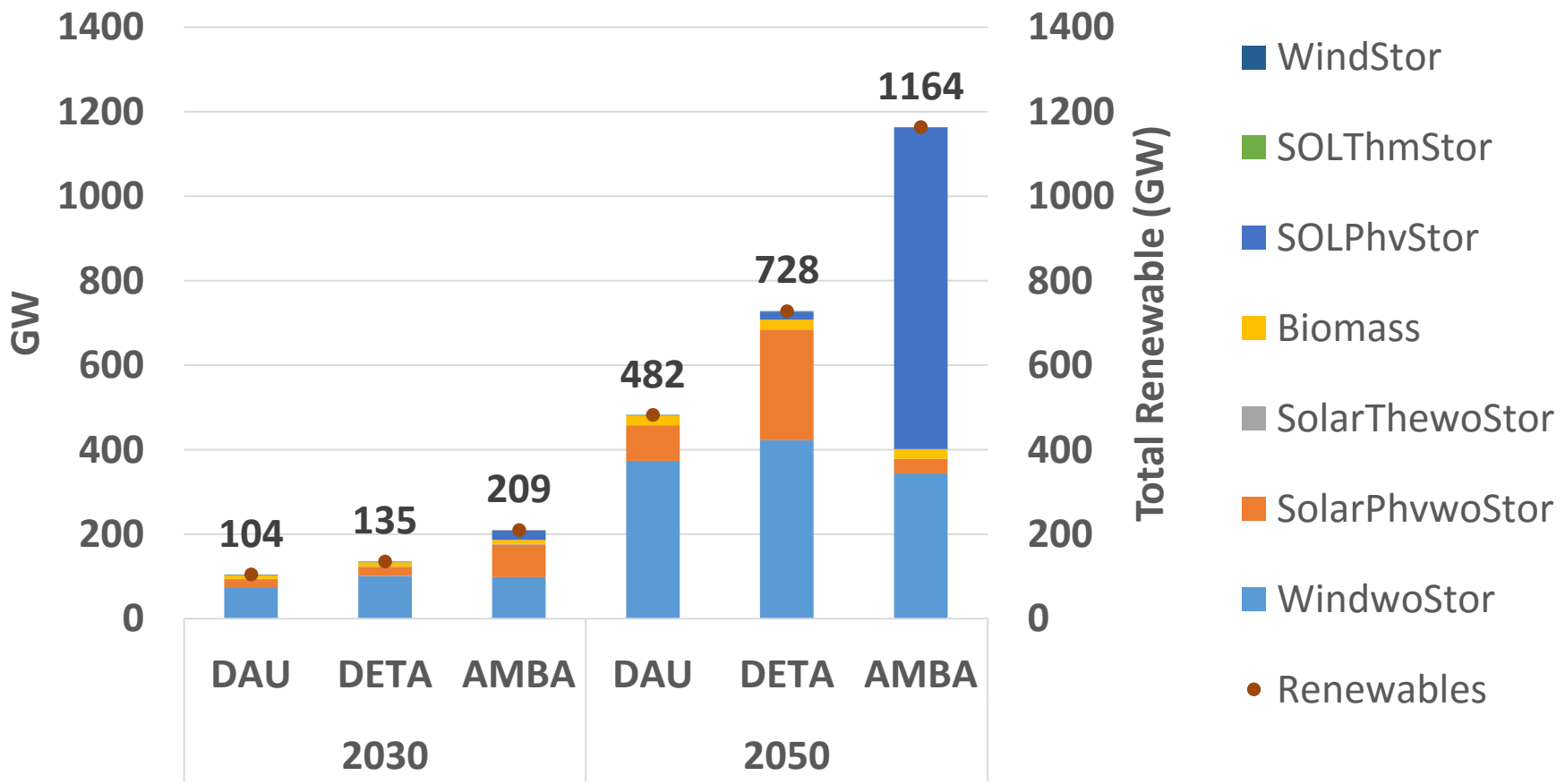
Technology-wise Power Generation Capacity Requirement (in GW)



Share of Non-Fossil fuel in installed capacity is **40% in DETA and 51% in AMBA** consistent with INDC pledges.

Overall Total Generation decreases but Total capacities increase because of Renewables which have low load factors

Renewable Capacities Required (in GW)



Under the DAU scenario, the total solar and wind installed capacities by 2030 and 2050 are expected to be **94 GW and 458 GW** respectively. This increases to **124 GW and 703 GW** respectively in DETA. This further increases to **199 GW and 1139 GW** respectively in AMBA.

Transportation sector

Petroleum products flow across sector (in MT)

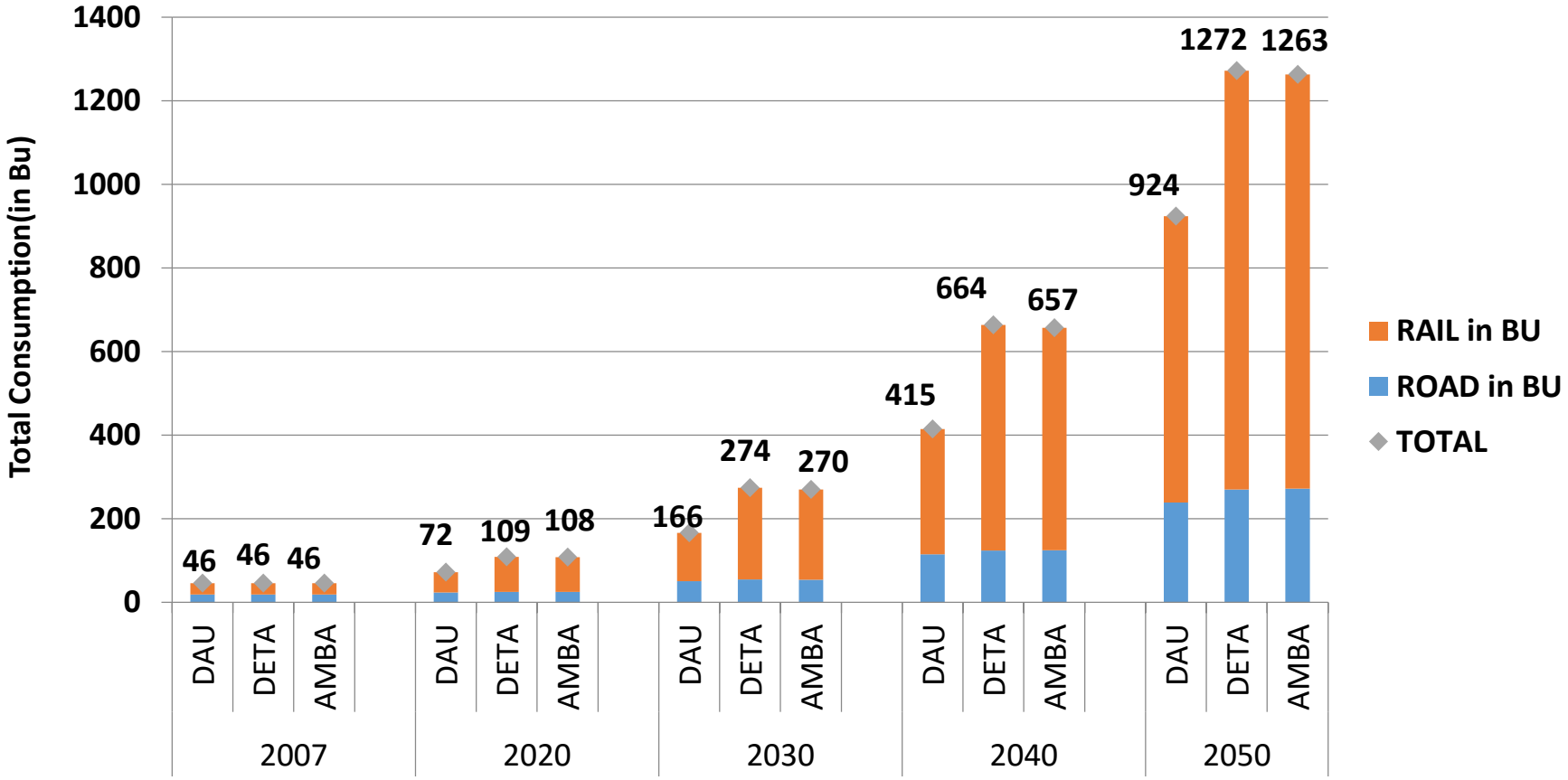
2030	Road &Other Trans*	Rail Trans	Consumption**	2050	Other Transport	Rail Transport	Consumption
DAU	122.38	1.72	172.47	DAU	572.21	10.24	629.17
DETA	80.01	3.28	169.92	DETA	242.34	14.99	544.71
AMBA	79.13	3.24	167.23	AMBA	223.27	14.82	535.61

**Other transport includes air, water and inland water , **Consumption includes private and government*

Freight shift results in nearly 48% rise in fuel consumption (Electricity and Diesel) in 2030 and nearly 32% in 2050 in DETA and AMBA compared to DAU in Railways.

Low Carbon policies in transport sector results in nearly 16% reduction in use of petroleum products in 2030 and nearly 36% in 2050 in the in the Road transport sector.

Electricity consumption flowing across Railways and Road and other transport (In BU)



freight shift from road to railways leads to high growth of Railways and higher fuel demand-Electricity and Diesel

All together Low carbon policies in Transport sector leads to 19% reduction in CO_2 emissions in 2050

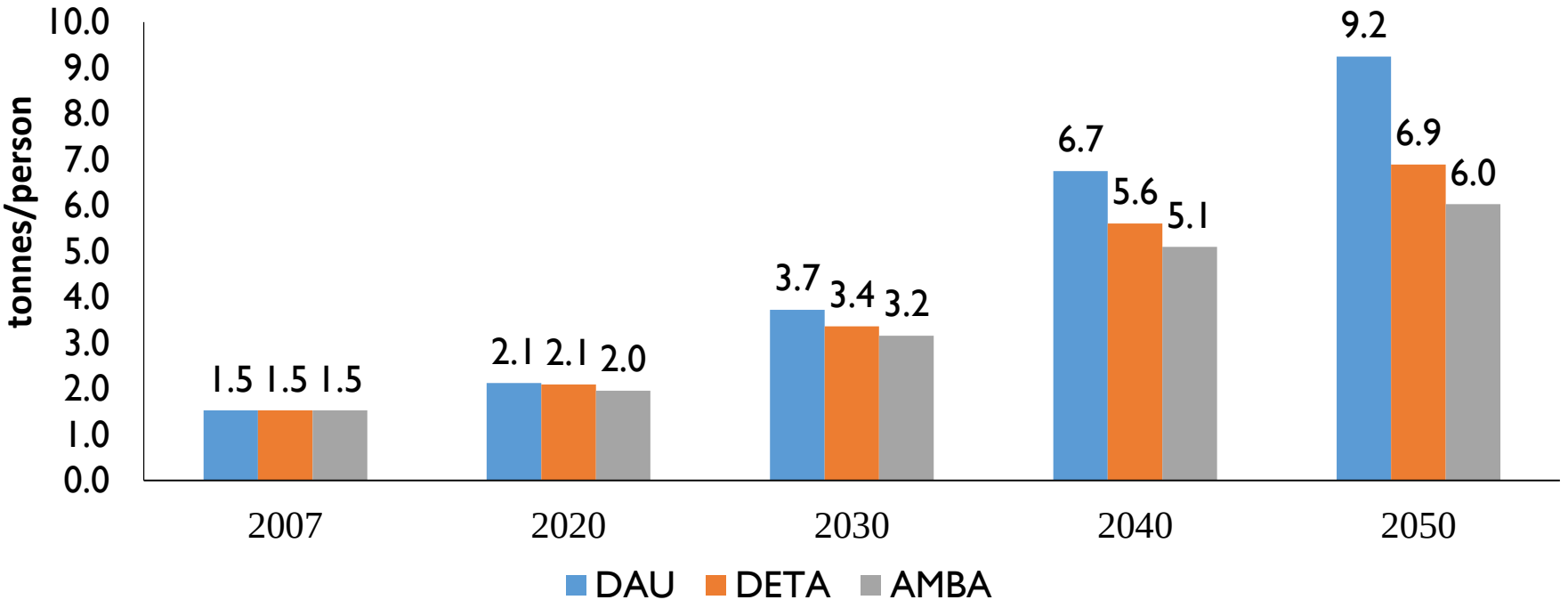
Emissions

GHG emissions (MT of CO_2 equivalent)

	DAU	DETA	AMBA
2007	**1727**		
2030	**5588**	**5052 (9.6%)**	**4742 (15.1%)**
2050	**16082**	**11991 (25%)**	**10483 (35%)**

GHG intensity decreases from **0.52 Kg/$ GDP** (PPP 2007) in 2007 to **0.35, 0.32 and 0.30 Kg/$ (GDP 2007)** in 2030 and to **0.25, 0.19 and 0.17** in 2050 for DAU, DETA and AMBA respectively.

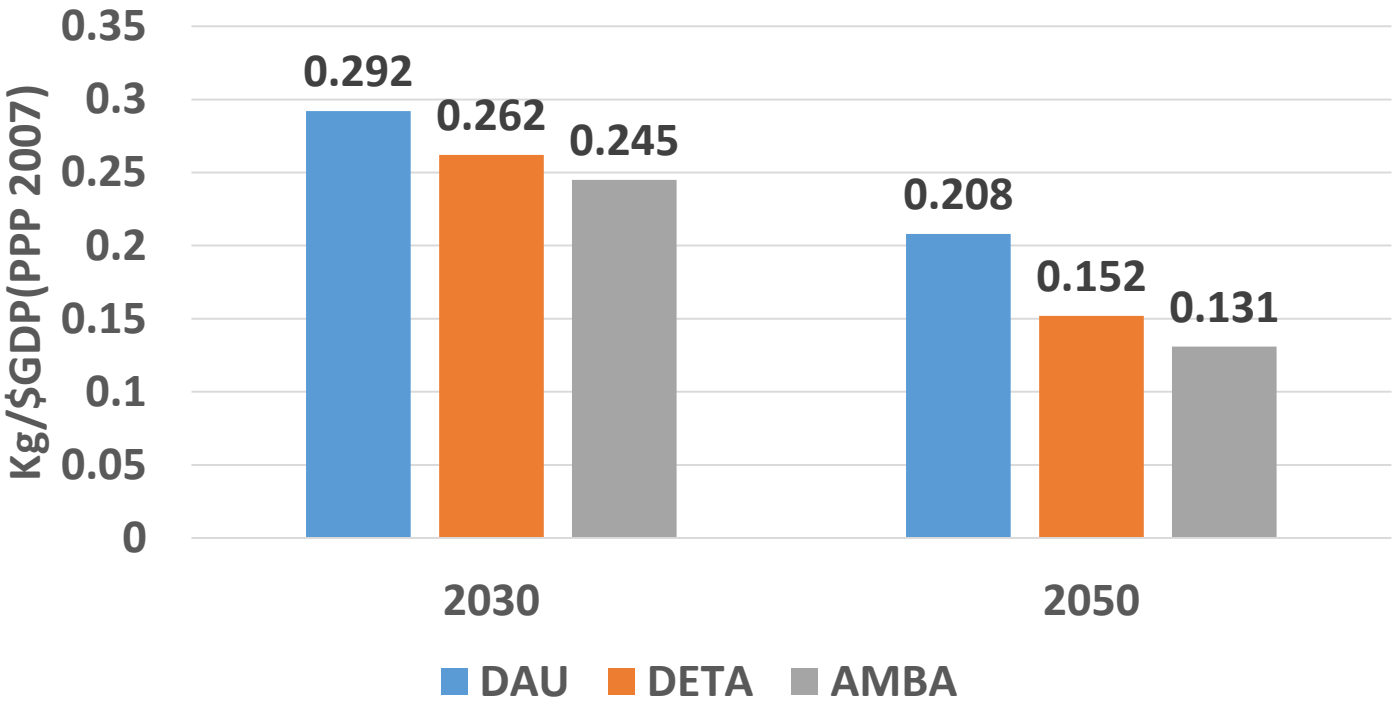
Per capita GHG emissions (t/p)



Per capita CO_2 emissions reduces from of 7.60 tonnes/person in DAU to 4.9 to 4.4 tonnes per capita in the DETA and AMBA scenarios respectively in 2050. which is still far below where many developed countries are today and would be below that of what china has today.

Per Capita GHG Emissions (tonnes/person)		
	1990	2012
USA	23.01	18.55
China	2.84	7.91
World	6.4	6.8

CO_2 Emissions intensity in Kg/$GDP(PPP 2007)



CO_2 Emissions Intensity reduces 32% in DAU, 39% in DETA, 43% in AMBA compared to 2005

The CO_2 emissions intensity reduction commitment of **25% reduction by 2020 by India holds in the DAU scenario** and would be further reduced in DETA (determined effort) and AMBA scenarios.

CO_2 emissions from power sector are reduced by **52% and 68% in 2050** in the DETA and AMBA scenario. In the transport sector, CO_2 emissions reduce **34%** in 2050 in both DETA and AMBA scenario.

Economy Wide Impact

Macro Economic Impacts – Cumulated GDP reductions

	DAU	DETA	AMBA
2007-2030	7.1	7.06	7.03
2007-2050	7.19	7.12	7.08

Cumulated GDP loss from 2007 (billion US$ 2007 PPP)			**Cumulated Energy Investment increase from 2007 (billion US$ 2007 PPP)**		
Year	DETA	AMBA	Year	DETA	AMBA
2030	1886	2627	**2030**	477	782
2050	33589	43316	**2050**	2091	5605

Economy slows down due to crowding out effect of higher investment requirements of low carbon pathways of DETA and AMBA.

Financial Requirements

- **The measures in determined actions (DETA) involve additional investment of 477 billion US$ (PPP US$ 2007) over 2007 to 2030 and 2091 billion US$ over 2007 to 2050 at 2007 constant prices and in PPP US$ 2007.**
- **The additional investment required with ambitious actions (AMBA) is 782 billion US$ over 2007 to 2030 and 5605 billion US$ over 2007 to 2050 at 2007 constant prices and in PPP US$ 2007.**
- **The cumulated but un- discounted loss in GDP would be 1886 billion US$ over 2007 to 2030 and 33589 billion US$ over 2007 to 2050 with determined actions scenario.**
- **The loss in cumulated but un- discounted GDP would be 2627 billion US$ over 2007 to 2030 and 43316 billion US$ over 2007 to 2050 with ambitious actions scenario.**
- **These losses occurs even with optimistic assumptions in the rates of technical progress leading to substantial reduction in the cost of solar power plants.**

Final Conclusions

- India can bring down its per capita GHG emissions to less than 6 tonnes by 2050 where non fossil electricity generation would be 47% and 60 % in the two scenarios.
- Support from international community on two fronts: Financial support for meeting the additional investment needed and access to technology or international co operation in technology development.
- Financial support as well as low interest long term loans with interest payment moratorium for 20 years.
- Technology access at reasonable costs to advances in solar, wind and other power sector technologies.
- Thus, access to technology becomes critical including that for storage technologies, smart grid, ICT technologies for promoting energy efficiency and energy efficient transport technologies etc.

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Thank You